                 Special-Use Domain Names Problem Statement

Abstract

   The policy defined in RFC 6761 for IANA registrations in the
   "Special-Use Domain Names" registry has been shown, through
   experience, to present challenges that were not anticipated when RFC
   6761 was written. This memo presents a list, intended to be
   comprehensive, of the problems that have since been identified. In
   addition, it reviews the history of domain names and summarizes
   current IETF publications and some publications from other
   organizations relating to Special-Use Domain Names.

   This document should be considered required reading for IETF
   participants who wish to express an informed opinion on the topic of
   Special-Use Domain Names.

Copyright Notice

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 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 not to assume that the term domain name implies the use of
   the Domain Name System [RFC1034] for resolving these names. An
   excellent presentation on this topic can be found in Domain Names
   [DOMAIN-NAMES].

   "Special-Use Domain Names" [RFC6761] created the "Special-Use Domain
   Names" IANA registry [SDO-IANA-SUDR], defined policies for adding to
   the registry, and made some suggestions about how those policies
   might be implemented. Since the publication of RFC 6761, the IETF
   has been asked to designate several new Special-Use Domain Names in
   this registry. During the evaluation process for these Special-Use
   Domain Names, 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 process defined in RFC 6761 can be improved, or
   whether it should be deprecated. The IETF DNSOP Working Group
   charter was extended to include conducting a review of the process
   for adding names to the registry that is defined in RFC 6761. This
   document is a product of that review.

   Based on current ICANN and IETF practice, including RFC 6761, there
   are several different types of names in the root of the Domain
   Namespace:

   o Names reserved by the IETF for technical purposes

   o Names assigned by ICANN to the public DNS root; some names
      reserved by the IETF for technical purposes may appear in the
      global DNS root for reasons pertaining to the operation of the DNS

   o ICANN Reserved Names; names that may not be applied for as TLDs
      (see "Reserved Names" and "Treatment of Country or Territory
      Names" (Sections 2.2.1.2.1 and 2.2.1.4.1, respectively) of
      [SDO-ICANN-DAG]).

   o Names used by other organizations without following established
      processes

   o Names that are unused and are available for assignment to one of
      the previous categories

   This document presents a list, derived from a variety of sources,
   including discussion in the IETF DNSOP Working Group, of the problems
   associated with the assignment of Special-Use Domain Names. The list
   is intended to be an unfiltered compilation of issues. In support of
   its analysis of the particular set of issues described here, the
   document also includes descriptions of existing practice as it
   relates to the use of domain names, a brief history of domain names,
   and some observations by various IETF participants who have
   experience with various aspects of the current situation.

2. Terminology

   This document uses the terminology from RFC 7719 [RFC7719]. Other
   terms used in this document are defined here:

   Domain Name: This document uses the term "domain name" as defined in
      Section 2 of RFC 7719 [RFC7719].

   Domain Namespace: The set of all possible domain names.

   Special-Use Domain Name: A domain name listed in the "Special-Use
      Domain Names" registry [SDO-IANA-SUDR].

   For the sake of brevity, this document uses some abbreviations, which
   are expanded here:

   IANA: Internet Assigned Numbers Authority

   ICANN: Internet Corporation for Assigned Names and Numbers

   TLD: Top-Level Domain, as defined in Section 2 of RFC 7719
            [RFC7719]

   gTLD: Generic Top-Level Domain (see Section 2 of RFC 2352
            [RFC2352])

3. Problems Associated with Special-Use Domain Names

   This section presents a list of problems that have been identified
   with respect to the assignment of Special-Use Domain Names.
   Solutions to these problems, including their costs or trade-offs, are
   out of scope for this document and will be covered in a separate
   document. New problems that might be created in the process of
   solving problems described in this document are also out of scope:
   these problems are expected to be addressed in the process of
   evaluating potential solutions.

   Special-Use Domain Names exist to solve a variety of problems. This
   document has two goals: enumerate all of the problems that have been
   identified to which Special-Use Domain Names are a solution and
   enumerate all of the problems that have been raised in the process of
   trying to use RFC 6761 as it was intended. As some of those problems
   may fall into both categories, this document makes no attempt to
   categorize the problems.

