Special-Use Names Problem Statement
draft-tldr-sutld-ps-04

Abstract

   The Special-Use Domain Names registration policy in RFC 6761 has been
   shown through experience to present unanticipated challenges. This
   memo presents a list, intended to be comprehensive, of the problems
   that have been identified. In addition it reviews the history of
   Domain Names and summarizes current IETF publications and some
   publications from other standards organizations relating to special-
   use domain names.

   [Ed note: John Levine suggested we use 'Domain Names' instead of
   'Internet Names'; this is the only change between -03 and -04.
   Please let us know which term you prefer.]

Status of This Memo

   This Internet-Draft is submitted in full conformance with the
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Table of Contents

[1](#). Introduction

One of the key services required to use the Internet is name
resolution. Name resolution is the process of translating a human-
readable symbolic name into some object or set of objects to which
the name refers, most typically one or more IP addresses. These
names are often referred to as domain names. When reading this
document, care must be taken to not assume that the term Domain Name
implies the particular protocol for resolving these names, the Domain
Name System [[RFC1034](#)]. An excellent presentation on this topic can
be found in Domain Names [[I-D.lewis-domain-names](#)].

At the time of this writing, the IETF has recently been asked to
allocate several new special-use top-level Domain Names. In
evaluating the process for additional special-use top-level Domain
Names as documented in Special-Use Domain Names [RFC6761], the IETF
encountered several different sorts of issues. Because of this, the
IETF has decided to investigate the problem and decide if and how the
RFC 6761 process can be improved, or whether it should be deprecated.

This document presents a list, believed to be complete, of the
problems associated with the allocation of special-use names. In
support of the particular set of problems described here, the
document also includes documentation of existing practice as it
relates to the use of Domain Names, as well as a brief history of
domain names, and finally to describe the set of problems that exist
as reported by various IETF participants with experience in the
various aspects of the problem.

2. Terminology

For the sake of brevity this document uses a number of abbreviations.
These are expanded here:

Domain Name A name which serves as input to a host's ordinary name
   resolution process, for example 'EXAMPLE.ORG'.

SUDN   Special Use Domain Name

SUTLDN   Special-Use Top-Level Domain Name

IANA   Internet Assigned Numbers Authority

ICANN   Internet Corporation for Assigned Names and Numbers

3. Problems associated with Special-Use Internet Names

This section presents a list of problems that have been identified
with respect to the allocation of special-use names. Solutions to
these problems are out of scope. Because of that, problems with
solutions to these problems are also out of scope, and will be
covered in a separate document.

No assertion is made that any of these problems is more or less
important than any other. The point of this is simply to enumerate
and briefly describe the problems that have been raised during
discussions of the special-use name problem. The degree of detail is
intended to be sufficient that that participants in the discussion
can agree that the problems they've raised have been adequately
described, and no more.

In addition, no assertion is made that all of these problems must be addressed; while each problem has one or more solutions, the solutions may in some cases be mutually contradictory, or may come with costs that do not justify the benefit that would be obtained from solving them.

This is the list of problems:

o IETF and ICANN independently have remit to assign names out of the namespace that Domain Names represent; a formal coordination process does not exist.

o Although IETF and ICANN nominally have authority over this namespace, neither organization can enforce that authority over any third party who wants to just start using a subset of the namespace. Reasons for doing this may include:

   * Unaware that a process exists for allocating such names

   * Intended use is covered by gTLD allocation, but no gTLD allocation is ongoing

   * Intended use is covered by gTLD allocation, don't want to pay fee

   * Intended use is covered by some IETF process, but don't want to follow process

   * Intended use is covered by ICANN or IETF process, but expected outcome is refusal

o There is demand for more than one name resolution protocol for Domain Names, but Domain Names contain no metadata to indicate which protocol to use to resolve them.

o When a top-level name is used as a means either of marking the rest of a Domain Name for resolution using a protocol other than DNS, or is used for resolution of names with no global meaning, not all software that processes such names will understand the names' special meanings. Consequently, any such use results in queries for those names being sent to authoritative servers.

o The RFC6761 process is sufficiently uncertain that some protocol developers have assumed they could not get a name assigned; the process of assigning the first new name following RFC 6761 took more than ten years from beginning to end: longer by a factor of ten than any other part of the protocol development process. Other uses of the process have proceeded more smoothly, but there

is a reasonably justified perception that using this process is
likely to be slow and difficult, with an uncertain outcome.

o There is strong resistance within the IETF to assigning names to
   things outside of the DNS, for a variety of reasons:

   * Requires a mechanism for identifying which of a set of
      resolution processes is required in order to resolve a
      particular name.

