DNS Web Service Discovery

Abstract

This document describes a standardized approach to discovering Web
Service Endpoints from a DNS name. Services are advertised using the
DNS SRV and TXT records and the HTTP Well Known Service conventions.

This document is also available online at http://mathmesh.com/
Documents/draft-hallambaker-web-service-discovery.html.

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1. Introduction

Web services are traditionally identified by means of a URI
specifying a Web Service Endpoint (WSE). This is approach is
unsatisfactory in many situations:

  *Specification of the Web Service requires the transport and
   presentation protocols to be fixed.

  *The discovery mechanism does not provide support for load
   balancing or fault tolerance.

  *The identifiers are unsuited for human interaction.

The last consideration is a particular concern where an account
identifier is exposed to the user. Attempts to 'teach' users to use
URIs as account identifiers have been predictably unsuccessful.
Users expect and require accounts to be of the form user@example.com
and not http://service.example.com/service/user.

The Web Service discovery process described in this specification
builds on the approach specified in DNS-Based Service Discovery
[RFC6763]. This uses DNS SRV records as the basis for service
discovery and TXT records as the basis for service description. This
approach allows Web Services to make use of the load balancing and

fault tolerance features of SRV and the service negotiation
capabilities provided by the service description.

One difficulty that is frequently encountered in attempting to make
use of DNS records for service discovery is that it is not always
possible for an application process to access this information.
Specifications address the world as it actually is rather than as
some believe it should be have proven more robust in real world
deployment than those that do not. The discovery process defined
includes a fallback strategy to enable clients to achieve Web
Service discovery in these circumstances.

Another difficulty that is encountered is that the SRV record maps
service names to host names rather than Web Service Endpoints. A
convention is thus required to map a host name and protocol prefix
to a Web Service Endpoint. The HTTP Well Known Service [RFC5785]
mechanism is used for this purpose.

While the approach adopted in this specification closely follows
that of [RFC6763], there is an important difference in that the
earlier specification sets out a framework which Web Services may
apply to develop a discovery approach that suits their particular
needs while this specification defines exactly one such approach. In
particular, the use of a common set of TXT keys to specify service
parameters enables service discovery and negotiation to be delegated
to common support libraries rather than being implemented
independently in each application.

2. Definitions

This section presents the related specifications and standard, the
terms that are used as terms of art within the documents and the
terms used as requirements language.

2.1. Requirements Language

The key words **"MUST"**, **"MUST NOT"**, **"REQUIRED"**, **"SHALL"**, **"SHALL NOT"**,
"SHOULD", **"SHOULD NOT"**, **"RECOMMENDED"**, **"MAY"**, and **"OPTIONAL"** in this
document are to be interpreted as described in [RFC2119].

2.2. Defined Terms

Web Service An Internet service provided by one or more Web Service
   Hosts that are addressable by a single Web Service Endpoint and
   are intended to provide logically equivalent services.

Web Service Endpoint (WSE) A URI that specifies a Web Service or
   Web Service Host.

Web Service Host The actual machine (physical or virtual) that
   provides a Web Service

3. Service Discovery

Service discovery is the process of resolving the address of a Web
Service to a Web Service Endpoint, a URI [RFC3986] at which the
service is provided.

3.1. Host Identification

The first step in service discovery is to resolve the <domain> and
<service> identifiers to the IP address of a host that provides that
service.

3.1.1. SRV Host discovery

A client attempting to connect to the service first attempts to
locate an SRV record [RFC2782] for the specified service:

_<service>._tcp.<domain> SRV <priority> <weight> <port> <host>

Where <service> is the IANA assigned service name, <priority> and
<weight> are the SRV priority and weight parameters specified in
[RFC2782], <port> is the TCP port number and <host> is the DNS name
of the host for which the service advertisement is made.

If no SRV records are found, the client **MAY** abort the connection or
attempt use of the Fallback Discovery process described below.

3.2. Service Description

The second step in service discovery is to identify the attributes
of the Web Service and Web Service Hosts providing that service.

3.2.1. TXT Service and Host Description

A service **MAY** advertise service and/or host description information
using TXT records as described in DNS-Based Service Discovery
[RFC6763] . These have the following format:

```
_<service>._tcp.<domain>  TXT "<key>=<value> [<tag>=<value>]*"
_<service>._tcp.<host>  TXT "<key>=<value> [<tag>=<value>]*"
```

Where <domain> and <host> are the domain names specified in the
corresponding SRV records.

Service descriptions specified under the domain address of the
service apply to all host instances of the service. Descriptions
specified under the domain address of a host instance apply only to
that host instance and take precedence over values specified at the
service level.

The following keys are currently defined:

path The path to use to construct the Web Service Endpoint.

version The service version(s) supported in the format <max>-<min>

encoding An IANA media type specifying a supported encoding format

3.3. Service Selection

Web Service Hosts that do not meet the requirements of the client
attempting to create a connection are eliminated before applying SRV
service selection criteria specified in [RFC2782].

Clients **SHOULD** limit the number of connections attempted before
abandoning the attempt to connect.

