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DNS Resolver MIB Extensions

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes a set of extensions which instrument DNS resolver functions. This memo was produced by the DNS working group.

With the adoption of the Internet-standard Network Management Framework [4,5,6,7], and with a large number of vendor implementations of these standards in commercially available products, it became possible to provide a higher level of effective network management in TCP/IP-based internets than was previously available. With the growth in the use of these standards, it has become possible to consider the management of other elements of the infrastructure beyond the basic TCP/IP protocols. A key element of

the TCP/IP infrastructure is the DNS.

Up to this point there has been no mechanism to integrate the management of the DNS with SNMP-based managers. This memo provides the mechanisms by which IP-based management stations can effectively manage DNS resolver software in an integrated fashion.

We have defined DNS MIB objects to be used in conjunction with the Internet MIB to allow access to and control of DNS resolver software via SNMP by the Internet community.

2. The SNMPv2 Network Management Framework

The SNMPv2 Network Management Framework consists of four major components. They are:

- RFC 1442 which defines the SMI, the mechanisms used for describing and naming objects for the purpose of management.
- STD 17, RFC 1213 defines MIB-II, the core set of managed objects for the Internet suite of protocols.
- RFC 1445 which defines the administrative and other architectural aspects of the framework.
- RFC 1448 which defines the protocol used for network access to managed objects.

The Framework permits new objects to be defined for the purpose of experimentation and evaluation.

2.1. Object Definitions

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) defined in the SMI. In particular, each object object type is named by an OBJECT IDENTIFIER, an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the descriptor, to refer to the object type.

3. Overview

In theory, the DNS world is pretty simple. There are two kinds of entities: resolvers and name servers. Resolvers ask questions. Name servers answer them. The real world, however, is not so simple.

Implementors have made widely differing choices about how to divide DNS functions between resolvers and servers. They have also constructed various sorts of exotic hybrids. The most difficult task in defining this MIB was to accommodate this wide range of entities without having to come up with a separate MIB for each.

We divided up the various DNS functions into two, non-overlapping classes, called "resolver functions" and "name server functions." A DNS entity that performs what we define as resolver functions contains a resolver, and therefore must implement the MIB groups required of all resolvers which are defined in this module. Some resolvers also implement "optional" functions such as a cache, in which case they must also implement the cache group contained in this MIB. A DNS entity which implements name server functions is considered to be a name server, and must implement the MIB groups required for name servers which are defined in a separate module. If the same piece of software performs both resolver and server functions, we imagine that it contains both a resolver and a server and would thus implement both the DNS Server and DNS Resolver MIBs.

3.1. Resolvers

In our model, a resolver is a program (or piece thereof) which obtains resource records from servers. Normally it does so at the behest of an application, but may also do so as part of its own operation. A resolver sends DNS protocol queries and receives DNS protocol replies. A resolver neither receives queries nor sends replies. A full service resolver is one that knows how to resolve queries: it obtains the needed resource records by contacting a server authoritative for the records desired. A stub resolver does not know how to resolve queries: it sends all queries to a local name server, setting the "recursion desired" flag to indicate that it hopes that the name server will be willing to resolve the query. A resolver may (optionally) have a cache for remembering previously acquired resource records. It may also have a negative cache for remembering names or data that have been determined not to exist.

3.2. Name Servers

A name server is a program (or piece thereof) that provides resource records to resolvers. All references in this document to "a name server" imply "the name server's role"; in some cases the name server's role and the resolver's role might be combined into a single program. A name server receives DNS protocol queries and sends DNS protocol replies. A name server neither sends queries nor receives replies. As a consequence, name servers do not have caches. Normally, a name server would expect to receive only those queries to which it could respond with authoritative information. However, if a

name server receives a query that it cannot respond to with purely authoritative information, it may choose to try to obtain the necessary additional information from a resolver which may or may not be a separate process.