   * Assertion of authority: there is a sense that the namespace is
      "owned" by the IETF or by ICANN, and so, if a name is allocated
      outside of that process, the person or entity that allocated
      that name should suffer some consequence that would,
      presumably, deter future circumvention of the official process.

   * More than one name resolution protocol is bad, in the sense
      that a single protocol is less complicated to implement and
      deploy.

   * The semantics of alternative resolution protocols may differ
      from the DNS protocol; DNS has the concept of RRtypes; other
      protocols may not support RRtypes, or may support some entirely
      different data structuring mechanism.

   * If there is an IETF process through which a name can be
      allocated at zero cost other than time, this process will be
      used as an alternative to allocating the name through ICANN.

   * Some names that might be allocated would be sufficiently
      generic that other legitimate uses of those names would overlap
      with a proposed use, so that assigning the name would preclude
      some future, better use of it.

   * If the IETF allocates a name that some third party or parties
      believes belongs to them in some way, the IETF could become
      embroiled in an expensive dispute with those parties.

o In cases where the IETF has made assignments through the RFC 6761
   process, technical mistakes have been made due either to
   insufficiently well-defined process or to a failure to follow the
   process that was defined in RFC 6761.

o In principal, the RFC 6761 process could be used to document the
   existence of domain names that are not safe to allocate, and
   provide information on how those names are used in practice.
   However, attempts to use RFC6761 to accomplish this
   [I-D.chapin-additional-reserved-tlds] have not been successful.

o No process exists for checking documents to make sure they don't
   accidentally assign names (e.g. RFC 7788).

o Use of the registry is inconsistent--some SUTLIN RFCs specify
   registry entries; some don't; some specify delegation, some don't.

o There exists no safe, non-process-violating mechanism for ad-hoc
   allocation of special-use names.

o RFC 6761 uses the term "Domain Name" to describe the thing for
   which special uses are registered. This creates a great deal of
   confusion because some readers take "Domain Name" to imply the use
   of the DNS protocol.

The problems we have stated here represent the current understanding
of the authors of the document as to the complete set of problems
that have been identified during discussion by the working group on
this topic. The remainder of this document provides additional
context that will be needed for reasoning about these problems.

4. Existing Practice Regarding SUINs

There are three primary and numerous secondary documents to consider
when thinking about the Special-Use Domain Names process.

4.1. Primary SUIN Documents

The primary documents are considered primary because they directly
address the IETF's past thoughts on this topic in a general way, and
also because they describe what the IETF does in practice. Only one
of these documents is an IETF consensus document.

4.1.1. IAB Technical Comment on the Unique DNS Root

This document [RFC2826] is not an IETF consensus document, and
appears to have been written to address a different problem than the
SUDN problem. However, it speaks directly to several of the key
issues that must be considered, and of course coming as it does from
the IAB, it is rightly given with a great deal of authority despite
not being an IETF consensus document.

