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DNS Multiple QTYPEs
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Abstract

This document specifies a method for a DNS client to request additional DNS record types to be delivered alongside the primary record type specified in the question section of a DNS QUERY (OpCode=0).

About This Document

This note is to be removed before publishing as an RFC.

The latest revision of this draft can be found at <https://dnssd-wg.github.io/draft-ietf-dnssd-multi-qtypes/draft-ietf-dnssd-multi-qtypes.html>. Status information for this document may be found at <https://datatracker.ietf.org/doc/draft-ietf-dnssd-multi-qtypes/>.

Discussion of this document takes place on the DNSSD Working Group mailing list (<mailto:dnssd@ietf.org>), which is archived at <https://mailarchive.ietf.org/arch/browse/dnssd/>. Subscribe at <https://www.ietf.org/mailman/listinfo/dnssd/>.

Source for this draft and an issue tracker can be found at <https://github.com/dnssd-wg/draft-ietf-dnssd-multi-qtypes>.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

A commonly requested DNS [RFC1035] feature is the ability to receive multiple related resource records (RRs) in a single DNS response.

For example, it may be desirable to receive the A, AAAA and HTTPS records for a domain name together, rather than having to issue multiple queries.

The DNS wire protocol in theory supported having multiple questions in a single packet, but in practise this does not work. In [RFC9619], [RFC1035] is updated to only permit a single question in a QUERY (OpCode=0) request.

Sending QTYPE=ANY does not guarantee that all RRsets will be returned. [RFC8482] specifies that responders may return a single RRset of their choosing.

This document provides a solution for those cases where only the QTYPE varies by specifying a new option for the Extension Mechanisms for DNS (EDNS [RFC6891]) that contains an additional list of QTYPE values that the client wishes to receive in addition to the single QTYPE appearing in the question section. A different EDNS option is used in response packets as protection against DNS middleboxes that echo EDNS options verbatim.

The specification described herein is applicable both for queries from a stub resolver to recursive servers, and from recursive resolvers to authoritative servers. It does not apply to Multicast DNS queries [RFC6762], which are already designed to allow requesting multiple records in a single query.

2. Terminology used in this document

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.

3. Description

3.1. Multiple QTYPE EDNS Options Format

The overall format of an EDNS option is shown for reference below, per [RFC6891], followed by the option specific data:

```

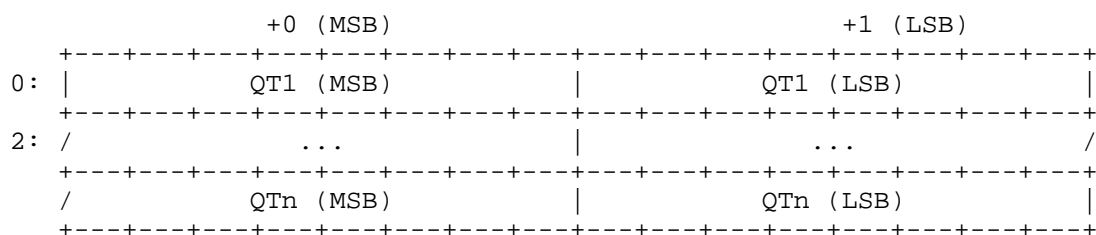
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
0: |                                     OPTION-CODE                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
2: |                                     OPTION-LENGTH                                    |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
4: |                                     /                                     /
   |                                     /                                     /
   |                                     /                                     /
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+

```

OPTION-CODE: MQTYPE-Query (20) in queries and MQTYPE-Response (21) in responses.

OPTION-LENGTH: Size (in octets) of OPTION-DATA.

OPTION-DATA: Option specific, as below:



QT: a (potentially empty) list of 2 byte fields (QTx) in network order (MSB first) each specifying a DNS RRTYPE that must be for a data RRTYPE as described in Section 3.1 of [RFC6895].

3.2. Server Handling

3.2.1. Request Parsing

If MQTYPE-Query is received in any inbound DNS message with an OpCode other than QUERY (0) the server MUST return a FORMERR response.

A server that receives an MQTYPE-Response option in any inbound DNS message MUST return a FORMERR response.

A server that receives more than one MQTYPE-Query option in a query MUST return a FORMERR response.

