ICANN/IANA-IETF MoU Supplemental Agreement

Introduction

This document is concluded between the IETF Administrative Support Activity (IASA) and ICANN to supplement the Memorandum of Understanding between the IETF and ICANN concerning the technical work of the Internet Assigned Numbers Authority function of ICANN (ICANN/IANA) dated March 1, 2000.

This supplemental agreement between ICANN/IANA and the IASA, forms part of the missing criteria and procedures referred to in section 4.1 of the MoU and describes the commitments, services, and tasks ICANN/IANA undertakes on behalf of the IETF, as well as the commitments, services, and tasks members of the IETF community will provide to ICANN/IANA at the direction of the IESG and/or IAB.

This agreement describes a base level of commitment on behalf of both parties. It is anticipated that this document will evolve over time as new tasks are identified, existing tasks are completed, and service time expectations are revised. This is an amendment of the supplemental agreement that was implemented in January 2007. Specific details of this SLA may be modified (or clarified) at any time by mutual agreement.

Services

1. ICANN/IANA will maintain a publicly accessible, web-based "Resource Registry Matrix" document that describes:

    a. The name of each registry;
    b. Registration requirements for parameters in that registry;
    c. The normative RFC defining the requirement for the registry if applicable;
    d. Expert's name if applicable

    This Resource Registry Matrix will:

    a. Be kept current;
    b. Use hyperlinks to connect the Matrix to the registries it describes;
    c. Use nesting to indicate sub-registries.

    ICANN/IANA will continue to modify the format of the Matrix with the final display format being mutually agreed to by the IETF-IANA committee and ICANN/IANA.

2. IANA will provide, on a queue-by-queue basis, mechanisms that allow for Public and IESG transparency into status of individual requests. This transparency includes the ability to:

    a. Find/verify the existence of a request;
    b. View the actual status of request and who holds the "action item".

    Note that the Public and IESG/requester views may be different. The IESG/requester view may include more detail that is not appropriate for public visibility.

    The IANA will continue to provide the public view of the status of all approved Internet Drafts and their state in the IANA processing queue (www.iana.org/draft-status/draft-queue-status-all.html).

3. ICANN/IANA will make reasonable efforts to ensure that no single point of failure/expertise exists for its processes. During the reporting year of 2007, IANA prepared an initial report for all known single points of failure. Subsequent reports for additional single points of failure were provided as they were identified. ICANN/IANA shall, in confidence to the IETF-IANA committee, continue to document (in a separate document to the monthly report) all new single points of failure/expertise and will detail efforts undertaken to address and/or ameliorate them.

4. In 2008, IANA completed the second phase of the RFC Inventory project. This phase included initiating communications for all tickets created where there were actions needing to be fulfilled or clarified. Phase three of the RFC-Inventory project will be closure of all tickets created and therefore the end of the project. ICANN/IANA will provide an update of progress made to the IETF-IANA Working Group at the IETF-75 meeting. This update will include a detailed list of all outstanding tickets where IANA needs assistance with either getting a response to requests for clarification or making decisions regarding actions to perform.

    ICANN/IANA will document the final results of the project in a summary within twelve (12) months of agreement implementation.

5. ICANN/IANA will notify the resource requester WITHIN THREE (3) BUSINESS DAYS of when ICANN/IANA has an expectation that action on the request will exceed established service levels with an explanation for the delay and, when possible, a forecast as to when action will be completed on the request.

6. ICANN/IANA will continue to provide Fast Track Expedited Processing as an exception to its first-in, first-out policy when requested by the IESG.

Service Levels

Due to the nature of resource request reviews, ICANN/IANA and the IETF community are jointly responsible for cooperatively managing the resource request process. ICANN/IANA has control over the functions it performs directly, e.g., receiving requests, making sure they are syntactically and semantically sensible, forwarding the requests to Designated Experts where appropriate, creating and modifying the registries, etc. The IETF community has direct or indirect control over functions performed by third parties, including IESG Designated Experts, the IESG, the IAB, the RFC Editor, and the requester. As such, the processing of requests has a "total processing time" calendar days goal established for each function and a "IANA processing time" calendar days goal to reflect time expended directly by ICANN/IANA.

7. When registries using Designated Experts are created, the IESG shall assign Designated Experts for resource registries at time of document approval and notify ICANN/IANA of those assignments. ICANN/IANA may not assign resources in a registry until after the IESG has assigned Designated Experts for that resource's registry.

8. ICANN/IANA shall meet or exceed IANA processing time service expectations/commitments for 90% of all work requests as defined in "Appendix A – ICANN/IANA Service Time Commitments".