This document should be considered required reading for IETF
participants who wish to express an informed opinion on the topic of
SUDNs. The main points that appear relevant to the specal use names
problem are:

o The Internet requires a globally unique namespace

o Private networks may operate private namespaces, but still require
   that names in the public namespace be globally unique.

o The Domain Name System [RFC1035] is not the only protocol that may
   be used for resolving domain names.

o Users cannot be assumed to know how to distinguish between symbols
   that have local meaning and symbols that have global meaning.
   Users may therefore share symbols that incorporate domain names
   with no global meaning (for example, a URL of
   'http://mysite.example.corp', where 'example.corp' is a domain
   allocated privately and informally as described in
   [SDO-ICANN-COLL]). Such symbols might refer to the object the
   user intends to share within that user's context, but either refer
   to some other object any recipient's context, or might not refer
   to any object at all in a recipient's context. The effect of this
   is that the user's intended communication will not be able to be
   understood by the recipients of the communication. This same
   problem can also occur simply because a single user copies a name
   from one context in which it has one meaning, into a different
   context in which it has a different meaning-- for example copying
   a '.onion' Domain Name out of a TOR browser, where it has meaning,
   and pasting this name into an ssh client that doesn't support
   connecting over TOR. [TODO: Consider "labels" instead of
   "symbols".]

   To boil this down even further, we can take the following advice from
   this document:

o Domain names with unambiguous global meaning are preferable to
   domain names with local meaning which will be ambiguous.
   Nevertheless both globally-meaningful and locally-special names
   are in use and must be supported.

o At the time of the writing of this document the IAB was of the
   opinion that there might well be more than one name resolution
   protocol used to resolve domain names.

4.1.2. Special-Use Domain Names

   The second important document is Special-Use Domain Names [RFC6761].
   RFC6761 represents the current IETF consensus on designating and
   recording SUDNs. The IETF has experienced problems with the
   designation process described in RFC6761; these concerns motivate
   this document. Again, familiarity with RFC6761 is a prerequisite for
   having an informed opinion on the topic of SUDNs.

RFC 6761 defines two aspects of SUDNs: designating a domain name to
have a special purpose and registering that special use in the
Special-Use Domain Names registry. The designation process is
defined in a single sentence (RFC6761, section 4):

> If it is determined that special handling of a name is required in
> order to implement some desired new functionality, then an IETF
> "Standards Action" or "IESG Approval" specification [RFC5226] MUST
> be published describing the new functionality.

This sentence implies that any designation of a special-use name is
subject to the same open review and consensus process as used to
produce and publish all other IETF specifications.

The registration process is a purely mechanical process, in which the
existence of the newly designated special use name is recorded, with
a pointer to a section in the relevant specification document that
defines the ways in which special handling is to be applied to the
name.

RFC6761 provided the process wherebyMulticast DNS [RFC6762]designated
".local" as a special-use name and included it in the Special-Use
Names registry. It itself also enumerated a set of names that had
been previously used or defined to have special uses prior to the
publication of RFC6761. Since there had been no registry for these
names prior to the publication of RFC 6761, the documents defining
these names could not have added them to the registry.

There are at least several important points to think of with respect
to the RFC6761:

o A special-use name may be a name that should be resolved using the
   DNS protocol with no special handling. An example of this is
   .ARPA.

o A special-use name may be a name that is resolved using the DNS
   protocol, requires no special handling in the stub resolver, but
   requires special handling in the recursive resolver. An example
   of this would be "10.in-addr.arpa."

o A special-use name may be name that requires special handling in
   the stub resolver. An example would be a special-use top-level
   name like '.local' which acts as a signal to indicate that the
   local stub resolver should use a non-DNS protocol for name
   resolution.

o The current IETF consensus (from a process perspective, not
   necessarily from the perspective of what would be consensus if the

IETF were to attempt to produce a new consensus document) is that these purposes for special-use names are valid. [TODO: "Both" implies that there are only two applications; the above bullet points outline 3...]

The term "stub resolver" in this case does not mean "DNS protocol stub resolver." The stub resolver is the entity within a particular software stack that takes a question about a Domain name and answers it. One way a stub resolver can answer such a question is using the DNS protocol, but it is in the stub resolver, as we are using the term here, that the decision as to whether to use a protocol, and if so which protocol, or whether to use a local database of some sort, is made.

RFC6761 does not limit special-use names to TLDs. However, at present, all special-use names registered in the IANA Special-Use Domain Names registry [SDO-IANA-SUDR] are either intended to be resolved using the DNS protocol, or are top-level domains, or both. That is, at present there exist no special-use names which require special handling by stub resolvers and which are not at the top level of the naming hierarchy.