3.3. Selected Objects

Many of the objects included in this memo have been created from information contained in the DNS specifications [1,2], as amended and clarified by subsequent host requirements documents [3]. Other objects have been created based on experience with existing DNS management tools, expected operational needs, the statistics generated by existing DNS implementations, and the configuration files used by existing DNS implementations. These objects have been ordered into groups as follows:

- Resolver Configuration Group
- Resolver Counter Group
- Resolver Lame Delegation Group
- Resolver Cache Group
- Resolver Negative Cache Group
- Resolver Optional Counter Group

This information has been converted into a standard form using the SNMPv2 SMI defined in [9]. For the most part, the descriptions are influenced by the DNS related RFCs noted above. For example, the descriptions for counters used for the various types of queries of DNS records are influenced by the definitions used for the various record types found in [2].

3.4. Textual Conventions

Several conceptual data types have been introduced as a textual conventions in the DNS Server MIB document and have been imported into this MIB module. These additions will facilitate the common understanding of information used by the DNS. No changes to the SMI or the SNMP are necessary to support these conventions.

Readers familiar with MIBs designed to manage entities in the lower layers of the Internet protocol suite may be surprised at the number of non-enumerated integers used in this MIB to represent values such as DNS RR class and type numbers. The reason for this choice is simple: the DNS itself is designed as an extensible protocol,

allowing new classes and types of resource records to be added to the protocol without recoding the core DNS software. Using non-enumerated integers to represent these data types in this MIB allows the MIB to accommodate these changes as well.