9. "Third party processing time", that is, the total processing time minus the IANA processing time, which exceeds the goals in Appendix A (unless otherwise stated elsewhere herein) shall trigger the appropriate escalation procedure described in the section entitled "Escalation".

10. ICANN/IANA shall provide due dates in assignments for third party actions, such as Designated Experts, based upon processing times specified for such action herein.

11. As such, the "total processing time" of a request can be further broken down into an "IANA time", "Requester time", and "Other time". When measuring the time taken to process requests, the "overall processing time" refers to the total amount of time (from whatever source) to complete the request. The "IANA time" refers to that portion of the time that is directly attributable to IANA activity, etc. This SLA includes target service times for the IANA portion of servicing requests. Target times for some (but not all) of the other components are also defined here.

Escalation

The following escalation processes shall continue to be followed to ensure an orderly escalation path to handle the cases where timely responses are not forthcoming.

12. Designated Experts Escalation:

    a. ICANN/IANA shall forward the request to the primary Designated Expert within seven (7) calendar days after receiving a correct and complete request.
    b. ICANN/IANA shall wait for a response from the Designated Expert for fourteen (14) calendar days. ICANN/IANA shall re-forward the request to the primary Designated Expert and forward the request to the secondary Designated Expert(s) (if applicable) every two (2) business days if no response is received thereafter for a period of thirty days.
    c. If ICANN/IANA does not receive a response within thirty (30) calendar days from the Designated Expert, ICANN/IANA shall notify the IESG of Designated Expert failure and request resolution of the problem (e.g., by replacing the Designated Expert per RFC 2434 and subsequent revisions).

13. IESG Escalation:

    a. Upon issuing a request to the IESG (and document shepherds when appropriate), ICANN/IANA shall wait for a response from the IESG for fourteen (14) calendar days. ICANN/IANA shall re-forward the request to the IESG at least once per business week thereafter until the thirtieth day.
    b. If ICANN/IANA does not receive a response within thirty (30) calendar days, ICANN/IANA shall notify the IETF-IANA committee of the lack of an IESG response to a request in a timely fashion and will request instruction as to what to do with the request.
    c. ICANN/IANA shall wait for a response from the IETF-IANA committee for fourteen (14) calendar days. ICANN/IANA shall re-forward the request to the IETF/IANA committee at least once per week until the thirtieth day.
    d. If ICANN/IANA does not receive a response from the IETF/IANA committee within thirty (30) calendar days, ICANN/IANA shall notify the IAB of the lack of a response from the IESG and/or the IETF-IANA committee. The IAB is tasked with working with the IESG and other relevant parties to resolve the issue. In order to preserve the normal appeals chain (RFC 2434bis), the IAB is not expected to directly resolve the request itself.

14. Requester Escalation:
    When ICANN/IANA is waiting on a response from the requestor, ICANN/IANA will re-forward the request regularly (e.g., once per week). If no response is received within 30 days, ICANN/IANA may send a notification of the administrative close of the request (without prejudice) to the requester and close the ticket.

15. ICANN/IANA has publicly documented an external escalation path that can provide the IESG and others with a standard path for escalating issues regarding requests, work, process, and productivity. This document can be found at http://www.iana.org/escalation/procedure.html. ICANN/IANA will continue to keep this document current. ICANN/IANA will continue to maintain an internal escalation path to ensure that requests do not get "stuck" in a particular state.

Documentation

16. ICANN/IANA will keep the documentation up-to-date for the functions it performs for the IETF. The processes and procedures to be documented include:

    a. Creation of new public registries as called for in IESG approved documents;
    b. Maintenance of public registries including updating registries as called for in IESG approved documents as well as updating registries via appropriate requests submitted directly to ICANN/IANA (i.e., for registries not requiring action as part of a document approval process);
    c. Review (for ICANN/IANA actions) all documents that appear on IESG telechats (not all of which undergo a formal IETF Last Call). For approved documents, see Appendix B – IANA Document Flow for a depiction of how documents are processed within ICANN/IANA;
    d. Interactions with document authors (and the IESG) when ensuring the ICANN/IANA considerations are sufficiently clear and unambiguous so that ICANN/IANA can carry out any associated actions (done prior to the document approval by the IESG);
    e. Coordination with the RFC Editor in the final steps of document publication;
    f. Maintenance of a publicly accessible list of the Designated Experts associated with those registries that make use of a Designated Expert, as well as a non-publicly accessible list of the contact information for those experts;
    g. Continue to provide regular updates, not less than once per business day, of a publicly accessible web page that provides a listing of the state of all approved Internet Draft documents in ICANN/IANA Internet-Draft queue.