   There is a broad diversity of opinion about this set of problems.
   Not every participant agrees that each of the problems enumerated in
   this document is actually a problem. This document takes no position
   on the relative validity of the various problems that have been
   enumerated, nor on the organization responsible for addressing each
   individual problem, if it is to be addressed. This document only
   enumerates the problems, provides the reader with context for
   thinking about them, and provides a context for future discussion of
   solutions, regardless of whether such solutions may work for IETF,
   ICANN, IANA, or some other group.

   The list of problems is not presented in order of importance; numbers
   are assigned so that each problem can easily be referenced by number,
   not to indicate priority. The list of problems is as follows:

   1. Although the IETF and ICANN have a liaison relationship through
       which special-use allocations can be discussed, there exists no
       formal process for coordinating these allocations (see
       Section 4.1.3). The lack of coordination complicates the
       management of the root of the Domain Namespace and could lead to
       conflicts in name assignments [SDO-ICANN-SAC090].

   2. There is no explicit scoping as to what can constitute a
       "technical use" [RFC2860] and what cannot; there is also no
       consensus within the IETF as to what this term means.

   3. Not all developers of protocols on the Internet agree that
       authority over the entire Domain Namespace should reside solely
       with the IETF and ICANN.

   4. Although the 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. Such parties may observe that the IETF has never
       asserted control or authority over what protocols are "allowed"
       on the Internet, and that the principle of "permissionless
       innovation" suggests there should be a way for people to include
       new uses of domain names in new protocols and applications.

5. Organizations do in fact sometimes use subsets of the Domain
    Namespace without following established processes. Reasons a
    third party might do this include:

    1. Lack of knowledge that a process exists for assigning such
        names.

    2. Intended use is covered by the gTLD process [SDO-ICANN-DAG],
        but no gTLD process is ongoing.

    3. Intended use is covered by the gTLD process, but the third
        party doesn't want to pay a fee.

    4. Intended use is covered by some IETF process, but the third
        party doesn't want to follow the process.

    5. Intended use is covered by an ICANN or IETF process, but the
        third party expects that the outcome will be refusal or non-
        action.

    6. Lack of knowledge that a name intended to be used only
        locally may nevertheless leak.

    7. Lack of knowledge that a name used locally with informal
        allocation may subsequently be allocated formally, creating
        operational problems.

6. There is demand for more than one name resolution protocol for
    domain names. Domain names contain no metadata to indicate
    which protocol to use to resolve them. Domain name resolution
    APIs do not provide a way to specify which protocol to use.

7. When a Special-Use Domain Name is added to the "Special-Use
    Domain Names" registry, not all software that processes such
    names will understand the special use of that name. In many
    cases, name resolution software will use the Domain Name System
    for resolution of names not known to have a special use.
    Consequently, any such use will result in queries for Special-
    Use Domain Names being sent to Domain Name System authoritative
    servers. These queries may constitute an operational problem
    for operators of root zone authoritative name servers. These
    queries may also inadvertently reveal private information
    through the contents of the query, which is a privacy
    consideration.

8. Some protocol developers have assumed that they could not
    succeed in getting a name assigned through the IETF using the
    process defined in RFC 6761. This is because when the IETF has
    attempted to follow the process defined in RFC 6761, it has been
    slow and uncertain. For example, the process of assigning the
    first new name ('.local') using the process defined in 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 (largely because this ten years included time to develop
    the process as well as use it). 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.

9. There is strong resistance within the IETF to assigning domain
    names to resolution systems outside of the DNS, for a variety of
    reasons:

    1. It requires a mechanism for identifying which set of
        resolution processes is required in order to resolve a
        particular name.

    2. Assertion of authority: there is a sense that the Domain
        Namespace is "owned" by the IETF or by ICANN, so, if a name
        is claimed without following their processes, the person or
        entity that claimed that name should suffer some consequence
        that would, presumably, deter future circumvention of the
        official processes.

