DNS Service Discovery(DNS-SD)

Summary of Basic Functionalities

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Introduction

DNS-SD [RFC 6763] allows clients to discover a list of instances of a desired service using standard DNS Queries. When used with mDNS [RFC 6762], DNS-SD can provide zero-configuration operation.

In a nutshell, using DNS-SD a client can discover the list of available instances of a given service type by sending a query for a DNS PTR record [RFC 1035] with a name of the form:

"<*Service*>.<*Domain*>".

Such a query returns a set of zero or more PTR records giving service instance names, in the form:

"<*Instance*>.<*Service*>.<*Domain*>".

After that, DNS SRV records [RFC 2782] can be used to provide the target host and port where the service instance can be reached, while DNS TXT records [RFC 1035] provide additional information about this instance.

DNS (and consequently mDNS) responders may put for efficiency purposes additional records in the additional section of the DNS messages (i.e. records that a client did not explicitly request); it is client responsibility whether or not to trust them.

The aforementioned process is described in more detail in the next subsections.

Service Type Enumeration – Discovery of Available Types of Services

To discover all available types of services, a special meta-query is defined (actually for problem diagnosis and network management purposes, as explained in [RFC 6763]). Specifically, a DNS query for PTR records with the name "*_services._dns-sd._udp.*<*Domain*>" yields a set of PTR records, where the rdata of each PTR record is the two-label <Service> name, plus the same domain, e.g., "_http._tcp.<Domain>". These two-label service types can then be used to construct subsequent Service Instance Enumeration PTR queries, in this <Domain> or others, to discover instances of that service type.

Service Instance Enumeration (Browsing)

Typically, traditional DNS SRV records are useful for locating instances of a particular type of service when all the instances are effectively indistinguishable and provide the same service to the client. However, since this is not necessarily the case at the local link (e.g. not all the printers are convenient for a user), instead of requesting records of type "SRV", the client requests records of type "PTR" for the name "<Service>.<Domain>"; the results is a set of zero or more PTR records giving Service Instance Names of the form:

Service Instance Name = <Instance> . <Service> . <Domain>

The <Instance> portion of the Service Instance Name is a user-friendly name consisting of arbitrary Net-Unicode text. While this name is initially auto-configured, the user can later define a name of his choice.

The <Service> portion of the Service Instance Name consists of a pair of DNS labels, following the convention for SRV records [RFC 2782]; the first label is an underscore character followed by the Service Name [RFC 6335]. The second label is either "_tcp" (for application protocols that run over TCP) or "_udp" (for all others). Service names may not be more than fifteen characters long (not counting the mandatory underscore), consisting of only letters, digits and hyphens. For further restrictions to Service names, as well as for examples, the reader can refer to Section 7 of [RFC 6763].

The <Domain> portion of the Service Instance Name specifies the DNS subdomain within which those names are registered; it may be "local." (when mDNS is used), or a conventional Unicast DNS domain name.

RFC 6763 also foresees the usage of selective service instance enumeration, e.g. the use of subtypes, so as to narrow the set of results, when needed. For instance, in order to discover the web pages that provide management for printers, a request for “_printer._sub._http._tcp.<Domain> will provide the desired outcome (whilst a request for _http._tcp.<Domain> would return all the available web pages, not only the ones used for printer management purposes). Subtype strings are not required to begin with an underscore, though they often do. Subtypes, are only appropriate in two-level scenarios.

Finally, as far as the name lengths are concerned, while the service names can be up to 15 bytes (plus the underscore), the instance name as well as the subtypes identifier can be up to 63 bytes each. As explained in RFC 6763 (paragraph 7.2), these leaves 100 bytes to accommodate organisation’s domain name (if other than “.local” in the case of mDNS).

Service Instance Resolution

When a client needs to contact a particular service instance name discovered previously via Service Instance Enumeration, it queries for the SRV and TXT records of that name.

The SRV record gives the port number and target host name where the service may be found. When more than one SRV is returned, clients MUST correctly interpret the priority and weight fields. Service

types are given on a first-serve basis. A service type registry was originally maintained by DNS-SD.org [Cheshire, 2016], but it has been merged into IANA's registry for DNS SRV records[1].

On the other hand, the TXT record provides additional information about the service (if available). The specific nature of that additional data, and how it is to be used, is service- dependent, but the overall syntax of the data in the TXT record is standardized. Every DNS-SD service MUST have a TXT record in addition to its SRV record, with the same name, even if the service has no additional data to store and the TXT record contains no more than a single zero byte. This allows a service to have explicit control over the Time to Live (TTL) of its (empty) TXT record.

A DNS TXT record can be up to 65535 byres long (the total length is indicated by the length given in the resource record header in the DNS message). However, when used with mDNS, an upper limit of about 8900 bytes is imposed [RFC 6763]. Nevertheless, using TXT records larger than 1300 bytes is not recommended. The format rules for TXT records are not DNS-SD specific; it is defined in [RFC 1035]. DNS TXT record format rules for use in DNS-SD are given in paragraph 6.3 of RFC 6763.

Typically, every DNS-SD service instance has exactly one TXT record. It is possible though, but not often, to have multiple TXT records to describe a single service instance. Specifically, in such a case each TXT record describes a different variant of the same logical service, which is offered using the same underlying protocol on the same port, and it is described by the same SRV record.

Discovery of Browsing and Registration Domains (Domain Enumeration)

Zero-day configuration (aka mDNS and DNS-SD) would be nice to be used not only for service discovery, but also for recommended registration and browsing domain discovery. This can actually be achieved by using either mDNS or even unicast DNS PTR queries (when a DNS server is known) by employing five special RR names reserved for this purpose:

b._dns-sd._udp.<domain>.	used to discover <domain> as a potential place to browse
db._dns-sd._udp.<domain>.	if you want <domain> to be chosen as the default
r._dns-sd._udp.<domain>.	to show up in the list of potential registration <domain>.
dr._dns-sd._udp.<domain>.	if you want <domain> to be chosen as the default registration one
lb._dns-sd._udp.<domain>.	applications that do empty-string domain browses will browse your zone in addition to "local."

The <domain> part of the Domain Enumeration query name may be "local." (meaning "perform the query using link-local multicast") or it may be learned through some other mechanism, such as the DHCP "Domain" option (option code 15) [RFC 2132], the DHCP "Domain Search" option (option code 119) [RFC 3397], or IPv6 Router Advertisement Options [RFC 6106].

1 https://www.iana.org/assignments/service-names-port-numbers/service-names-port-numbers.txt

The <domain> part of the query name may also be derived a different way, from the host's IP address. For example, if a host has the address 192.168.12.34, with the subnet mask 255.255.0.0, then the 'base' address of the subnet is 192.168.0.0, and to discover the recommended automatic browsing domain(s) for devices on this subnet, the host issues a DNS PTR query for the name:

"lb._dns-sd._udp.0.0.168.192.in-addr.arpa."

Equivalent address-derived Domain Enumeration queries should also be done for the host's IPv6 address(es).

Address-derived Domain Enumeration queries SHOULD NOT be done for IPv4 link-local addresses [RFC 3927] or IPv6 link-local addresses [RFC 4862].

Starting in Mac OS X v10.4 Tiger and Bonjour for Windows, a network administrator can set up a Bonjour name server to enable wide-area capable devices and applications to discover services anywhere in the world [Cheshire, n.d.]. Wide-Area Bonjour uses DNS Service Discovery [Cheshire, n.d.a.] along with DNS Update [RFC 2136] and TSIG security [RFC 2845].

References

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