Reports

17. ICANN/IANA will continue to track and publicly report on a monthly basis the following:

    a. Resource allocation statistics as described in item18;

b. The utilization of parameters (e.g., the percentage of available values and those registries in danger of being exhausted) within ICANN/IANA registries;
c. Efforts that have addressed single points of failure/expertise (see item 3).

18. ICANN/IANA will continue to provide publicly accessible, clear, and accurate monthly statistics showing work that has been done and the work items that are currently queued. These statistics should be drawn over all IETF-related ICANN/IANA requests broken down into meaningful categories, i.e.:

    a. IESG approved documents;
    b. Reference Updates
    c. Last Calls
    d. Evaluations
    e. New MIME type requests;
    f. Modifications to and/or deletions of MIME type requests;
    g. New Port number requests;
    h. Modifications to and/or deletions of Port number requests;
    i. New Private Enterprise Number (PEN) requests;
    j. Modifications to and/or deletions of PEN requests;
    k. New TRIP ITAD Numbers
    l. Miscellaneous Protocol Parameter requests (for those where IANA does not receive more than 5 per month, they are grouped together here)

    For those requests relating to other IETF-created registries for which the request rate is more than five per month, IANA will track the rate for which requests are coming in and consult with the IETF-IANA committee regarding the need to track separately.

    For each of these categories information should be collected for:

    a. Number of requests in the queue at the beginning of the reporting period
    b. Number of new requests received during the reporting period
    c. Number of requests completed during the reporting period
    d. Number of requests in the queue at the end of the reporting period
    e. Histogram showing the ages of requests still in the queue at end of reporting period
    f. Histogram for cumulative IETF requests for created/closed/resolved at the end of the reporting period and the year to date

    For completed requests, information should be reported for:

    a. Mean service times (i.e., "total" and "IANA");

b. Mean service times, showing individual contribution from "IANA", "Requester", and "Other";
c. Standard deviation from the average service times;
d. Minimum service time;
e. Median service time;
f. Cumulative stats reflecting outliers, i.e., the totals of all completed requests within their respected categories, including outliers;
g. Maximum service time;
h. Histogram of cumulative stats reflecting outliers (as e. above), data by proportion.
   (1) Number completed within 0-7 days,
   (2) Number completed within 8-14 days,
   (3) Number completed within 15-30 days,
   (4) Number completed in more than 30 days

These service times should be collected and published for total, IANA and third party times.

The exact statistics in this SLA continues to be reviewed and may change over time based upon experience. Such changes may be made by mutual agreement.

19. The optimal form for displaying monthly statistics is a work in progress and will likely change over time. ICANN/IANA will continue to provide access to the raw "event log" data from which statistics can be generated to allow others to generate statistics/reports from the underlying data.

Collaboration

20. ICANN/IANA shall work with the appropriate parties to integrate the IANA ticketing system with other IETF tools (e.g., ID Tracker) and the RFC Editor tracker by. For an example of integration, it should be possible to:

    a. "Click" from ID tracker to see actual IANA state, when applicable;
    b. Post ICANN/IANA document review comments to the ID tracker
    c. Easily find IANA review comments from within ID tracker
    d. See a clear indication within ID tracker as to whether IANA has performed a review, has significant concerns, and whether they have been addressed (e.g., an IANA "discuss")

ICANN/IANA will continue work on preparing the IANA ticketing system for integration. After a model is chosen for the new IETF Tools, ICANN/IANA will work cooperatively with all parties to integrate systems. Future deliverables will be determined following discussions with the IETF-IANA Working Group.

ICANN/IANA shall continue to provide raw data weekly, including states and sub-states, to the IETF-IANA committee until the completion of the integration.

21. The IETF has intent to develop metrics to measure the overall process for publishing new specifications. These metrics include separating time spent in WGs, IESG, IANA, RFC-Editor, and so on. The IANA shall work together with the IETF to define the requirements such metrics place on the data from the IANA. The actual production of possible additional data will be agreed upon separately.

22. ICANN/IANA shall work with the IETF-IANA committee to review all registries for clarity:

    a. Prioritize "clarity challenged" registries (as defined by the IESG) ;
    b. Request input from existing working groups as appropriate
    c. Request input from the wider community

23. ICANN/IANA and IESG will examine if using the mechanisms defined in RFC 3553 to refer precisely to the registry name spaces by URN is a useful feature to the community.

24. ICANN/IANA will provide a teleconference bridge to facilitate monthly teleconferences between ICANN/IANA and the IETF-IANA committee. The date, time, and duration of these calls will be mutually agreed between ICANN/IANA and the IETF-IANA committee members. At a minimum, IANA will, as part of these monthly teleconferences, provide a status update of all outstanding issues raised at the previous month's teleconference.

25. The Parties agree to review the terms of this document in one year to determine whether any modifications may be required. Prior to this review, this document will be interpreted flexibly.