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

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

    5. If there is an IETF process through which a TLD can be
        assigned at zero cost other than time, this process will be
        used as an alternative to the more costly process of getting
        the name registered through ICANN.

    6. A name might be assigned for a particular purpose when a
        more general use of the name would be more beneficial.

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

   10. If there were no process for assigning names for technical use
        through the IETF, there is a concern that protocols that require
        such names would not be able to get them.

   11. In some cases where the IETF has made assignments through the
        process defined in RFC 6761, technical mistakes have been made
        due to misunderstandings as to the actual process that RFC 6761
        specifies (e.g., treating the list of suggested considerations
        for assigning a name as a set of requirements, all of which must
        be met). In other cases, the IETF has made de facto assignments
        of Special-Use Domain Names without following the process in RFC
        6761 (see [RFC7050] and [RFC7788]).

   12. There are several Top-Level Domain Names that are in use without
        due process for a variety of purposes. The status of these
        names need to be clarified and recorded to avoid future disputes
        about their use [SDO-ICANN-COLL].

   13. In principle, the process defined in RFC 6761 could be used to
        document the existence of domain names that are not safe to
        assign and provide information on how those names are used in
        practice. However, attempts to use RFC 6761 to accomplish this
        documentation have not been successful (for example, see
        "Additional Reserved Top Level Domains" [RESERVED-TLDS] and
        Section 4.2.7 of this document). One side effect of the lack of
        documentation is that any mitigation effect on the root name
        servers or on privacy considerations has been missed.

   14. A domain name can be identified as either a DNS name by placing
        it in the DNS zone(s) or a Special-Use Domain Name by adding it
        to the IANA registry. Some names are in both places; for
        example, some locally served zone names are in DNS zones and
        documented in the "Special-Use Domain Names" registry. At
        present, the only way a domain name can be added to the
        "Special-Use Domain Name" registry is for the IETF to take
        responsibility for the name and designate it for "technical
        use". There are other potential uses for domain names that
        should be recorded in the registry, but for which the IETF
        should not take responsibility.

   15. In some cases, the IETF may see the need to document that a name
        is in use without claiming that the use of the name is the
        IETF's particular use of the name. No mechanism exists in the
        current registry to mark names in this way.

16. During any of the review stages of a document, there is no
    formal process in which a check is made to ensure that the
    document does not unintentionally violate the IETF process for
    adding Special-Use Domain Names to the registry, as was the
    case, for example, in RFC 7788 [RFC7788].

17. Use of the registry is inconsistent -- some Special-Use Domain
    Name RFCs specifically add registry entries, some don't; some
    specify how and whether special-use name delegations should be
    done, some don't.

18. There exists no safe, non-process-violating mechanism for ad hoc
    assignment of Special-Use Domain Names.

19. It is generally assumed that protocols that need a Special-Use
    Domain Name need a mnemonic, single-label, human-readable
    Special-Use Domain Name for use in user interfaces such as
    command lines or URL entry fields. While this assumption is
    correct in some cases, it is likely not correct in all cases,
    for example, in applications where the domain name is never
    visible to a user.

20. 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.

21. The use of DNSSEC with Special-Use Domain Names is an open
    issue. There is no consensus or guidance about how to use
    DNSSEC with various classes of Special-Use Domain Names.
    Considerations in the use of DNSSEC with Special-Use Domain
    Names include:

    1. What class of Special-Use Domain Name is under
        consideration: non-DNS, locally served zone, or other?

    2. Does the Special-Use Domain Name require a delegation in the
        root zone; if so, should that delegation be signed or not?
        If there is no delegation, then this will be treated by
        validating resolvers as a secure denial of existence for
        that zone. This would not be appropriate for a name being
        resolved using the DNS protocol.

    3. A process would be required through which the IETF can cause
        a delegation in the root zone to be instantiated.

    4. What are the recommended practices for using DNS with the
        specific Special-Use Domain Name?

   The above list represents the current understanding of the authors 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 related to these problems.

