

Associating a DoH Server with a Resolver
draft-hoffman-resolver-associated-doh-05

Abstract

Browsers and web applications may want to know if there are one or more DoH servers associated with the DNS recursive resolver that the operating system is already using. This would allow them to get DNS responses from a resolver that the user (or, more likely, the user's network administrator) has already chosen. This document describes two protocols for a resolver to tell a client what its associated DoH servers are.

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[1.](#) Introduction

DoH [[RFC8484](#)] requires that one or more DoH servers be configured for the DoH client. That document does not say how the DoH servers are found, nor how to select from a list of possible DoH servers, nor what the user interface (UI) for the configuration should be.

There is a use case for browsers and web applications who have one or more currently-configured DNS recursive resolvers wanting to use DoH for DNS resolution instead. For example, the recursive resolver knows how to give correct answers to DNS queries that contain names that are only resolvable in the local context. Users typically configure their DNS recursive resolvers with through manual configuration (such as manually editing a `/etc/named.conf` file) or through automatic configuration from a protocol such as DHCP.

The client that wants to change from its currently-configured Do53 recursive resolver(s) to one or more DoH servers might be the stub resolver in an operating system, although at this time it is rare that such stub resolvers can use DoH. A much more likely use case is

a browser or web application that is getting name resolution through the stub resolver on the computer on which it is running. The user of the browser might have a preference for using a DoH server, and they might need to use a DoH server that is associated with the resolver that the computer is currently using so that its queries for non-global names are answered correctly. They may also be required to use only resolvers that are approved by their organization's network operators.

To address these use cases, this document defines two different protocols to get the list of URI templates [[RFC6570](#)] associated for the DoH servers associated with at least one of the resolvers being used by the operating system on the system on which the application is being run. Each uses its own special use domain name (SUDN); SUDNs are described in [[RFC6761](#)].

- o The first, called "DoH servers by TXT" and described in [Section 2.1](#), is a new SUDN that can be queried for a TXT RRset. This protocol is most likely useful only to browsers that can call operating system functions that in turn query the DNS for text records; web applications can only query for IP addresses.
- o The second, called "DoH servers by Addresses" and described in [Section 2.2](#) is combination of a new SUDN that that can be queried for IP addresses, and a well-known URI [[I-D.nottingham-rfc5785bis](#)] that can be resolved to return the URI templates. This protocol is useful for a browser or web application that can query for the addresses associated with a domain name (such as using the POSIX "getaddrinfo()" function) and resolve HTTP and HTTPS URLs.

The design choices for this protocol, particularly earlier designs that were deemed unusable, are described in [Section 3](#).

[1.1](#). Terminology

In this document, "DoT" is used to indicate DNS over TLS as defined in [[RFC7858](#)].

In this document, "Do53" is used to indicate DNS over UDP or TCP as defined in [[RFC1035](#)].

"DoH client" and "DoH server" are defined in [[RFC8484](#)].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

2. Finding the URI Templates of the DoH Servers Associated with a Resolver

A client (a browser or web application) uses either the protocol in [Section 2.1](#) or [Section 2.2](#) to get a list of URI templates for the DoH servers associated with a resolver. The following sub-sections describe the protocols and have notes that are common to both protocols.

2.1. DoH Servers by TXT

To find the DoH Servers associated with a resolver, an application sends that resolver a query for "resolver-associated-doh.arpa" in class IN with the RRtype of TXT [[RFC1035](#)] (that is, the query is resolver-associated-doh.arpa/IN/TXT).

The resolver replies with its associated DoH servers as URI templates in the TXT RRset in the Answer section.

A resolver that understands this protocol MUST send a TXT RRset in the Answer section. Each TXT record contains one URI template. If a resolver that understands this protocol has no associated DoH servers, the TXT RRset contains exactly one record that has an empty string as the RDATA; that is, the RDLENGTH in that record is 1, and the RDATA contains just the byte 0x00.

As described in [Section 4](#), the zone resolver-associated-doh.arpa is not delegated. The resolver acts as if it is and adds its own TXT records to the answer.

The client uses the TXT records in the response to the resolver-associated-doh.arpa/IN/TXT query as a list of the URI templates of the DoH servers associated with the resolver. Note that TXT records can contain multiple "character-strings" [[RFC1035](#)]; for this protocol, all characters-strings in a TXT record are concatenated to form a single URI template.

2.2. DoH Servers by Addresses

To find the DoH Servers associated with a resolver, an application uses a SUDN that causes a resolver to return its IP addresses. It uses those IP addresses as part of a well-known URI to find out the URI templates [[RFC6570](#)] to use for the DoH server(s) associated with the resolver.