26. IANA Action Summary Table

IANA Action Summary			
	Action	**Reference**	**Delivery Date After Effective Date**
1	Single points of failure documentation to IETF-IANA WG	3	Monthly
2	Complete Phase 3 of the RFC-Inventory project	4	Within 12 months
3	Track and publicly report on a monthly basis	17	Monthly
4	Provide publicly accessible, clear and accurate monthly statistics	18	Monthly
5	Provide access to raw "event log" data	19	Monthly
6	Continue integration work with the IETF related tools	20	Not yet determined
7	Provide raw data weekly to IETF-IANA WG	20	Weekly until tracker integration
8	Review terms of agreement	25	In 1 year

Effective Date

27. This agreement is effective January 1, 2009.

Agreed to on March 26, 2009 by

(Month) (Day) (Year)

On behalf of ICANN:

Signature

Barbara Roseman
Name

General Manager, IANA
Title

ICANN
Organization

On behalf of IASA:

Signature

Ray Pelletier
Name

IETF Administrative Director
Title

IASA
Organization

Appendix A – ICANN/IANA Service Time Commitments

Resource	Proc Time	Clock starts at	Clock stops at
Documents (including IETF and RFC Editor submissions)	14	Receipt of official IESG approval of the document or receipt of official notice of intend to publish from the RFC-Editor.	Sending an "IANA Actions Complete" message to the RFC Editor
Protocol parameter requests requiring IESG Designated expert and/or IETF mailing list review	14	Receipt of initial request	Notification of resource assignment
Protocol parameter requests that do not require technical review	7	Receipt of initial request	Notification of resource assignment
All other requests	14	Receipt of initial request	Notification of resource assignment

Additional ICANN/IANA and Third Party Service Time Requirements:

A. ICANN/IANA shall update the Resource Registry Matrix with the IESG Designated Experts within 1 week of notification of the appointment.

B. The processing time goals for third parties shall be in calendar days as follows:

a. Designated Experts – 14 days
b. Requester – 30 days
c. IESG – 14 days
d. Other – 7 days

Notes:

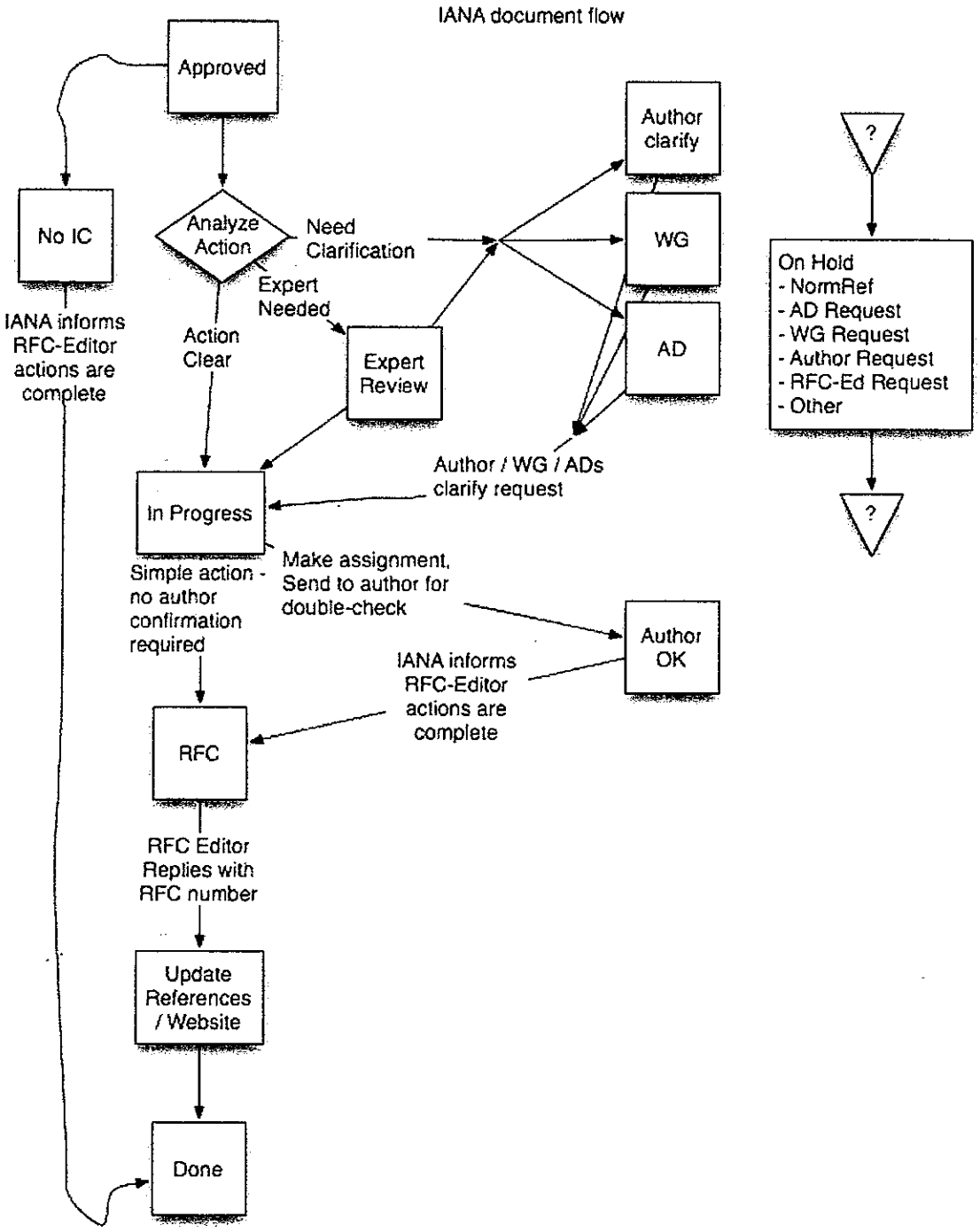
- At implementation, ICANN/IANA commits to continuous process improvement leading to the reduction of outliers as reflected on histograms, and of processing times less than or equal to the values in the column entitled "Processing Time Now". ICANN/IANA commits to processing times less than or equal to the values for 90% of the requests.