4. Existing Practice regarding Special-Use Domain Names

   There are three primary (see Section 4.1) and numerous secondary
   (Section 4.2) documents to consider when thinking about the Special-
   Use Domain Names process.

   How names are resolved is ambiguous, in the sense that some names are
   Special-Use Domain Names that require special handling and some names
   can be resolved using the DNS protocol with no special handling.

   The assignment of Internet Names is not under the sole control of any
   one organization. The IETF has authority in some cases, but only
   with respect to "technical uses". At present, ICANN is the
   designated administrator of the root zone; but generally not of zones
   other than the root zone. Neither of these authorities can, in any
   practical sense, exclude the practice of ad hoc use of names.
   Unauthorized use of domain names can be accomplished by any entity
   that has control over one or more name servers or resolvers, in the
   context of any hosts and services that entity operates. It can also
   be accomplished by authors of software who decide that a Special-Use
   Domain Name is the right way to indicate the use of an alternate
   resolution mechanism.

4.1. Primary Special-Use Domain Name 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.

4.1.1. IAB Technical Comment on the Unique DNS Root

   [RFC2826] is not an IETF consensus document, and it appears to have
   been written to address a different problem than the Special-Use
   Domain Name problem. However, it speaks directly to several of the
   key issues that must be considered, and, coming as it does from the
   IAB, it is rightly treated as having significant 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
   Special-Use Domain Names. The main points that appear relevant to
   the Special-Use Domain Names problem are:

o The Internet requires a globally unique namespace: a namespace in
   which any given name refers to the same information (has the same
   meaning) no matter who requests that information and no matter
   from which specific name server they request it.

o Private networks may operate private namespaces, with names that
   have meanings only locally (within the private network), but they
   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
   symbolic references that have local meaning and references that
   have global meaning. Therefore, users may share references that
   incorporate domain names with no global meaning (for example, a
   URL of 'http://mysite.example.corp', where 'example.corp' is a
   domain used privately and informally as described in
   [SDO-ICANN-COLL]).

o While such a reference in the user's context refers to the object
   the user wishes to share, when the reference is used in a
   different context, it could refer either to some different object
   in the recipient's context or to no object at all. The effect of
   this reference escaping the context in which it is valid 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 when 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 [TOR], where
   it has meaning, and pasting this name into an SSH client that
   doesn't support connecting over the Tor network.

We can summarize the advice in this document as follows:

o Domain names with unambiguous global meaning are preferable to
   domain names with local meaning that 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]. RFC 6761 represents the current IETF consensus on
   designating and recording Special-Use Domain Names. The IETF has
   experienced problems with the designation process described in RFC
   6761; these concerns motivate this document. Familiarity with RFC
   6761 is a prerequisite for having an informed opinion on the topic of
   Special-Use Domain Names.

   RFC 6761 defines two aspects of Special-Use Domain Names: 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 (RFC 6761, 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 requires that any designation of a Special-Use Domain
   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 Domain 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.

   RFC 6761 provides the process whereby "Multicast DNS" [RFC6762]
   designated '.local' as a Special-Use Domain Name and included it in
   the "Special-Use Domain Names" registry. RFC 6761 also enumerates a
   set of names that were previously used or defined to have special
   uses prior to its publication. 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.

   Several important points to think about with respect to RFC 6761 are:

   o A Special-Use Domain Name may be a name that should be resolved
      using the DNS protocol with no special handling. An example of
      this is 'in-addr.arpa' (which is an example of a Special-Use
      Domain Name that is not a TLD).

o A Special-Use Domain Name may be a name that is resolved using the
   DNS protocol and that requires no special handling in the stub
   resolver but that requires special handling in the recursive
   resolver. An example of this would be '10.in-addr.arpa.'.

o A Special-Use Domain Name may be a name that requires special
   handling in the stub resolver. An example would be a Special-Use
   Top-Level Domain 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
   all of these purposes for Special-Use Domain Names are valid.

