Requirements for DNS-SD/mDNS Extensions
draft-lynn-mdnsext-requirements-02

Abstract

   DNS-SD/mDNS is widely used today for discovery and resolution of
   services and names on a local link, but there are use cases to extend
   DNS-SD/mDNS to enable service discovery beyond the local link. This
   document provides a problem statement and a list of requirements.

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1. Introduction

   DNS-based service discovery [DNS-SD]/[mDNS] is widely used today for
   discovery and resolution of services and names on a local link.
   However, as users move to multi-link home or campus networks they
   find that mDNS does work across routers. DNS-SD can also be used in
   conjunction with conventional unicast DNS to enable wide-area service
   discovery, but this capability is not yet widely deployed. This
   disconnect between customer needs and current practice has led to
   calls for improvement, such as the Educause petition [EP].

   In response to this and similar evidence of market demand, several
   products now enable service discovery beyond the local link using
   different ad-hoc techniques. However, it's unclear which approach
   represents the best long-term direction for DNS-based service
   discovery protocol development.

   DNS-SD/mDNS in its present form is also not optimized for network
   technologies where multicast transmissions are relatively expensive.
   Wireless networks such as [IEEE.802.11] may be adversely affected by
   excessive mDNS traffic due to the higher network overhead of
   multicast transmissions. Wireless mesh networks such as 6LoWPAN are
   effectively multi-link subnets where multicasts must be routed by
   intermediate nodes.

   It is in the best interests of end users, network administrators, and
   vendors for all interested parties to cooperate within the context of
   the IETF to develop an efficient, scalable, and interoperable
   standards-based solution.

   This document defines the problem statement and gathers requirements
   for DNS-SD/mDNS Extensions.

2. Problem Statement

Service discovery beyond the local link is probably the most
important feature missing currently in the DNS-SD/mDNS framework.
The following describes some of the issues.

2.1. Multilink Naming and Discovery

A list of desired DNS-SD/mDNS improvements from network
administrators in the research and education community was issued in
the form of the Educause petition [EP]. The following is a technical
summary of the issues:

o Current products advertising services such as printing and
   multimedia streaming via DNS-SD/mDNS do not work when devices are
   on different links. It is common for enterprise-grade wireless
   and wired networks in the institutions to utilize different links.
   DNS-SD used with conventional unicast DNS does work when devices
   are on different links, but the records need to get into the
   unicast DNS namespace somehow.

o Entering DNS-SD records manually into a unicast DNS zone file
   works, (as has been done for many years for the Terminal Room
   printers at IETF meetings) but requires the DNS administrator to
   know how to do that [static] and is fragile when IP address of
   devices may change, as is common when DHCP is used.

o Automatically adding DNS-SD records using DNS Update works, but
   requires that the DNS server be configured to allow DNS Updates,
   and requires that devices be configured with the DNS Update
   credentials to permit such updates, which has proved to be overly
   onerous.

o Therefore, a mechanism is desired that populates the unicast DNS
   namespace with the appropriate DNS-SD records with less manual
   administration.

The following is a technical summary of the requirements:

o It must scale to a range of hundreds or thousands of DNS-SD/mDNS
   enabled devices in a given environment.

o It must work with wired and wireless networks from different
   vendors.

o It must not significantly negatively impact network traffic (wired
   or wireless).

   o It must be easily manageable at an enterprise scale.

   o If it requires a separate hardware solution, the solution must be
      enterprise grade (rack mountable, dual power supplies, etc.)

   o It must be provided at a reasonable cost.

2.2. Wireless LANs

   Multicast DNS was originally designed to run on Ethernet - the
   dominant link-layer at the time. In shared Ethernet networks,
   multicast frames place little additional demand on the shared network
   medium above unicast frames. In IEEE 802.11 networks however,
   multicast frames are transmitted at a low data rate supported by all
   receivers. In practice, this data rate is often very low and leads
   to a larger fraction of airtime being devoted to multicast
   transmission. Some network administrators block multicast traffic or
   convert it to a series of link-layer unicast frames.

   To improve transmission reliability, the IEEE 802.11 MAC requires
   positive acknowledgement of unicast frames. It does not however,
   require positive acknowledgement of multicast frames. As a result,
   it is common to observe much higher loss of multicast frames on
   802.11 than other IEEE 802 network technologies.