4. Definitions

```
DNS-RESOLVER-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, IpAddress, Counter32, Integer32
        FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, RowStatus, DisplayString
        FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP
        FROM SNMPv2-CONF
    dns, DnsName, DnsNameAsIndex, DnsClass, DnsType, DnsQClass,
    DnsQType, DnsTime, DnsOpCode, DnsRespCode
        FROM DNS-SERVER-MIB;

-- DNS Resolver MIB

dnsResMIB MODULE-IDENTITY
    LAST-UPDATED "9401282250Z"
    ORGANIZATION "IETF DNS Working Group"
    CONTACT-INFO
            "       Rob Austein
            Postal: Epilogue Technology Corporation
                    268 Main Street, Suite 283
                    North Reading, MA 10864
                    US
               Tel: +1 617 245 0804
               Fax: +1 617 245 8122
            E-Mail: sra@epilogue.com

                    Jon Saperia
            Postal: Digital Equipment Corporation
                    110 Spit Brook Road
                    ZKO1-3/H18
                    Nashua, NH 03062-2698
                    US
               Tel: +1 603 881 0480
               Fax: +1 603 881 0120
            E-mail: saperia@zko.dec.com"
    DESCRIPTION
            "The MIB module for entities implementing the client
            (resolver) side of the Domain Name System (DNS)
            protocol."
```

```
        ::= { dns 2 }

    dnsResMIBObjects        OBJECT IDENTIFIER ::= { dnsResMIB 1 }

    -- (Old-style) groups in the DNS resolver MIB.

    dnsResConfig            OBJECT IDENTIFIER ::= { dnsResMIBObjects 1 }
    dnsResCounter           OBJECT IDENTIFIER ::= { dnsResMIBObjects 2 }
    dnsResLameDelegation    OBJECT IDENTIFIER ::= { dnsResMIBObjects 3 }
    dnsResCache             OBJECT IDENTIFIER ::= { dnsResMIBObjects 4 }
    dnsResNCache            OBJECT IDENTIFIER ::= { dnsResMIBObjects 5 }
    dnsResOptCounter        OBJECT IDENTIFIER ::= { dnsResMIBObjects 6 }


    -- Resolver Configuration Group

    dnsResConfigImplementIdent OBJECT-TYPE
        SYNTAX      DisplayString
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "The implementation identification string for the
                resolver software in use on the system, for example;
                `RES-2.1'"
        ::= { dnsResConfig 1 }

    dnsResConfigService OBJECT-TYPE
        SYNTAX      INTEGER { recursiveOnly(1),
                              iterativeOnly(2),
                              recursiveAndIterative(3) }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Kind of DNS resolution service provided:

                recursiveOnly(1) indicates a stub resolver.

                iterativeOnly(2) indicates a normal full service
                resolver.

                recursiveAndIterative(3) indicates a full-service
                resolver which performs a mix of recursive and iterative
                queries."
         ::= { dnsResConfig 2 }

    dnsResConfigMaxCnames OBJECT-TYPE
        SYNTAX      INTEGER (0..2147483647)
        MAX-ACCESS  read-write
```

```
        STATUS      current
        DESCRIPTION
                "Limit on how many CNAMEs the resolver should allow
                before deciding that there's a CNAME loop.  Zero means
                that resolver has no explicit CNAME limit."
        REFERENCE
                "RFC-1035 section 7.1."
        ::= { dnsResConfig 3 }

    -- DNS Resolver Safety Belt Table

    dnsResConfigSbeltTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF DnsResConfigSbeltEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Table of safety belt information used by the resolver
                when it hasn't got any better idea of where to send a
                query, such as when the resolver is booting or is a stub
                resolver."
        ::= { dnsResConfig 4 }

    dnsResConfigSbeltEntry OBJECT-TYPE
        SYNTAX      DnsResConfigSbeltEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in the resolver's Sbelt table.
                Rows may be created or deleted at any time by the DNS
                resolver and by SNMP SET requests.  Whether the values
                changed via SNMP are saved in stable storage across
                `reset' operations is implementation-specific."
        INDEX     { dnsResConfigSbeltAddr,
                    dnsResConfigSbeltSubTree,
                    dnsResConfigSbeltClass }
        ::= { dnsResConfigSbeltTable 1 }

    DnsResConfigSbeltEntry ::=
        SEQUENCE {
            dnsResConfigSbeltAddr
                IpAddress,
            dnsResConfigSbeltName
                DnsName,
            dnsResConfigSbeltRecursion
                INTEGER,
            dnsResConfigSbeltPref
                INTEGER,
            dnsResConfigSbeltSubTree
```

```
            DnsNameAsIndex,
        dnsResConfigSbeltClass
            DnsClass,
        dnsResConfigSbeltStatus
            RowStatus
    }

dnsResConfigSbeltAddr OBJECT-TYPE
    SYNTAX      IpAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The IP address of the Sbelt name server identified by
            this row of the table."
    ::= { dnsResConfigSbeltEntry 1 }

dnsResConfigSbeltName OBJECT-TYPE
    SYNTAX      DnsName
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "The DNS name of a Sbelt nameserver identified by this
            row of the table.  A zero-length string indicates that
            the name is not known by the resolver."
    ::= { dnsResConfigSbeltEntry 2 }

dnsResConfigSbeltRecursion OBJECT-TYPE