This does mean, however, that at present, RFC6762 requires the use of a special label, '.LOCAL', to indicate to stub resolvers that mDNS[RFC6762] be used to resolve names under that label.

4.1.3. MoU Concerning the Technical Work of the IANA

There exists a Memorandum of Understanding[RFC2860] between the IETF and ICANN (Internet Corporation for Assigned Names and Numbers) which discusses how names and numbers will be managed through the IANA (Internet Assigned Numbers Authority). This document is important to the discussion of SUDNs because, while it delegates authority for managing the Domain Name System Namespace generally to ICANN, it reserves to the IETF the authority that RFC 6761 formalizes:

Note that (a) assignments of domain names for technical uses (such as domain names for inverse DNS lookup), (b) assignments of specialised address blocks (such as multicast or anycast blocks), and (c) experimental assignments are not considered to be policy issues, and shall remain subject to the provisions of this Section 4.

The above text is an addendum to the following:

Two particular assigned spaces present policy issues in addition to the technical considerations specified by the IETF: the

assignment of domain names, and the assignment of IP address
blocks. These policy issues are outside the scope of this MOU.

In general, then, the assignment of names in the DNS root zone, and
the management of the DNS namespace, is a function that is performed
by ICANN. However, the MoU specifically exempts domain names
assigned for technical use, and uses the example of 'IN-ADDR.ARPA'
and 'IP6.ARPA' to illustrate. Both of these names are in the RFC
6761 registry.

The point here is not to say what the implications of this statement
in the MoU are, but rather to call the reader's attention to the
existence of this statement.

4.2. Secondary documents relating to the SUTLIN question

In addition to these documents, there are several others with which
participants in this discussion should be familiar.

4.2.1. Multicast DNS

Multicast DNS [RFC6762] defines the Multicast DNS protocol, which
uses the '.LOCAL' SUTLDN. Section 3 describes the semantics of
"multicast DNS names." It is of considerable historical importance
to note that the -00 version of this document, an individual
submission, was published in July of 2001. This version contains
substantially the same text in section 3, and was discussed in the
DNSEXT working group at IETF 51 in August of 2001[IETF-PRO-51]. The
first version of this document designated '.LOCAL.ARPA' as the
special-use name. This idea was strongly opposed by DNSEXT working
group participants, and as a result the author eventually switched to
using '.LOCAL'.

The history of RFC 6762 is documented in substantial detail in
Appendix H; some notable milestones include the initial proposal to
replace Appletalk's NBP in July 1997, the chartering of the Zeroconf
working group in September 1999, allocation of a multicast address
for link-local name discovery in April of 2000. A companion
requirements document, eventually published as [RFC6760] was first
published in September of 2001.

The point of mentioning these dates is so that discussions involving
the time when the '.LOCAL' domain was first deployed, and the context
in which it was deployed, may be properly informed.

4.2.2. The .onion Special-Use TLD

The .onion Special Use TLD [RFC7686] is important because it is the
most recent IETF action on the topic of SUTLDNs; although it does not
set new policy, the mere fact of its publication is worth thinking
about.

Two important points to consider about this document are that:

o The IETF gained consensus to publish it

o The situation was somewhat forced, both by the fact of its
   unilateral allocation by the TOR project without following the RFC
   6761 process, and because a deadline had been set by the CA/
   Browser Forum [SDO-CABF-INT] after which all .onion PKI
   certificates would expire and no new certificates would be issued,
   unless the .onion SUTLDN were to be recognized by the IETF.

4.2.3. Locally Served DNS Zones

Locally Served DNS Zones [RFC6303] describes a particular use case
for zones that exist by definition, and that are resolved using the
DNS protocol, but that cannot have a global meaning, because the host
IP addresses they reference are not unique. This applies to a
variety of addresses, including Private IPv4 addresses [RFC1918],
Unique Local IPv6 Unicast Addresses [RFC4193] (in which this practice
was first described) and IANA-Reserved IPv4 Prefix for Shared Address
Space [RFC6598].