If an MQTYPE-Query option is received in a query that contains no primary question (i.e. QDCOUNT=0) the server MUST return a FORMERR response.

If an MQTYPE-Query option is received in a query where the primary question is a non-data RRTYPE (e.g. ANY, AXFR, etc.) the server MUST return a FORMERR response.

If any invalid QTx is received in the query (e.g. one corresponding to a Meta RRTYPE) the server MUST return a FORMERR response.

If any duplicate QTx (or one duplicating the primary QTYPE field) is contained in a query the server MUST return a FORMERR response.

3.2.2. Response Generation

A conforming server that receives an MQTYPE-Query option in a query MUST return an MQTYPE-Response option in its response, even if that response is truncated (TC=1).

The server MUST first start constructing a response for the primary (QNAME, QCLASS, QTYPE) tuple specified in the Question section per the existing DNS sections. The RCODE and all other flags (e.g. AA, AD, etc) MUST be determined at this time.

If this initial response results in truncation (TC=1) then the additional queries specified in the MQTYPE-Query option MUST NOT be processed.

After the initial response is prepared, the server MUST attempt to combine the responses for individual (QNAME, QCLASS, QT_x) combinations into the response for the first query. If a recursive server does not yet have those responses available it MUST first make appropriate outbound queries to populate its caches.

For each individual combination the server MUST evaluate the resulting RCODE and other flags and check that they all match the values generated from the primary query.

If any mismatch is detected the mismatching additional response MUST NOT be included in the final combined response and its QT_x value MUST NOT be included in the MQTYPE-Response option's list. This might happen, for example, if the primary query resulted in a NOERROR response but a QT_x query resulted in a SERVFAIL, or if the primary response has AA=0 but a QT_x response has AA=1, such as might happen if the NS and DS records were both requested at the parent side of a zone cut.

The server MUST attempt to combine the remaining individual RRs into the same sections in which they would have appeared in a standalone query, i.e. as if each combination had been "the question" per section 4.1 of [RFC1035].

The server MUST detect duplicate RRs and keep only a single copy of each RR in its respective section. Duplicates can occur e.g. in the Answer section if a CNAME chain is involved, or in the Authority section if multiple QTYPES don't exist, etc. Note that RRs can be legitimately duplicated in different sections, e.g. for the (SOA, TYPE12345) combination on apex where TYPE12345 is not present.

Handling of an MQTYPE-Request option MUST NOT itself trigger a truncated response. If message size (or other) limits do not allow all of the data obtained by querying for an additional QTx to be included in the final response in their entirety (i.e. as complete RRsets) then the server MUST NOT include the respective QTx in the MQTYPE-Response option's list and MAY stop processing further QTx combinations.

If all RRs for a single QTx combination fit into the message then the server MUST include the respective QTx in the MQTYPE-Response option's list to indicate that the given query type was completely processed.

3.3. Client Response Processing

Recursive resolvers MAY use this method to obtain multiple records from an authoritative server. For the purposes of Section 5.4.1 of [RFC2181] any authoritative answers received MUST be ranked the same as the answer for the primary question.

If the response to a query containing an MQTYPE-Query option does not contain an MQTYPE-Response option, or if it erroneously contains an MQTYPE-Query option, the client MUST treat the response as if this option is unsupported by the server and SHOULD process the response as if the MQTYPE-Query option had not been used.

If the MQTYPE-Response option is present more than once or if a QTx value is duplicated (or duplicates the primary QTYPE field) the client MUST treat the answer as invalid (equivalent to FORMERR)

The Question section and the list of types present in the MQTYPE-Response option indicates the list of (QNAME, QCLASS, qtypes) combinations which are completely contained within the received response. The answers to all query combinations share the same RCODE and all other flags.

All RRs required by existing DNS specifications are expected to be present in the respective sections of the DNS message, including proofs of nonexistence where required. The client MUST NOT rely on any particular order of RRs in the message sections.

Clients MUST take into account that individual RRs might originate from different DNS zones and that proofs of non-existence might have been produced by different signers.