    SYNTAX      INTEGER { iterative(1),
                          recursive(2),
                          recursiveAndIterative(3) }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
            "Kind of queries resolver will be sending to the name
            server identified in this row of the table:

            iterative(1) indicates that resolver will be directing
            iterative queries to this name server (RD bit turned
            off).

            recursive(2) indicates that resolver will be directing
            recursive queries to this name server (RD bit turned
            on).

            recursiveAndIterative(3) indicates that the resolver
            will be directing both recursive and iterative queries
            to the server identified in this row of the table."
     ::= { dnsResConfigSbeltEntry 3 }
```

```
   dnsResConfigSbeltPref OBJECT-TYPE
       SYNTAX      INTEGER (0..2147483647)
       MAX-ACCESS  read-create
       STATUS      current
       DESCRIPTION
               "This value identifies the preference for the name server
               identified in this row of the table.  The lower the
               value, the more desirable the resolver considers this
               server."
        ::= { dnsResConfigSbeltEntry 4 }

   dnsResConfigSbeltSubTree OBJECT-TYPE
       SYNTAX      DnsNameAsIndex
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
               "Queries sent to the name server identified by this row
               of the table are limited to those for names in the name
               subtree identified by this variable.  If no such
               limitation applies, the value of this variable is the
               name of the root domain (a DNS name consisting of a
               single zero octet)."
       ::= { dnsResConfigSbeltEntry 5 }

   dnsResConfigSbeltClass OBJECT-TYPE
       SYNTAX      DnsClass
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
               "The class of DNS queries that will be sent to the server
               identified by this row of the table."
       ::= { dnsResConfigSbeltEntry 6 }

   dnsResConfigSbeltStatus OBJECT-TYPE
       SYNTAX      RowStatus
       MAX-ACCESS  read-create
       STATUS      current
       DESCRIPTION
               "Row status column for this row of the Sbelt table."
       ::= { dnsResConfigSbeltEntry 7 }

   dnsResConfigUpTime OBJECT-TYPE
       SYNTAX      DnsTime
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "If the resolver has a persistent state (e.g., a
               process), this value will be the time elapsed since it
```

```
                started.  For software without persistant state, this
                value will be 0."
        ::= { dnsResConfig 5 }

    dnsResConfigResetTime OBJECT-TYPE
        SYNTAX      DnsTime
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "If the resolver has a persistent state (e.g., a process)
                and supports a `reset' operation (e.g., can be told to
                re-read configuration files), this value will be the
                time elapsed since the last time the resolver was
                `reset.'  For software that does not have persistence or
                does not support a `reset' operation, this value will be
                zero."
        ::= { dnsResConfig 6 }

    dnsResConfigReset OBJECT-TYPE
        SYNTAX      INTEGER { other(1),
                              reset(2),
                              initializing(3),
                              running(4) }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
                "Status/action object to reinitialize any persistant
                resolver state.  When set to reset(2), any persistant
                resolver state (such as a process) is reinitialized as if
                the resolver had just been started.  This value will
                never be returned by a read operation.  When read, one of
                the following values will be returned:
                    other(1) - resolver in some unknown state;
                    initializing(3) - resolver (re)initializing;
                    running(4) - resolver currently running."
        ::= { dnsResConfig 7 }


    -- Resolver Counters Group

    -- Resolver Counter Table

    dnsResCounterByOpcodeTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF DnsResCounterByOpcodeEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Table of the current count of resolver queries and
```

```
                answers."
        ::= { dnsResCounter 3 }

    dnsResCounterByOpcodeEntry OBJECT-TYPE
        SYNTAX      DnsResCounterByOpcodeEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Entry in the resolver counter table.  Entries are
                indexed by DNS OpCode."
        INDEX     { dnsResCounterByOpcodeCode }
        ::= { dnsResCounterByOpcodeTable 1 }

    DnsResCounterByOpcodeEntry ::=
        SEQUENCE {
            dnsResCounterByOpcodeCode
                DnsOpCode,
            dnsResCounterByOpcodeQueries
                Counter32,
            dnsResCounterByOpcodeResponses
                Counter32
        }

    dnsResCounterByOpcodeCode OBJECT-TYPE
        SYNTAX      DnsOpCode
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The index to this table.  The OpCodes that have already
                been defined are found in RFC-1035."
        REFERENCE
                "RFC-1035 section 4.1.1."
        ::= { dnsResCounterByOpcodeEntry 1 }