In this case, the term "stub resolver" 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; however, 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 a local database of some sort is made.

RFC 6761 does not limit Special-Use Domain Names to TLDs. However,
at present, all Special-Use Domain Names registered in the "Special-
Use Domain Names" registry [SDO-IANA-SUDR] either are intended to be
resolved using the DNS protocol, are TLDs, or are both. That is, at
present there exist no Special-Use Domain Names that require special
handling by stub resolvers and which are not at the top level of the
naming hierarchy.

One point to take from this is that there is already a requirement in
RFC 6762 that when a stub resolver encounters the special label,
'local' as the rightmost label of a domain name, it can only use the
Multicast DNS (mDNS) protocol to resolve that domain name.

4.1.3. MoU Concerning the Technical Work of IANA

There exists a Memorandum of Understanding (MoU) [RFC2860] between
the IETF and ICANN that discusses how names and numbers will be
managed through IANA. This document is important to the discussion
of Special-Use Domain Names because, while it delegates authority for
managing the DNS Namespace generally to ICANN, it reserves to the
IETF the authority that is then formalized in RFC 6761. RFC 2860
specifically states:

   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.

The assignment of names in the DNS root zone, and the management of
the Domain Namespace, is by default a function that is performed by
ICANN. However, the MoU specifically exempts domain names assigned
for technical use and uses the example of domains used for inverse
DNS lookup. Both 'in-addr.arpa' and 'ip6.arpa' are in the "Special-
Use Domain Names" registry.

Implicit in the MoU is the fact that the IETF and ICANN retain,
between them, sole authority for assigning any names from the Domain
Namespace. Both the IETF and ICANN have internal processes for
making such assignments.

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.

4.1.4. Liaison Statement on Technical Use of Domain Names

When the IETF received processing requests to add names to the
"Special-Use Domain Names" registry, as documented in [RESERVED-TLDS]
and [P2P-DOMAIN-NAMES], the IETF chartered a review of the process
defined in RFC 6761 for adding names to the registry (as explained
earlier). The IETF sent a liaison statement [SDO-IAB-ICANN-LS] to
ICANN to notify them of the review, affirm that the discussion would
be "open and transparent to participation by interested parties", and
explicitly invite members of the ICANN community to participate.

4.1.5. IAB Statement on the Registration of Special Use Names in the
        ARPA Domain

   As part of the process of resolving the controversy mentioned in
   Section 4.2.7, the IAB issued a statement saying, in part:

   There is currently no process defined with ICANN for special use
   names to be delegated in the root zone; it has seemed likely to take
   significant effort to create one. The IAB has noted that .arpa can
   be used "for technical infrastructure established by IETF standards"
   [SDO-IAB-SUDN-REG].

   Given the lack of an established process with ICANN, IETF documents
   cannot reserve names in the root of the DNS namespace if those names
   are to be delegated (that is, used by the DNS protocol). It would be
   possible to work with ICANN to develop a process for such
   delegations, but the success of that joint work, and the amount of
   time it would take, would still be uncertain.

4.2. Secondary Documents Relating to the Special-Use Domain Name
      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' Special-Use Top-Level Domain Name. Section 3
   describes the semantics of "multicast DNS names". It is of
   considerable historical importance to note that the -00 version of
   the document that eventually became RFC 6762, an individual
   submission, was published in July of 2001. The version posted at
   that time contains substantially the same text in Section 3 as RFC
   6762 did when published and was discussed in the DNSEXT Working Group
   at IETF 51 in August of 2001 [IETF-PRO-51]. The July 2001 draft
   designated '.local.arpa' as the Special-Use Domain 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 of RFC 6762; some notable milestones include the initial
   proposal to replace AppleTalk's Name Binding Protocol (NBP) in July
   1997, the chartering of the Zeroconf Working Group in September 1999,
   and the assignment 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 Top-Level Domain Name

The '.onion' Special-Use Top-Level Domain Name [RFC7686] is important
because it is the most recent IETF action on the topic of Special-Use
Domain Names; although it does not set a 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 Devising a resolution to the situation was constrained by at least
   two factors. First, there was no process for allocating Special-
   Use Domain Names at the time that the '.onion' project started
   using the name; at the time, and since the scope of use of the
   name was expected to be very constrained, the developers chose to
   allocate it unilaterally rather than asking the IETF or some other
   Standards Development Organization (SDO) to create a new process.