Absence of QTx values which were requested by client but are not present in MQTYPE-Response option indicates that:

- * the server was unwilling to process the request (e.g. because a limit was exceeded), and/or
- * the individual responses could not be combined into one message because of RCODE or other flag mismatches, and/or
- * the message size limit would be exceeded

The client SHOULD subsequently initiate standalone queries (e.g. without using the MQTYPE-Query option) for any QTx value which was requested but is missing in the response.

4. Security Considerations

The method documented here does not change any of the security properties of the DNS protocol itself.

It should however be noted that this method does increase the potential amplification factor when the DNS protocol is used as a vector for a denial of service attack.

Implementors SHOULD allow operators to configure limits on the number of QTx values specified and/or the resulting response size.

5. IANA Considerations

IANA has assigned the values of 20 and 21 in the DNS EDNS0 Option Codes registry for MQTYPE-Query and MQTYPE-Response options respectively.

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Appendix A. Examples

The examples below are shown as might be reported by the ISC Dig utility. For the purposes of brevity irrelevant content is omitted.

A.1. Stub query for A with MQType-Request for AAAA + HTTPS

In this example a stub resolver has requested the A record for `www.example.com`, along with an MQTYPE-Request option requesting AAAA and HTTPS records. The stub resolver has also set the DO bit, indicating DNSSEC support.

The presence of the HTTPS QTYPE in the MQTYPE-Response option of the response coupled with its absence from the answer section indicates that the recursive server currently holds no data for this QTYPE. The corresponding type fields in the NSEC3 record further provide a cryptographic proof of non-existence for the HTTPS QTYPE and the SOA record also indicates a "negative answer".

```
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 11111
;; flags: qr rd ra ad
;; QUERY: 1, ANSWER: 4, AUTHORITY: 4, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags: do; udp: 1232
; MQTYPE-Response: AAAA HTTPS

;; QUESTION SECTION:
;www.example.com.          IN   A

;; ANSWER SECTION:
www.example.com.    2849  IN   A           192.0.2.1
www.example.com.    2849  IN   RRSIG        A [...]
www.example.com.    3552  IN   AAAA        3fff::1234
www.example.com.    3552  IN   RRSIG        AAAA [...]

;; AUTHORITY SECTION:
example.com.        2830  IN   SOA          ns.example.com. [...]
example.com.        2830  IN   RRSIG        SOA 13 2 [...]
[...]example.com.   2830  IN   NSEC3        [...] A TXT AAAA RRSIG
[...]example.com.   2830  IN   RRSIG        NSEC3 [...]
```

Figure 1: A + AAAA + HTTPS

A.2. Stub query for DS with MQType-Request for DNSKEY

In this similar example, the primary QTYPE is for DS and the MQTYPE-Request field only contains DNSKEY.

Both the DS and DNSKEY records are returned, along with their corresponding RRSIG records.

```
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 33333
;; flags: qr rd ra ad
;; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags: do; udp: 1232
; MQTYPE-Response: DNSKEY

;; QUESTION SECTION:
;example.com.                IN      DS

;; ANSWER SECTION:
example.com.      625     IN      DNSKEY  256 3 13 [...]
example.com.      625     IN      DNSKEY  257 3 13 [...]
example.com.      625     IN      RRSIG   DNSKEY [...] example.com. [...]
example.com.      86185   IN      DS      370 13 2 [...]
example.com.      86185   IN      RRSIG   DS [...] com. [...]
```

Figure 2: Stub DS + DNSKEY

A.3. Recursive query for DS with MQType-Request for NS

In this instance, a recursive resolver is sending a DS record query to the parent zone's authoritative server and simultaneously requesting the NS records for the zone.

Since the DS record response is marked as authoritative (AA = 1) but the NS record data on the parent side of a zone cut is not authoritative (AA = 0) the server is unable to merge the responses, and the NS QTYPE is omitted from the MQTYPE-Response field.

```
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 33333
;; flags: qr aa
;; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags: do; udp: 1232
; MQTYPE-Response: [empty]

;; QUESTION SECTION:
;example.com.                IN      DS

;; ANSWER SECTION:
example.com.      86185   IN      DS      370 13 2 [...]
example.com.      86185   IN      RRSIG   DS [...] com. [...]
```

Figure 3: Recursive DS + NS

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