- All processing times ("Proc Time") are given in "net" ICANN/IANA time in terms of "calendar days".

- ICANN/IANA will notify the committee in advance if it anticipates that any of these service time commitments will not be met. In such a case, ICANN/IANA will provide documentation on the cause(s) of being unable to meet the commitment(s) and steps taken to address those causes.

- Changes to the service time commitments will be mutually agreed between ICANN/IANA and the IETF-IANA committee.

Appendix B – IANA Document Flow



Root Scaling Study Steering Group Meeting
San Francisco IETF Meeting
March 23, 2009

Desired Results

- Agreement on scope and a Terms of Reference
- Agreement on approach
- Agreement on required resources and support
- Agreement on a tentative schedule
- Identification of questions and open problems
- Agreement on working arrangements for the steering group

Agenda

8:00	Breakfast, reading of draft ToR
8:45	Agenda Bashing
9:00	Discussion of scope, Terms of Reference, and Deliverables
10:30	Break
10:45	Work session – writing of additional sections, possible parallel groups
11:45	Merge of writings
12:30	Lunch
1:00	Discussion of approach and sequence of steps
2:00	Discussion of resources and schedule
2:40	Discussion of tentative schedule
3:00	Break
3:15	Review of open issues; collecting of questions
4:00	Agreement on working agreements, next steps
4:30	Adjournment