3.4. Web Service Endpoint Determination

Having selected a Web Service Host, the client determines the Web
Service Endpoint as follows:

  *If the description of the host specifies a path key, the
   corresponding value is used as the path, otherwise,

  *if the description of the service specifies a path key, the
   corresponding value is used as the path, otherwise,

  *the path is /.well-known/srv/<service>

3.5. DNS Fallback

Despite the fact that SRV records have been a part of the DNS standard for 20 years, it is not uncommon for network intermediaries to implement SRV record resolution incorrectly or block it entirely. If no SRV record is found, a client **MAY** perform fallback discovery if explicitly authorized to do so by the corresponding Web Service protocol specification.

The Web Service Endpoint used is:

```
https://<service>.<domain>/.well-known/srv/<service>
```

Fallback discovery constrains the service provider to use a specific DNS configuration and provides inferior load balancing or fault tolerance capabilities to use of SRV records. It does however ensure that the service is reachable in situations where it would otherwise be unavailable.

3.6. Example

The Mathematical Mesh has the Well-Known Service name of 'MMM'. Accounts used in the Mathematical Mesh follow the [RFC5322] format of <user>@<domain>.

Alice has the account alice@example.com and the DNS configuration file for example.com has the following entries:

```
_mmm._tcp.example.com SRV host1.example.com 0 10 80 host1.example.com
_mmm._tcp.example.com SRV host2.example.com 0 40 80 host2.example.com
_mmm._tcp.example.com TXT "version=1.0-2.0"
mmm.example.com        CNAME host3.example.com
host1.example.com      A 10.0.1.1
host2.example.com      A 10.0.1.2
_mmm._tcp.host2.example.com TXT "path=/service"
host3.example.com      A 10.0.1.1
host3.example.com      A 10.0.1.2
```

The client attempts to resolve the address alice@example.com as follows:

0. Client attempts to resolve SRV and TXT records for _mmm._tcp.example.com

1. DNS resolver returns two SRV entries and one TXT entry

2. Client makes a random selection between host1 (20% weighting)
      and host2 (80% weighting). Chooses host1.

   3. Client resolves A/AAAA for host1.example.com and TXT for
      _mmm._tcp.host1.example.com

   4. DNS resolver returns A=10.0.1.1 and TXT=none

   5. Client attempts to POST Web Service request to http://
      host1example.com/.well-known/srv/mmm at host address 10.0.1.1

   6. The host at 10.0.1.1 returns 503 Service Unavailable

   7. Client resolves A/AAAA for host2.example.com and TXT for
      _mmm._tcp.host2.example.com

   8. DNS resolver returns A=10.0.1.2 and TXT "path=/service"

   9. Client attempts to POST Web Service request to http://
      host2example.com/service at host address 10.0.1.2

   10. Request succeeds, session proceeds.

If the same client is used in a network location where the SRV
record resolution fails due to a faulty firewall configuration, the
resolution proceeds as follows:

   0. Client attempts to resolve SRV record for _mmm._tcp.example.com

   1. DNS resolver returns 'not found'

   2. Client attempts to resolve A and AAAA record

   3. DNS resolver returns 10.0.1.1, 10.0.1.2

   4. Client makes a random selection between 10.0.1.1 (50%
      weighting) and 10.0.1.2 (50% weighting). Chooses host1.

   5. Client attempts to POST Web Service request to http://
      example.com/.well-known/srv/mmm at host address 10.0.1.1

   6. The host at 10.0.1.1 returns 503 Service Unavailable

   7. Client attempts to POST Web Service request to http://
      example.com/.well-known/srv/mmm at host address 10.0.1.2

   8. Request succeeds, session proceeds.

Note that the main differences between these two scenarios is that
the use of the SRV record allows the service configuration to

account for load balancing with tiers of fallback support and use of
service description information while the use of round robin A/AAAA
records does not.

4. Further Work

4.1. Additional Description Keys

The use of service and host descriptions to specify security
enhancements is currently being considered. This provides a superset
of the capabilities specified in [RFC6698].

   *Specify minimum TLS version.

   *Specify trust roots more flexibly

   *Specify client authentication requirements

   *Use of security enhancements other than TLS.

   *Publish public keys to be used to protect negotiation of security
    enhancements

The use of service and host descriptions to specify use of non-HTTP
presentation transports is currently being considered.

4.2. Service Scaling

This document considers the problem of establishing a connection to
a Host providing a particular Web Service. When constructing
services at very large scale (e.g. millions of concurrent users), it
becomes desirable to enable discovery of a Web Service Host
responsible for a particular partition of that data (e.g. a
particular user account).

Since this is clearly a different problem, it is judged that the
best approach is to give it a different name and rule it out of
scope of the present work.

5. Security Considerations

A treatment of the security considerations will follow.

6. IANA Considerations

The following registrations are required:

6.1. Well-Known URIs

The following registration is requested in the well-known URI
registry in accordance with [RFC5785]

URI suffix

srv

Change controller

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Specification document(s):

[This document]

Related information

[draft-hallambaker-web-service-discovery]

7. Normative References

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8. Informative References

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