This use case is distinct from the use-case for SUTLDNs like '.local'
and '.onion' in that the names are resolved using the DNS protocol.
But it shares the problem that such names cannot be assumed either to
be unique or to be functional in all contexts for all Internet-
connected hosts.

4.2.4. Name Collision in the DNS

Name Collision in the DNS [SDO-ICANN-COLL] is a study commissioned by
ICANN that attempts to characterize the potential risk to the
Internet of adding global DNS delegations for names that were not
previously delegated in the DNS, not reserved under any RFC, but also
known to be (.local) or surmised to be (.corp) in significant use for
special-use-type reasons (local scope DNS, or other resolution
protocols altogether).

4.2.5. Discovery of the IPv6 Prefix Used for IPv6 Address Synthesis

Discovery of the IPv6 Prefix Used for IPv6 Address Synthesis
[RFC7050] is an example of a document that successfully used the RFC
6761 process to designate '.ipv4only.arpa' as a special-use name; in
this case the process worked smoothly and without controversy.

4.2.6. Additional Reserved Top Level Domains

Additional Reserved Top Level Domains
[I-D.chapin-additional-reserved-tlds] is an example of a document
that attempted to reserve several TLDs identified by ICANN as
particularly at risk for collision as special-use domain names with
no documented use. This attempt failed.

Although this document failed to gain consensus to publish, the need
it was intended to fill still exists. Unfortunately, although a fair
amount is known about the use of these names, no document exists that
documents how they are used, and why it would be a problem to
allocate them. Additionally, to the extent that the uses being made
of these names are valid, no document exists indicating when it might
make sense to use them, and when it would not make sense to use them
(the simplest version of this document would of course say "never use
them." If that were the IETF consensus, that would be a good reason
not to bother to publish the document.

4.3. Summary

The assignment of Internet Names is not under the sole control of any
one organization. ICANN has authority in many cases, and could be
considered in some sense the default. IETF has authority in other
cases, but only with respect to protocol development. And neither of
these authorities can in any practical sense exclude the practice of
ad-hoc allocation of names, which can be done by any entity that has
control over one or more name servers or resolvers, in the context of
any hosts and services that that entity operates.

5. History

Newcomers to the problem of resolving domain names may be under the
mistaken impression that the DNS sprang, as in the Greek legend of
Athena, directly from Paul Mockapetris' forehead. This is not the
case. At the time of the writing of the IAB technical document,
memories would have been fresh of the evolutionary process that led
to the DNS' dominance as a protocol for domain name resolution.

In fact, in the early days of the Internet, hostnames were resolved
using a text file, HOSTS.TXT, which was maintained by a central

authority, the Network Information Center, and distributed to all
hosts on the Internet using the File Transfer Protocol (FTP)
[RFC0959]. The inefficiency of this process is cited as a reason for
the development of the DNS [RFC0882] [RFC0883] in 1983.

However, the transition from HOSTS.TXT to the DNS was not smooth.
For example, Sun Microsystems's Network Information System
[CORP-SUN-NIS], at the time known as Yellow Pages, was an active
competitor to the DNS, although it failed to provide a complete
solution to the global naming problem.

Another example was NetBIOS Name Service, also known as WINS
[RFC1002]. This protocol was used mostly by Microsoft Windows
machines, but also by open source BSD and Linux operating systems to
do name resolution using Microsoft's own name resolution protocol.

Most modern operating systems can still use the '/etc/hosts' file for
name resolution. Many still have a name service switch that can be
configured on the host to resolve some domains using NIS or WINS.
Most have the capability to resolve names using mDNS by recognizing
the special meaning of the '.local' SUTLDN.

The Sun Microsystems model of having private domains within a
corporate site, while supporting the global domain name system for
off-site persisted even after the NIS protocol fell into disuse.
Microsoft used to recommend that site administrators allocate a
"private" top-level domain for internal use, and this practice was
very much a part of the zeitgeist at the time. This attitude is the
root of the widespread practice of simply picking an unused top-level
domain and using it for experimental purposes, which persists even at
the time of writing of this memo.