Appendix: Priming *[app-priming]*

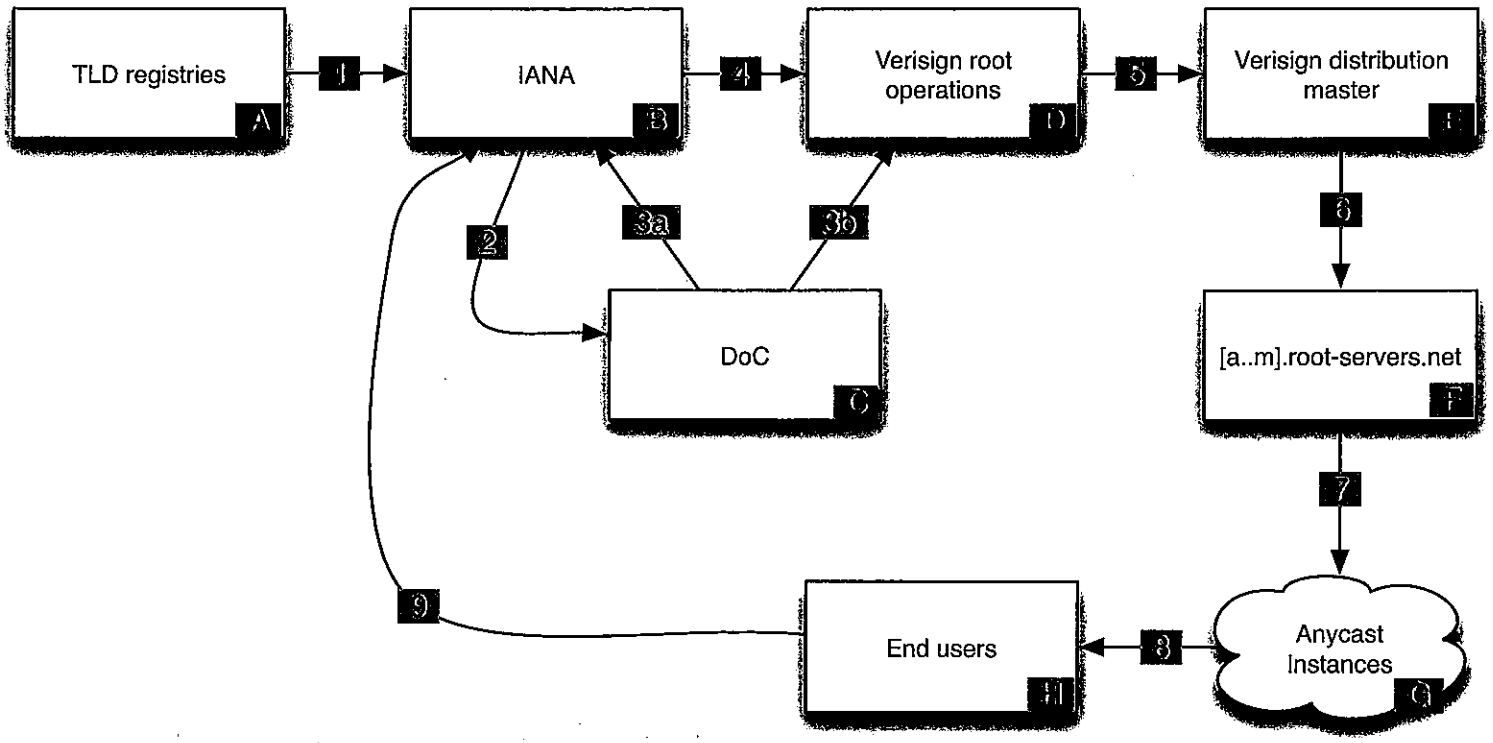
The only specific question identified so far that is related to complexity as opposed to size is the impact of DNSSEC on the priming sequence for validating resolvers. That is:

When a validating resolver is first started, it uses a hints file or other initial "guess" to find a root server, and then it asks that root server for the current list of root servers. The answer is the full list of thirteen root servers and their addresses. Until very recently, that answer fit within the 512 byte limit of a traditional IPv4 packet. With the inclusion of IPv6 addresses for root servers, the response is now longer. Fortunately, longer packets are routinely supported by most transport systems. See SSAC report 018, http://www.icann.org/committees/security/sac018.pdf .

However, when DNSSEC signatures are added to the root zone, the response to the priming query will increase yet again. Preliminary examination suggests the response cannot be accommodated within a single packet, so the primary query will necessarily become a priming sequence. Moreover, it appears that responses from NSD and BIND are different, so there is some work to be done to flesh out the details and make sure there is a feasible priming sequence for all of the implementations used across the thirteen root servers.

Key contacts are Jelte Jansen at NLnetLabs and Michael Graff at ISC.

Root Delegation Change Process



DRAFT
Root Scaling Study Major Steps

Information Gathering

- Interviews with the following organizations: IANA, NTIA, VeriSign (as editor and distributor), Root Server Operators, OARC, CAIDA, GAC, GNSO, CCNSO
- Interviews with selected TLD operators as clients who creates transactions
- Interviews with selected ISPs operating large recursive resolvers
- Outreach meetings TBD. Likely to include business community, governments, regional operator groups (NOGs), etc.
- Inputs from a publicly accessible forum

Initial Public Documents

- Description of the existing system, with capacities, rates, delays, errors, etc.
- Initial catalog of questions and intended treatment of them, e.g. "to be answered within this study," "longer term research required" or "not within the scope of this study."
- Bibliography of prior and current reports and sources

Initial Assessment

- Review of information gathering and initial description
- Review of planned next steps including subcontracts
- Identification of obstacles

Draft Results

- Drafts of primary results
- Review and agreement on path to completion

Final Results

DRAFT
Root Scaling Study Deliverables

- Baseline Description of the Root System

  A description of how the existing root system works, including both the provisioning and lookup sides of the system. The description should include quantitative measures of frequencies of transactions, volumes of data transferred along each link, delays, variances, and error rates. Where data is not available, the description should identify what data is missing. The description should also include the capacities of the various parts of the system.

- Reports from Interviews and Outreach Meetings

  Reports from each of the interviews and outreach meetings as intermediate outputs.

- Catalog of Questions

  A compendium of questions related to the scaling of the root zone. The collection should be as comprehensive as possible, even if the questions are somewhat out of scope to be answered within this study. The catalog should be organized into a sensible taxonomy.