    dnsResCounterByOpcodeQueries OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Total number of queries that have sent out by the
                resolver since initialization for the OpCode which is
                the index to this row of the table."
        ::= { dnsResCounterByOpcodeEntry 2 }

    dnsResCounterByOpcodeResponses OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
```

```
        DESCRIPTION
                "Total number of responses that have been received by the
                resolver since initialization for the OpCode which is
                the index to this row of the table."
        ::= { dnsResCounterByOpcodeEntry 3 }

    -- Resolver Response Code Counter Table

    dnsResCounterByRcodeTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF DnsResCounterByRcodeEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Table of the current count of responses to resolver
                queries."
        ::= { dnsResCounter 4 }

    dnsResCounterByRcodeEntry OBJECT-TYPE
        SYNTAX      DnsResCounterByRcodeEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Entry in the resolver response table.  Entries are
                indexed by DNS response code."
        INDEX     { dnsResCounterByRcodeCode }
        ::= { dnsResCounterByRcodeTable 1 }

    DnsResCounterByRcodeEntry ::=
        SEQUENCE {
            dnsResCounterByRcodeCode
                DnsRespCode,
            dnsResCounterByRcodeResponses
                Counter32
        }

    dnsResCounterByRcodeCode OBJECT-TYPE
        SYNTAX      DnsRespCode
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "The index to this table.  The Response Codes that have
                already been defined are found in RFC-1035."
        REFERENCE
                "RFC-1035 section 4.1.1."
        ::= { dnsResCounterByRcodeEntry 1 }
```

```
   dnsResCounterByRcodeResponses OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of responses the resolver has received for the
               response code value which identifies this row of the
               table."
       ::= { dnsResCounterByRcodeEntry 2 }

   -- Additional DNS Resolver Counter Objects

   dnsResCounterNonAuthDataResps OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of requests made by the resolver for which a
               non-authoritative answer (cached data) was received."
       ::= { dnsResCounter 5 }

   dnsResCounterNonAuthNoDataResps OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of requests made by the resolver for which a
               non-authoritative answer - no such data response (empty
               answer) was received."
       ::= { dnsResCounter 6 }

   dnsResCounterMartians OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of responses received which were received from
               servers that the resolver does not think it asked."
       ::= { dnsResCounter 7 }

   dnsResCounterRecdResponses OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of responses received to all queries."
       ::= { dnsResCounter 8 }
```

```
   dnsResCounterUnparseResps OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of responses received which were unparseable."
       ::= { dnsResCounter 9 }

   dnsResCounterFallbacks OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of times the resolver had to fall back to its
               seat belt information."
       ::= { dnsResCounter 10 }


   -- Lame Delegation Group

   dnsResLameDelegationOverflows OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of times the resolver attempted to add an entry
               to the Lame Delegation table but was unable to for some
               reason such as space constraints."
       ::= { dnsResLameDelegation 1 }

   -- Lame Delegation Table

   dnsResLameDelegationTable OBJECT-TYPE
       SYNTAX      SEQUENCE OF DnsResLameDelegationEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
               "Table of name servers returning lame delegations.

               A lame delegation has occured when a parent zone
               delegates authority for a child zone to a server that
               appears not to think that it is authoritative for the
               child zone in question."
       ::= { dnsResLameDelegation 2 }

   dnsResLameDelegationEntry OBJECT-TYPE
       SYNTAX      DnsResLameDelegationEntry
       MAX-ACCESS  not-accessible
```

```
        STATUS      current
        DESCRIPTION
                "Entry in lame delegation table.  Only the resolver may
                create rows in this table.  SNMP SET requests may be used
                to delete rows."
        INDEX     { dnsResLameDelegationSource,
                    dnsResLameDelegationName,
                    dnsResLameDelegationClass }
        ::= { dnsResLameDelegationTable 1 }

    DnsResLameDelegationEntry ::=
        SEQUENCE {
            dnsResLameDelegationSource
                IpAddress,
            dnsResLameDelegationName
                DnsNameAsIndex,
            dnsResLameDelegationClass
                DnsClass,
            dnsResLameDelegationCounts
                Counter32,
            dnsResLameDelegationStatus
                RowStatus
        }

    dnsResLameDelegationSource OBJECT-TYPE
        SYNTAX      IpAddress
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Source of lame delegation."
        ::= { dnsResLameDelegationEntry 1 }

    dnsResLameDelegationName OBJECT-TYPE
        SYNTAX      DnsNameAsIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "DNS name for which lame delegation was received."
