

DNS-SD/mDNS Extensions
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K. Lynn, Ed.
Consultant
S. Cheshire
Apple, Inc.
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**Requirements for DNS-SD/mDNS Extensions
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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 traffic 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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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