- Analysis of "Plus 1" issues

  Impact of both the qualitative issues related to the addition of DNSSEC, IPv6 and IDNs, and increasing the root by as much as a factor of ten. Estimate of capacity to add TLDs on a daily, monthly or annual basis. Analysis of impact on the lookup. Identification of relevant unknowns. Suggestions for reports or signals to monitor the growth and its impacts.

- Analysis of "Plus 2" issues

  Impact of increasing the root by as much as a factor of 100, i.e. to 30,000 TLDs. Identification of second order factors that may become dominant with that much growth. Discussion of what things might go wrong, including the rate of errors or intentional disruptions, e.g. hijackings or denial of service of a TLD.

- Analysis of "Plus 4" issues

  Impact of increasing the root zone by as much as a factor of 10,000, i.e. to 3,000,000 names with particular attention to the structural changes that may be needed throughout the entire system.

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Root Scaling Study
Terms of Reference

PURPOSE

To prepare for the ICANN Board an overall root zone stability study in accordance with Board resolution 2009-02-03-04, with particular attention to the dynamic interactions of several new and upcoming changes to the root zone. These include, but are not limited to:

- Addition of IPv6 to glue records
- DNSSEC signing the root zone
- Addition of DS Resource Records to the root zone
- Addition of IDN TLDs
- Addition of new TLDs at an accelerated rate and
- The impact of accumulated growth of the root zone

The Board has expressed interest in hearing of the impact of the distinct changes, but also their aggregate effect on root zone operations. The Board also asks that the study, address the technical and operational concerns regarding expanding the DNS root zone that have been expressed on this topic.

SCOPE

Root zone operations is understood to mean all aspects of root zone data production, compilation, publication to the root servers, serving data from the root servers including anycast implementations, and overall interoperability of the DNS software implementations with the root zone. Additionally, some elements of DNS-user practice will have relevance, such as whether there will be an increase in number of queries to the root zone (from new entrants to the Internet), or whether rapid changes to the root zone might introduce substantial and therefore harmful confusion to DNS users.

Certain aspects of the implementation of these potential changes are assumed to be beyond the scope of this study. These include how browser software must be modified to enable DNSSEC, how Whois should be modified to account for IDN data beyond the maintenance of Whois for the root zone, and the economic impact of implementing these changes beyond the impact to the organizations involved in management of the root zone operations. While all of these are important issues to be addressed in discussions of whether, how, and when to implement changes to the top-level domain structure, they do not specifically impinge on root zone operations and are therefore outside the bounds of this root zone stability study. That said, **one key element of this study is to gather and catalog the many questions that get asked about the scaling up of the root, even if the answering of some of those questions is beyond the scope of this study.**

DIMENSIONS

In analyzing the effect of increase the size and complexity of the root, it is useful to divide the study along the following dimensions.

1. Qualitative vs quantitative effects

   While most of the questions will revolved around the quantitative effects of increasing the size of the root zone and increases in the processes related to the root zone, some questions are related to the complexity of adding DNSSEC, IPv6, and/or IDNs as part of the scaling process. An example is given in appendix *app-priming*.

2. Impact on the provisioning system vs impact on the lookup system vs other aspects

   The provisioning system is the collection of activities that put information into the root servers. This covers the entire process of adding entries to the root zone or making changes. Organizationally, the TLD operators, IANA, NTIA, VeriSign and the Root Server operators all involved.

   The lookup system is the interaction among the root servers, the caching resolvers and the end systems. This is the core function of the domain name system.

3. Impacts at different ranges of scale

   The root currently has fewer than 300 top level domains, and there are very few new top level domains added each year. It is unclear how large the root might grow, and also unclear what the rate of change will be. For purposes of analysis, it seems useful to focus on three broad ranges of root size, as measured by the number of names in the zone, not the number of bytes:

- "Plus 1" – 300 to 3,000 names
- "Plus 2" – 3,000 to 30,000 names
- "Plus 4" – 30,000 to 3,000,000 names

PROVISIONING – Transaction types

Within the provisioning system, the process may viewed as a pipeline. Changes are requested by TLD operators. They are processed first by ICANN, then passed to NTIA for authorization, then to VeriSign for assembly into the root zone and

distribution, and then to the root zone operators for insertion into their servers. Several of the root zone operators operate a distributed complex of servers, so the distribution process has multiple steps even within a single root server operator.

There are multiple types of transactions that affect the root zone. The main types of transactions are:

Delegation and re-delegation

These are additions of new top level domains or the transfer of operation a top level domain from an existing operator to a new operator. (In principle, there might also be the removal of a top level domain. This has rarely happened in the past, though it might happen more often in the future.)

Changes in contact information

There are usually three official points of contact for a top level domain, the formal head of the operator, the administrative contact and the technical contact. Each of these can change from time to time.