        ::= { dnsResLameDelegationEntry 2 }

    dnsResLameDelegationClass OBJECT-TYPE
        SYNTAX      DnsClass
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "DNS class of received lame delegation."
        ::= { dnsResLameDelegationEntry 3 }
```

```
   dnsResLameDelegationCounts OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "How many times this lame delegation has been received."
       ::= { dnsResLameDelegationEntry 4 }

   dnsResLameDelegationStatus OBJECT-TYPE
       SYNTAX      RowStatus
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
               "Status column for the lame delegation table.  Since only
               the agent (DNS resolver) creates rows in this table, the
               only values that a manager may write to this variable
               are active(1) and destroy(6)."
       ::= { dnsResLameDelegationEntry 5 }


   -- Resolver Cache Group

   dnsResCacheStatus OBJECT-TYPE
       SYNTAX      INTEGER { enabled(1), disabled(2), clear(3) }
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
               "Status/action for the resolver's cache.

               enabled(1) means that the use of the cache is allowed.
               Query operations can return this state.

               disabled(2) means that the cache is not being used.
               Query operations can return this state.

               Setting this variable to clear(3) deletes the entire
               contents of the resolver's cache, but does not otherwise
               change the resolver's state.  The status will retain its
               previous value from before the clear operation (i.e.,
               enabled(1) or disabled(2)).  The value of clear(3) can
               NOT be returned by a query operation."
       ::= { dnsResCache 1 }

   dnsResCacheMaxTTL OBJECT-TYPE
       SYNTAX      DnsTime
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
```

```
                "Maximum Time-To-Live for RRs in this cache.  If the
                resolver does not implement a TTL ceiling, the value of
                this field should be zero."
        ::= { dnsResCache 2 }

    dnsResCacheGoodCaches OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of RRs the resolver has cached successfully."
        ::= { dnsResCache 3 }

    dnsResCacheBadCaches OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of RRs the resolver has refused to cache because
                they appear to be dangerous or irrelevant.  E.g., RRs
                with suspiciously high TTLs, unsolicited root
                information, or that just don't appear to be relevant to
                the question the resolver asked."
        ::= { dnsResCache 4 }

    -- Resolver Cache Table

    dnsResCacheRRTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF DnsResCacheRREntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "This table contains information about all the resource
                records currently in the resolver's cache."
        ::= { dnsResCache 5 }

    dnsResCacheRREntry OBJECT-TYPE
        SYNTAX      DnsResCacheRREntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in the resolvers's cache.  Rows may be created
                only by the resolver.  SNMP SET requests may be used to
                delete rows."
        INDEX     { dnsResCacheRRName,
                    dnsResCacheRRClass,
                    dnsResCacheRRType,
                    dnsResCacheRRIndex }
```

```
        ::= { dnsResCacheRRTable 1 }

    DnsResCacheRREntry ::=
        SEQUENCE {
            dnsResCacheRRName
                DnsNameAsIndex,
            dnsResCacheRRClass
                DnsClass,
            dnsResCacheRRType
                DnsType,
            dnsResCacheRRTTL
                DnsTime,
            dnsResCacheRRElapsedTTL
                DnsTime,
            dnsResCacheRRSource
                IpAddress,
            dnsResCacheRRData
                OCTET STRING,
            dnsResCacheRRStatus
                RowStatus,
            dnsResCacheRRIndex
                Integer32,
            dnsResCacheRRPrettyName
                DnsName
        }

    dnsResCacheRRName OBJECT-TYPE
        SYNTAX      DnsNameAsIndex
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "Owner name of the Resource Record in the cache which is
                identified in this row of the table.  As described in
                RFC-1034, the owner of the record is the domain name
                were the RR is found."
        REFERENCE
                "RFC-1034 section 3.6."
        ::= { dnsResCacheRREntry 1 }

    dnsResCacheRRClass OBJECT-TYPE
        SYNTAX      DnsClass
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "DNS class of the Resource Record in the cache which is
                identified in this row of the table."
        ::= { dnsResCacheRREntry 2 }
```

```
   dnsResCacheRRType OBJECT-TYPE
       SYNTAX      DnsType
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
               "DNS type of the Resource Record in the cache which is
               identified in this row of the table."
       ::= { dnsResCacheRREntry 3 }

   dnsResCacheRRTTL OBJECT-TYPE
       SYNTAX      DnsTime
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Time-To-Live of RR in DNS cache.  This is the initial
               TTL value which was received with the RR when it was
               originally received."
       ::= { dnsResCacheRREntry 4 }

   dnsResCacheRRElapsedTTL OBJECT-TYPE
       SYNTAX      DnsTime