   Second, for some time, the CA/Browser Forum [SDO-CABF] had been
   issuing certificates for what they referred to as "internal
   names". Internal names are names allocated unilaterally for use
   in site-specific contexts. Issuing certificates for such names
   came to be considered problematic, since no formal process for
   testing the validity of such names existed. Consequently, the CA/
   Browser Forum decided to phase out the use of such names in
   certificates [SDO-CABF-INT] and set a deadline after which no new
   certificates for such names would be issued [SDO-CABF-DEADLINE].
   Because the '.onion' domain was allocated unilaterally, this would
   mean that certificates for subdomains of '.onion' could no longer
   be issued.

   The IETF's designation of '.onion' as a Special-Use Top-Level
   Domain Name was needed to facilitate the development of a
   certificate issuance process specific to '.onion' domain names
   [SDO-CABF-BALLOT144].

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 Special-Use Domain
   Names like '.local' and '.onion' in that the names are resolved using
   the DNS protocol (but they do require extensions or exceptions to the
   usual DNS resolution to enforce resolution in a local context rather
   than the global DNS context). It shares the problem that such names
   can be assumed neither to be unique across all contexts nor
   functional for all Internet-connected hosts.

4.2.4. Name Collision in the DNS

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

4.2.5. SSAC Advisory on the Stability of the Domain Namespace

   The ICANN Security and Stability Advisory Committee (SSAC)
   [SDO-ICANN-SSAC] specification "SSAC Advisory on the Stability of the
   Domain Namespace" [SDO-ICANN-SAC090] reports on some issues
   surrounding the conflicting uses, interested parties, and processes
   related to the Domain Namespace. The specification recommends the
   development of collaborative processes among the various interested
   parties to coordinate their activities related to the Domain
   Namespace.

4.2.6. 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
   process in RFC 6761 to designate '.ipv4only.arpa' as a Special-Use
   Domain Name; in this case, the process worked smoothly and without
   controversy.

   Unfortunately, while the IETF process worked smoothly, in the sense
   that there was little controversy or delay in approving the new use,
   it did not work correctly: the name 'ipv4only.arpa' was never added
   to the "Special-Use Domain Names" registry. This appears to have
   happened because the document did not explicitly request the addition
   of an entry for 'ipv4only.arpa' in the "Special-Use Domain Names"

   registry. This is an illustration of one of the problems that we
   have with the process in RFC 6761: it is apparently fairly easy to
   miss the step of adding the name to the registry.

4.2.7. Additional Reserved Top-Level Domains

   "Additional Reserved Top Level Domains" [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 the aforementioned document failed to gain consensus to be
   published, the need it was intended to fill still exists.
   Unfortunately, although a fair amount is known about the use of these
   names, no RFC exists that describes how they are used and why it
   would be a problem to delegate 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.

   RFC 7788 [RFC7788] defines the Top-Level Domain Name '.home' for use
   as the default name for name resolution relative to a home network
   context. Although, as defined in RFC 7788, '.home' is a Special-Use
   Domain Name, RFC 7788 did not follow the process specified in RFC
   6761: it did not request that '.home' be added to the "Special-Use
   Domain Names" registry. This was recognized as a mistake and
   resulted in the posting of an errata report [Err4677]. Additionally,
   '.home' is an example of an attempt to reuse a domain name that has
   already been put into use for other purposes without following
   established processes [SDO-ICANN-COLL], which further complicates the
   situation. At the time RFC 8244 was written, the IETF was developing
   a solution to this problem.