This history is being presented because discussions about special-use
names in the IETF often come down to the question of why users of new
name resolution protocols choose to use Domain names, rather than
using some other naming concept that doesn't overlap with the
namespace that, in modern times is, by default, resolved using the
DNS.

The answer is that as a consequence of this long history of resolving
Domain Names, Domain Names appear in a large variety of contexts in
user interfaces applications programming interfaces. Any name that
appears in such a context is a Domain Name. What this means is that
Domain Names have a highly privileged status in deployed software.
Proposals to change that will be almost possible to get adopted in a
useful or consistent way. And since in most operating systems,
mechanisms already exist for implementing special handling for some
Domain Names, from a practical perspective the only way to achieve

the goals of any new name resolution protocol is through the use of
special-use Domain Names.

6. Contributors

This document came about as a result of conversations that occurred
in the lobby, the weekend before IETF 95. Stuart Cheshire, Mark
Andrews, David Conrad, Paul Ebersman and Aaron Falk all made helpful
and insightful observations or patiently answered questions. This
should not be taken as an indication that any of these folks actually
agree with what the document says, but their generosity with time and
thought are appreciated in any case.

Ralph started out as an innocent bystander, but discussion with him
was the key motivating factor in the writing of this document, and he
agreed to co-author it without too much arm-twisting. Warren spent a
lot of time working with me on this document after it was first
published, and joined as an author in order to make sure that the
work got finished; without him the -01 and -02 versions might not
have happened.

And this document owes a great deal to Ed Lewis' excellent work on
what a "domain name" is [I-D.lewis-domain-names].

7. Informative References

[RFC0882] Mockapetris, P., "Domain names: Concepts and facilities",
           RFC 882, DOI 10.17487/RFC0882, November 1983,
           <http://www.rfc-editor.org/info/rfc882>.

[RFC0883] Mockapetris, P., "Domain names: Implementation
           specification", RFC 883, DOI 10.17487/RFC0883, November
           1983, <http://www.rfc-editor.org/info/rfc883>.

[RFC0959] Postel, J. and J. Reynolds, "File Transfer Protocol", STD
           9, RFC 959, DOI 10.17487/RFC0959, October 1985,
           <http://www.rfc-editor.org/info/rfc959>.

[RFC1002] NetBIOS Working Group in the Defense Advanced Research
           Projects Agency, Internet Activities Board, and End-to-End
           Services Task Force, "Protocol standard for a NetBIOS
           service on a TCP/UDP transport: Detailed specifications",
           STD 19, RFC 1002, DOI 10.17487/RFC1002, March 1987,
           <http://www.rfc-editor.org/info/rfc1002>.

[RFC1034] Mockapetris, P., "Domain names - concepts and facilities",
           STD 13, RFC 1034, DOI 10.17487/RFC1034, November 1987,
           <http://www.rfc-editor.org/info/rfc1034>.

   [RFC1035] Mockapetris, P., "Domain names - implementation and
              specification", STD 13, RFC 1035, DOI 10.17487/RFC1035,
              November 1987, <http://www.rfc-editor.org/info/rfc1035>.

   [RFC1918] Rekhter, Y., Moskowitz, B., Karrenberg, D., de Groot, G.,
              and E. Lear, "Address Allocation for Private Internets",
              BCP 5, RFC 1918, DOI 10.17487/RFC1918, February 1996,
              <http://www.rfc-editor.org/info/rfc1918>.

   [RFC2826] Internet Architecture Board, "IAB Technical Comment on the
              Unique DNS Root", RFC 2826, DOI 10.17487/RFC2826, May
              2000, <http://www.rfc-editor.org/info/rfc2826>.

   [RFC2860] Carpenter, B., Baker, F., and M. Roberts, "Memorandum of
              Understanding Concerning the Technical Work of the
              Internet Assigned Numbers Authority", RFC 2860, DOI
              10.17487/RFC2860, June 2000,
              <http://www.rfc-editor.org/info/rfc2860>.