Changes in the set of name servers

Each top-level domain is served by two or more name servers. Top-level domain operators occasionally change or add name servers to their set.

Changes in the addresses of name servers

Name servers are occasionally renumbered. Also, when a new name server is added to the set serving a TLD, its address must also be added.

We distinguish this transaction from a change to the set of name servers because some name servers serve multiple TLDs, and a change to the address of such a name server must be coordinated with all of the TLDs it serves. (One of the subtle effects to be examined in this study is the complexity of this coordination and how it will change as the number of TLDs increases. Is it likely there will be greater aggregation of service and hence a larger dependency on a small number of large name servers?)

PROVISIONING – Metrics

As noted above, there are currently fewer than 300 TLDs. These TLDs cause approximately one change per TLD per year on the average, aggregated across all types of transactions, so there's roughly one change per day for the entire system. This process also makes occasional errors, but there is little documentation of the details.

As the number of entries increases, how will these numbers change? What are the capacities of the system? Where are the thresholds?

Equally important to understanding the trends and limits, what mechanisms are in place to anticipate reaching these thresholds and to make adjustments? Are these realistic?

There are also quantitative questions related to the rate at which new TLDs can be added. Is there a limited capacity and, if so, what will happen if there is pressure to exceed that capacity?

All of these questions apply to all parts of the provisioning system, including the distribution of new zone files to remote instances of highly replicated root zone servers. For example, how much does DNSSEC and IPv6 expand the zone file and/or increase the required frequency of updates? At what point does the current method of distributing zone files become a problem for each root server operator?

Finally, it is important to address how the increase in the size of the root and/or the increase in the rate of change to the root will affect the number of errors made in the process. The current system is good but not perfect. Scaling it up is likely to increase the number of errors, at least in principle.

Additional assumptions should include:

- There is no expectation that this is an n+1 problem, that there will be gradual changes to root zone operations as different elements increase in scope
- Global interoperability of the DNS is a strong objective, including fostering continuation of a single root zone
- Some new TLDs will be added to the root zone
- ICANN anticipates that there will be an initial request for 40 IDN ccTLDs when applications open
- IDNs will be ASCII-encoded Unicode (punycode) in the root zone
- The number of new gTLDs is uncertain, but a reasonable initial figure would be at least 500 new TLD applications by the end of the first year that applications are open
- DNSSEC uptake will be gradual relying on many components beyond the root
- DS RR data is not currently in the root zone
- IPv6 glue is being added at an increasing rate
- Changes to the root zone data (either NS records or Whois data) currently occur on an annualized basis of ~330 changes, or approximately one per standard work day (though that is not how frequently they appear in the zone), or 1.2 per TLD
- The root zone is currently published on a twice-daily basis with changes batched into either or both of the two published versions
- Analysis of existing root zone operations data will provide understanding of current and future root zone operations
- An objective of this study is to determine whether there are limit points to how much change the root zone can absorb and still retain core stability and security, or intermediate milestones that can be used to identify when changes to operations, infrastructure, or process will be necessary to ensure the security and stability of the root zone operations, or even to identify limit points where further change should be limited or prohibited
- A possible outcome of this study may be identification of further necessary studies and studies of changes over time for measured impact. The need for further study does not preclude reaching preliminary findings nor producing appropriate recommendations that account for anticipated DNS behavior in light of existing data.

KEY ISSUES

The key areas of study appear to be:

1. How is root server system defined for the purposes of this study
2. Root zone update operations
    a. change request management
    b. scaling operational support for increased change rate
    c. scaling infrastructure support for increased change rate
    d. introduction of new data elements to the root zone (such as DS RRs)
    e. impact of errors in root zone data
3. Root zone compilation and publication

a. DNSSEC signing of the root zone
b. publication to the root servers
c. impact of changing twice-daily publication schedule
d. impact of error in root zone distribution (failed DS Key, partial zone publication, etc.)

4. Root server operations
    a. zone update management
    b. scaling operational support
    c. scaling technical support
    d. impact of dynamic updates on distribution of data within root server systems
    e. impact of increased query load on root servers
5. Measured rates of change to root zone
    a. what is current rate of change (as measured by ??)
    b. does looking at the examples of TLD registries aid in understanding possible large root zone behavior
    c. how much larger do different changes make the zone
    d. how dynamic is too dynamic
6. Impact to or from DNS users
    a. coherency of single root zone data set
    b. how many new queries will new TLDs (IDN or otherwise) generate
    c. confusion of responses to queries (dnssec signed or no?, IDNs, other issues?)
    d. registry failure plans

(grouped around key areas)

DELIVERABLES AND MAJOR STEPS

See attached documents on these.