5. History

   A newcomer to the problem of resolving domain names may be under the
   impression that the DNS sprang fully formed directly from Paul
   Mockapetris' head (as was the birth of Athena in Greek Mythology).
   This is not the case. At the time the IAB technical document was
   written [RFC2826], memories would have been fresh of the evolutionary
   process that led to 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)

[RFC959]. The inefficiency of this process is cited as a reason for
the development of the DNS [RFC882] [RFC883] in 1983.

However, the transition from HOSTS.TXT to the DNS was not smooth.
For example, Sun Microsystems' Network Information System (NIS)
[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 the NIS or WINS.
Most have the capability to resolve names using mDNS by recognizing
the special meaning of the '.local' Special-Use Top-Level Domain
Name.

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 use a "private"
TLD for internal use, and this practice was very much a part of the
zeitgeist at the time (see Section 5.1 of [SDO-ICANN-COLL] and
Appendix G of [RFC6762]). This attitude is at the root of the
widespread practice of simply picking an apparently unused TLD 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
Domain 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 using a wide variety of name resolution systems, domain
names are required in a large variety of contexts in user interfaces
and applications programming interfaces. Any name that appears in
such a context is a domain name. So, developers of new name
resolution systems that must work in existing contexts actually have
no choice: they must use a Special-Use Domain Name to segregate a
portion of the namespace for use with their system.

6. Security Considerations

   This document mentions various security and privacy considerations in
   the text. However, this document creates no new security or privacy
   concerns.

7. IANA Considerations

   This document does not require any IANA actions.

8. Informative References

   [CORP-SUN-NIS]
             Wikipedia, "Network Information Service", August 2017,
             <https://en.wikipedia.org/wiki/
             Network_Information_Service>.

   [DOMAIN-NAMES]
             Lewis, E., "Domain Names, A Case for Clarifying", Work in
             Progress, draft-lewis-domain-names-09, August 2017.

   [Err4677] RFC Errata, "Erratum ID 4677", RFC 7788,
             <https://www.rfc-editor.org/errata/eid4677>.

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

   [P2P-DOMAIN-NAMES]
             Grothoff, C., Wachs, M., Wolf, H., Ed., Appelbaum, J., and
             L. Ryge, "Special-Use Domain Names of Peer-to-Peer
             Systems", Work in Progress, draft-grothoff-iesg-special-
             use-p2p-names-04, January 2015.

   [PROBLEM-SPECIAL-NAMES]
             Huston, G., Koch, P., Durand, A., and W. Kumari, "Problem
             Statement for the Reservation of Special-Use Domain Names
             using RFC6761", Work in Progress, draft-adpkja-dnsop-
             special-names-problem-06, September 2016.

   [RESERVED-TLDS]
             Chapin, L. and M. McFadden, "Additional Reserved Top Level
             Domains", Work in Progress, draft-chapin-additional-
             reserved-tlds-02, March 2015.

   [RFC882]   Mockapetris, P., "Domain names: Concepts and facilities",
               RFC 882, DOI 10.17487/RFC0882, November 1983,
               <https://www.rfc-editor.org/info/rfc882>.

   [RFC883]   Mockapetris, P., "Domain names: Implementation
               specification", RFC 883, DOI 10.17487/RFC0883, November
               1983, <https://www.rfc-editor.org/info/rfc883>.

   [RFC959]   Postel, J. and J. Reynolds, "File Transfer Protocol",
               STD 9, RFC 959, DOI 10.17487/RFC0959, October 1985,
               <https://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,
               <https://www.rfc-editor.org/info/rfc1002>.

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

   [RFC1035]   Mockapetris, P., "Domain names - implementation and
               specification", STD 13, RFC 1035, DOI 10.17487/RFC1035,
               November 1987, <https://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,
               <https://www.rfc-editor.org/info/rfc1918>.

   [RFC2352]   Vaughan, O., "A Convention For Using Legal Names as Domain
               Names", RFC 2352, DOI 10.17487/RFC2352, May 1998,
               <https://www.rfc-editor.org/info/rfc2352>.