   [RFC4193] Hinden, R. and B. Haberman, "Unique Local IPv6 Unicast
              Addresses", RFC 4193, DOI 10.17487/RFC4193, October 2005,
              <http://www.rfc-editor.org/info/rfc4193>.

   [RFC6303] Andrews, M., "Locally Served DNS Zones", BCP 163, RFC
              6303, DOI 10.17487/RFC6303, July 2011,
              <http://www.rfc-editor.org/info/rfc6303>.

   [RFC6598] Weil, J., Kuarsingh, V., Donley, C., Liljenstolpe, C., and
              M. Azinger, "IANA-Reserved IPv4 Prefix for Shared Address
              Space", BCP 153, RFC 6598, DOI 10.17487/RFC6598, April
              2012, <http://www.rfc-editor.org/info/rfc6598>.

   [RFC6760] Cheshire, S. and M. Krochmal, "Requirements for a Protocol
              to Replace the AppleTalk Name Binding Protocol (NBP)", RFC
              6760, DOI 10.17487/RFC6760, February 2013,
              <http://www.rfc-editor.org/info/rfc6760>.

   [RFC6761] Cheshire, S. and M. Krochmal, "Special-Use Domain Names",
              RFC 6761, DOI 10.17487/RFC6761, February 2013,
              <http://www.rfc-editor.org/info/rfc6761>.

   [RFC6762] Cheshire, S. and M. Krochmal, "Multicast DNS", RFC 6762,
              DOI 10.17487/RFC6762, February 2013,
              <http://www.rfc-editor.org/info/rfc6762>.

   [RFC7050] Savolainen, T., Korhonen, J., and D. Wing, "Discovery of
              the IPv6 Prefix Used for IPv6 Address Synthesis", RFC
              7050, DOI 10.17487/RFC7050, November 2013,
              <http://www.rfc-editor.org/info/rfc7050>.

   [RFC7686] Appelbaum, J. and A. Muffett, "The ".onion" Special-Use
              Domain Name", RFC 7686, DOI 10.17487/RFC7686, October
              2015, <http://www.rfc-editor.org/info/rfc7686>.

   [I-D.chapin-additional-reserved-tlds]
              Chapin, L. and M. McFadden, "Additional Reserved Top Level
              Domains", draft-chapin-additional-reserved-tlds-02 (work
              in progress), March 2015.

   [I-D.lewis-domain-names]
              Lewis, E., "Domain Names", draft-lewis-domain-names-03
              (work in progress), June 2016.

   [SDO-CABF-INT]
              CA/Browser Forum, "Guidance on the Deprecation of Internal
              Server Names and Reserved IP Addresses", June 2012,
              <https://www.digicert.com/internal-names.htm>.

   [SDO-ICANN-COLL]
              Interisle Consulting Group, LLC, "Name Collisions in the
              DNS", August 2013,
              <https://www.icann.org/en/system/files/files/name-
              collision-02aug13-en.pdf>.

   [SDO-IANA-SUDR]
              Internet Assigned Numbers Authority, "Special-Use Domain
              Names registry", October 2015,
              <http://www.iana.org/assignments/special-use-domain-names/
              special-use-domain-names.xhtml>.

   [CORP-SUN-NIS]
              Sun Microsystems, "Large System and Network
              Administration", March 1990.

   [IETF-PRO-51]
              Internet Engineering Task Force, "Proceedings of the 51st
              IETF", August 2001,
              <http://www.ietf.org/proceedings/51/51-45.htm#TopOfPage>.

Appendix A.   **Change Log.**

   -03 to -04:

   o Replaced 'Internet Names' with 'Domain Names' - suggestion by John
      Levine.

   -02 to -03:

   o Readability fixes, small grammar updates.

   -01 to -02:

   o Cleaned up the abstract.

   o Fixed the case of Internet

   o Reference to Ed Lewis' "domain names"

   o Fleshed out the problems, primarily the coordination, collisions
      ones.

   -00 to -01:

   o Large refactoring, basically a rewrite. Incorporated comments,
      removed a bunch of unneeded text, etc.

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