   Enabling service discovery on IEEE 802.11 networks requires that the
   number of multicast frames be restricted to a suitably low value, or
   replaced with unicast frames to use the MAC's reliability features.

2.3. Low Power and Lossy Networks (LLNs)

   Emerging wireless mesh networking technologies such as RPL/6LoWPAN
   [RFC4944] [RFC6550] present several challenges for the current DNS-
   SD/mDNS design. First, "local link" is defined as a node's one-hop
   neighbors. This effectively means that a mesh is a multi-link
   single-prefix subnet and that link-local multicast scope is
   insufficient to span it.

   Not only is subnet-scoped multicast difficult on such networks, but
   low-power nodes may be offline for significant periods either because
   they are "sleeping" or due to connectivity problems. In such cases
   LLN nodes might fail to respond to queries or defend their names
   using the current design.

3. Use Cases

The following use cases are defined with different constraints to
help distinguish and classify the target requirements. [This is a
strawman proposal. MB]

   (A) Personal Area networks, e.g., one laptop and one printer.
   This is the simplest example of an mDNS network.

   (B) Home networks, consisting of:

   * Single exit router: the network may have multiple upstream
      providers or networks, but all outgoing and incoming trafic
      goes through a single router.

   * One level depth: all links on the network are connected to the
      same default router.

   * Single administrative domain: all nodes under the same admin
      entity.

   (C) Like B but may have a tree of links behind the single exit
   router. However, the forwarding nodes are almost self-configured
   and do not require routing protocol administrators.

   (D) Enterprise networks, consisting of:

   * Any depth of the forwarding tree, under a single administrative
      domain. The large majority of the forwarding and security
      devices are configured.

   (E) Higher Education networks, consisting of:

   * Any depth of the forwarding tree, core network under a central
      administrative domain but leaf networks under multiple
      administrative entities. The large majority of the forwarding
      and security devices are configured.

   (F) Mesh networks such as RPL/6LoWPAN, multi-link but single
   prefix networks.

[4](#). Internationalization Considerations

The solution should support rich international text, as do DNS-SD and
mDNS today. Users will not accept a solution that does not allow the
richness of service naming that they currently have with mDNS, manual
zone files, and DNS Update today.

[5](#). Namespace Considerations

The unicast DNS namespace is (somewhat) global. Naming services over
a local scope is local. Clients discovering services need to be able
to differentiate global names from local names.

6. Requirements

[This is a strawman proposal. MB]

REQ1: The scope of the discovery should be either automatically
   found by the discovering devices and/or configured.

REQ2: For use cases A, B and C, there should be a zero configuration
   operation.

REQ3: For use cases D and E, there should be a way to configure the
   scope of the discovery and also support both smaller (ex:
   department) and larger (ex: campus-wide) discovery.

REQ4: For use cases D and E, there should be an incremental way to
   deploy the solution.

REQ5: The new solution should integrate or at least should not break
   any current link scope DNS-SD/mDNS protocols and deployments.

7. IANA Considerations

This document currently makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an
RFC.

8. Security Considerations

[Not complete - initial ideas. MB]

If the scope of the discovery is not properly setup or constrained,
then information leaks will happen outside the appropriate network.

Visiting nodes on a network may discover more services than desired
by the network policies, if filtering of discovery packets was not
properly setup. [Is this a NAC or DNS problem? KL]

Depending on the chosen solution, there is a possibility of name
space conflicts between the DNS tree and this solution. In this
case, a node may not know if the target node or service is the right
one, therefore enabling ground for various attacks.

The [DNS-SD]/[mDNS] framework security considerations also apply.

9. Acknowledgments

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Marc Blanchet, Tim Chown, Ralph Droms, Educause, Matthew Gast, and
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Authors' Addresses

   Kerry Lynn (editor)
   Consultant

   Phone: +1 978 460 4253
   Email: kerlyn@ieee.org

      Stuart Cheshire
      Apple, Inc.
      1 Infinite Loop
      Cupertino , California   95014
      USA

      Phone: +1 408 974 3207
      Email: cheshire@apple.com