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Elapsed seconds since RR was received."
       ::= { dnsResCacheRREntry 5 }

   dnsResCacheRRSource OBJECT-TYPE
       SYNTAX      IpAddress
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Host from which RR was received, 0.0.0.0 if unknown."
       ::= { dnsResCacheRREntry 6 }

   dnsResCacheRRData OBJECT-TYPE
       SYNTAX      OCTET STRING
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "RDATA portion of a cached RR.  The value is in the
               format defined for the particular DNS class and type of
               the resource record."
       REFERENCE
               "RFC-1035 section 3.2.1."
       ::= { dnsResCacheRREntry 7 }
```

```
   dnsResCacheRRStatus OBJECT-TYPE
       SYNTAX      RowStatus
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
               "Status column for the resolver cache table.  Since only
               the agent (DNS resolver) creates rows in this table, the
               only values that a manager may write to this variable
               are active(1) and destroy(6)."
       ::= { dnsResCacheRREntry 8 }

   dnsResCacheRRIndex OBJECT-TYPE
       SYNTAX      Integer32
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
               "A value which makes entries in the table unique when the
               other index values (dnsResCacheRRName,
               dnsResCacheRRClass, and dnsResCacheRRType) do not
               provide a unique index."
       ::= { dnsResCacheRREntry 9 }

   dnsResCacheRRPrettyName OBJECT-TYPE
       SYNTAX      DnsName
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Name of the RR at this row in the table.  This is
               identical to the dnsResCacheRRName variable, except that
               character case is preserved in this variable, per DNS
               conventions."
       REFERENCE
               "RFC-1035 section 2.3.3."
       ::= { dnsResCacheRREntry 10 }

   -- Resolver Negative Cache Group

   dnsResNCacheStatus OBJECT-TYPE
       SYNTAX      INTEGER { enabled(1), disabled(2), clear(3) }
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
               "Status/action for the resolver's negative response
               cache.

               enabled(1) means that the use of the negative response
               cache is allowed.  Query operations can return this
               state.
```

```
                disabled(2) means that the negative response cache is
                not being used.  Query operations can return this state.

                Setting this variable to clear(3) deletes the entire
                contents of the resolver's negative response cache.  The
                status will retain its previous value from before the
                clear operation (i.e., enabled(1) or disabled(2)).  The
                value of clear(3) can NOT be returned by a query
                operation."
        ::= { dnsResNCache 1 }

    dnsResNCacheMaxTTL OBJECT-TYPE
        SYNTAX      DnsTime
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
                "Maximum Time-To-Live for cached authoritative errors.
                If the resolver does not implement a TTL ceiling, the
                value of this field should be zero."
        ::= { dnsResNCache 2 }

    dnsResNCacheGoodNCaches OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of authoritative errors the resolver has cached
                successfully."
        ::= { dnsResNCache 3 }

    dnsResNCacheBadNCaches OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of authoritative errors the resolver would have
                liked to cache but was unable to because the appropriate
                SOA RR was not supplied or looked suspicious."
        REFERENCE
                "RFC-1034 section 4.3.4."
        ::= { dnsResNCache 4 }

    -- Resolver Negative Cache Table

    dnsResNCacheErrTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF DnsResNCacheErrEntry
        MAX-ACCESS  not-accessible
        STATUS      current
```

```
        DESCRIPTION
                "The resolver's negative response cache.  This table
                contains information about authoritative errors that
                have been cached by the resolver."
        ::= { dnsResNCache 5 }

    dnsResNCacheErrEntry OBJECT-TYPE
        SYNTAX      DnsResNCacheErrEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "An entry in the resolver's negative response cache
                table.  Only the resolver can create rows.  SNMP SET
                requests may be used to delete rows."
        INDEX     { dnsResNCacheErrQName,
                    dnsResNCacheErrQClass,
                    dnsResNCacheErrQType,
                    dnsResNCacheErrIndex }
        ::= { dnsResNCacheErrTable 1 }

    DnsResNCacheErrEntry ::=
        SEQUENCE {
            dnsResNCacheErrQName
                DnsNameAsIndex,
            dnsResNCacheErrQClass
                DnsQClass,
            dnsResNCacheErrQType
                DnsQType,
            dnsResNCacheErrTTL
                DnsTime,
            dnsResNCacheErrElapsedTTL
                DnsTime,
            dnsResNCacheErrSource
                IpAddress,
            dnsResNCacheErrCode
                INTEGER,
            dnsResNCacheErrStatus
                RowStatus,
            dnsResNCacheErrIndex
                Integer32,
            dnsResNCacheErrPrettyName
                DnsName
        }

    dnsResNCacheErrQName OBJECT-TYPE
        SYNTAX      DnsNameAsIndex