2.2.1. Finding the IP Addresses of a Resolver

A browser is able to use an operating system function such as `gethostbyname()` to convert host names into IP addresses through the stub resolver in the operating system on which it is running. It can also send HTTPS queries to a resolver, but it would need to have the address of that resolver first. Web applications can do the same.

For this protocol, the browser or web application uses the SUDN "resolver-addresses.arpa". When a resolver that understands this SUDN receives a query for either `resolver-addresses.arpa/IN/A` or `resolver-addresses.arpa/IN/AAAA`, it returns its own IP addresses in the answer.

As described in [Section 4](#), the zone `resolver-addresses.arpa` is not delegated. The resolver acts as if it is and adds its own A or AAAA records to the answer.

2.2.2. Finding the DoH Servers Associated with a Resolver

To find the DoH servers associated with a resolver, the client uses the addresses returned from the query to `resolver-addresses.arpa` and sends a query to

<https://IPADDRESSGOESHERE/.well-known/doh-servers-associated/>

The resolver replies with its associated DoH servers as URI templates [\[RFC6570\]](#).

[[Need to describe the media types; likely JSON]]

[[Need to talk about what a response with an empty list means]]

[[Need to talk about what happens if authentication fails. This is complicated by the fact that the application doesn't know if the OS-to-resolver communication is authenticated.]]

[[Need to talk about HTTP caching]]

A client MUST try to establish a new list of DoH servers associated with a resolver every time the configured resolver in the operating system changes.

2.3. Issues Common to "DoH Servers by TXT" and "DoH Servers by Addresses"

See [Section 6](#) for warnings about sending the DNS queries over a transport that does not assure data integrity (such as Do53), and over a transport that does assure data integrity (such as DoT) but in circumstances where the browser or web application doesn't know the type of DNS transport being used.

A client MUST re-issue the queries in {#doh_by_txt} and {#doh_by_addresses} every time the configured resolver in the operating system changes.

[[What if there is a list of DoH servers? Pick one (how?) or jump around?]]

2.4. Choosing Between "DoH Servers by TXT" and "DoH Servers by Addresses"

[[by TXT only takes one step]]

[[by address gives you all the addressess, which might yield more servers]]

2.5. User Interface

For this protocol to be useful in a browser, the browser needs to have an entry in its configuration interface where the allowed DoH servers are listed that indicates that a DoH server from the configured Do53 or DoT resolver is allowed. That wording might say something like "DoH server associated with my current resolver" (or "servidor DoH asociado con mi resolucion actual" or "serveur DoH associe a mon resolveur actuel").

3. Design Choices

The primary use case for this protocol is a browser or web application that is getting name resolution through the stub resolver on the computer on which it is running wanting to switch its name resolution to DoH. A secondary use case is an OS that wants to make a similar switch.

An earlier design suggestion was to use a new RRtype with a query to ./IN/NEWRRTYPE. However, it was pointed out that this would not work going through stub resolvers that validate DNSSEC.

An earlier design suggestion was to use DHCP to tell the OS the DoH servers that the stub resolver might use. That protocol is

orthogonal to the one in this document in that it addresses a different use case. If both the protocol in this document and a DHCP-based protocol are standardized, they could co-exist. However, there is no current mechanism for a stub resolver to tell a browser, or a web application, what DoH server the stub resolver is using, so DoH configuration in the stub resolver would not prevent the browser from trying to find a DoH server on its own.

An earlier design suggestion was to use an EDNS0 [[RFC6891](#)] extension. The design chosen in this document meets the use case better because applications cannot communicate EDNS0 extensions to the stub resolver.

[4.](#) IANA Considerations

IANA will record the domain name "resolver-associated-doh.arpa" in the "Special-Use Domain Names" registry [[SUDN](#)]. IANA MUST NOT delegate resolver-associated-doh.arpa in the .arpa zone.

IANA will record the domain name "resolver-addresses.arpa" in the "Special-Use Domain Names" registry [[SUDN](#)]. IANA MUST NOT delegate resolver-addresses.arpa in the .arpa zone.

[[When this document settles down, need to register ".well-known/doh-servers-associated" as specified in [[I-D.nottingham-rfc5785bis](#)].]]

[5.](#) Privacy Considerations

Allowing a user to use DoH instead of Do53 increases communication privacy because of the TLS protection.

When a Do53 or DoT server indicates that a particular DoH server is associated with it, the client might assume that the DoH server has the same information privacy policies as the Do53 or DoT server. Therefore, a Do53 or DoT server SHOULD NOT recommend a DoH server unless that DoH server has the same (or better) information privacy policy as the Do53 or DoT server.

[6.](#) Security Considerations

There is currently no way for an application to know whether the operating system's stub resolver is using a transport that assures data integrity such as DoT.

Even if an application could determine the use of a transport like DoT, the application would also need to know whether the transport was authenticated or was simply chosen opportunistically.

7. References

7.1. Normative References

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