   [RFC2826]   Internet Architecture Board, "IAB Technical Comment on the
               Unique DNS Root", RFC 2826, DOI 10.17487/RFC2826, May
               2000, <https://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,
               <https://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,
              <https://www.rfc-editor.org/info/rfc4193>.

   [RFC6303] Andrews, M., "Locally Served DNS Zones", BCP 163,
              RFC 6303, DOI 10.17487/RFC6303, July 2011,
              <https://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, <https://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,
              <https://www.rfc-editor.org/info/rfc6760>.

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

   [RFC6762] Cheshire, S. and M. Krochmal, "Multicast DNS", RFC 6762,
              DOI 10.17487/RFC6762, February 2013,
              <https://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,
              <https://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, <https://www.rfc-editor.org/info/rfc7686>.

   [RFC7719] Hoffman, P., Sullivan, A., and K. Fujiwara, "DNS
              Terminology", RFC 7719, DOI 10.17487/RFC7719, December
              2015, <https://www.rfc-editor.org/info/rfc7719>.

   [RFC7788] Stenberg, M., Barth, S., and P. Pfister, "Home Networking
              Control Protocol", RFC 7788, DOI 10.17487/RFC7788, April
              2016, <https://www.rfc-editor.org/info/rfc7788>.

   [SDO-CABF] CA/Browser Forum, "CA/Browser Forum Home Page",
              <https://cabforum.org>.

   [SDO-CABF-BALLOT144]
             CA/Browser Forum, "Ballot 144 - Validation Rules for
             .onion Names", February 2015, <https://cabforum.org/2015/
             02/18/ballot-144-validation-rules-dot-onion-names>.

   [SDO-CABF-DEADLINE]
             CA/Browser Forum, "SSL Certificates for Internal Server
             Names", January 2013,
             <https://www.digicert.com/internal-names.htm>.

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

   [SDO-IAB-ICANN-LS]
             IETF, "Liaison Statement from the IAB to the ICANN Board
             on Technical Use of Domain Names", September 2014,
             <https://datatracker.ietf.org/liaison/1351>.

   [SDO-IAB-SUDN-REG]
             IAB, "Internet Architecture Board statement on the
             registration of special use names in the ARPA domain",
             March 2017, <https://www.iab.org/documents/
             correspondence-reports-documents/2017-2/iab-statement-on-
             the-registration-of-special-use-names-in-the-arpa-
             domain/>.

   [SDO-IANA-SUDR]
             IANA, "Special-Use Domain Names", <http://www.iana.org/
             assignments/special-use-domain-names>.

   [SDO-ICANN-COLL]
             Interisle Consulting Group, LLC, "Name Collision in the
             DNS", Version 1.5, August 2013, <https://www.icann.org/
             en/system/files/files/name-collision-02aug13-en.pdf>.

   [SDO-ICANN-DAG]
             ICANN, "gTLD Applicant Guidebook", Version 2012-06-04,
             June 2012, <https://newgtlds.icann.org/en/applicants/agb/
             guidebook-full-04jun12-en.pdf>.

   [SDO-ICANN-SAC090]
             ICANN Security and Stability Advisory Committee, "SSAC
             Advisory on the Stability of the Domain Namespace",
             ICANN SAC090, December 2016, <https://www.icann.org/en/
             system/files/files/sac-090-en.pdf>.

   [SDO-ICANN-SSAC]
              ICANN, "Security and Stability Advisory Committee (SSAC)",
              December 2016, <https://www.icann.org/groups/ssac>.

   [TOR]   Tor, "Tor - Anonymity Online",
              <https://www.torproject.org>.

Contributors

Authors' Addresses

   Ted Lemon
   Nominum, Inc.
   800 Bridge Parkway
   Redwood City, CA 94065
   United States of America

   Phone: +1 650 381 6000
   Email: ted.lemon@nominum.com

   Ralph Droms

   Email: rdroms.ietf@gmail.com

   Warren Kumari
   Google
   1600 Amphitheatre Parkway
   Mountain View, CA 94043
   United States of America

   Email: warren@kumari.net