        MAX-ACCESS  not-accessible
        STATUS      current
```

```
        DESCRIPTION
                "QNAME associated with a cached authoritative error."
        REFERENCE
                "RFC-1034 section 3.7.1."
        ::= { dnsResNCacheErrEntry 1 }

    dnsResNCacheErrQClass OBJECT-TYPE
        SYNTAX      DnsQClass
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "DNS QCLASS associated with a cached authoritative
                error."
        ::= { dnsResNCacheErrEntry 2 }

    dnsResNCacheErrQType OBJECT-TYPE
        SYNTAX      DnsQType
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
                "DNS QTYPE associated with a cached authoritative error."
        ::= { dnsResNCacheErrEntry 3 }

    dnsResNCacheErrTTL OBJECT-TYPE
        SYNTAX      DnsTime
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Time-To-Live of a cached authoritative error at the time
                of the error, it should not be decremented by the number
                of seconds since it was received.  This should be the
                TTL as copied from the MINIMUM field of the SOA that
                accompanied the authoritative error, or a smaller value
                if the resolver implements a ceiling on negative
                response cache TTLs."
        REFERENCE
                "RFC-1034 section 4.3.4."
        ::= { dnsResNCacheErrEntry 4 }

    dnsResNCacheErrElapsedTTL OBJECT-TYPE
        SYNTAX      DnsTime
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Elapsed seconds since authoritative error was received."
        ::= { dnsResNCacheErrEntry 5 }
```

```
   dnsResNCacheErrSource OBJECT-TYPE
       SYNTAX      IpAddress
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Host which sent the authoritative error, 0.0.0.0 if
               unknown."
       ::= { dnsResNCacheErrEntry 6 }

   dnsResNCacheErrCode OBJECT-TYPE
       SYNTAX      INTEGER { nonexistantName(1), noData(2), other(3) }
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "The authoritative error that has been cached:

               nonexistantName(1) indicates an authoritative name error
               (RCODE = 3).

               noData(2) indicates an authoritative response with no
               error (RCODE = 0) and no relevant data.

               other(3) indicates some other cached authoritative
               error.  At present, no such errors are known to exist."
       ::= { dnsResNCacheErrEntry 7 }

   dnsResNCacheErrStatus OBJECT-TYPE
       SYNTAX      RowStatus
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
               "Status column for the resolver negative response cache
               table.  Since only the agent (DNS resolver) creates rows
               in this table, the only values that a manager may write
               to this variable are active(1) and destroy(6)."
       ::= { dnsResNCacheErrEntry 8 }

   dnsResNCacheErrIndex OBJECT-TYPE
       SYNTAX      Integer32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "A value which makes entries in the table unique when the
               other index values (dnsResNCacheErrQName,
               dnsResNCacheErrQClass, and dnsResNCacheErrQType) do not
               provide a unique index."
       ::= { dnsResNCacheErrEntry 9 }
```

```
   dnsResNCacheErrPrettyName OBJECT-TYPE
       SYNTAX      DnsName
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "QNAME associated with this row in the table.  This is
               identical to the dnsResNCacheErrQName variable, except
               that character case is preserved in this variable, per
               DNS conventions."
       REFERENCE
               "RFC-1035 section 2.3.3."
       ::= { dnsResNCacheErrEntry 10 }


   -- Resolver Optional Counters Group

   dnsResOptCounterReferals OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of responses which were received from servers
               redirecting query to another server."
       ::= { dnsResOptCounter 1 }

   dnsResOptCounterRetrans OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number requests retransmitted for all reasons."
       ::= { dnsResOptCounter 2 }

   dnsResOptCounterNoResponses OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of queries that were retransmitted because of no
               response."
       ::= { dnsResOptCounter 3 }

   dnsResOptCounterRootRetrans OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
               "Number of queries that were retransmitted that were to
```

```
                root servers."
        ::= { dnsResOptCounter 4 }

    dnsResOptCounterInternals OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of requests internally generated by the
                resolver."
        ::= { dnsResOptCounter 5 }

    dnsResOptCounterInternalTimeOuts OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
                "Number of requests internally generated which timed
                out."
        ::= { dnsResOptCounter 6 }


    -- SNMPv2 groups.

    dnsResMIBGroups         OBJECT IDENTIFIER ::= { dnsResMIB 2 }

    dnsResConfigGroup OBJECT-GROUP
        OBJECTS   { dnsResConfigImplementIdent,
                    dnsResConfigService,
                    dnsResConfigMaxCnames,
                    dnsResConfigSbeltAddr,
                    dnsResConfigSbeltName,
                    dnsResConfigSbeltRecursion,
                    dnsResConfigSbeltPref,
                    dnsResConfigSbeltSubTree,
                    dnsResConfigSbeltClass,
                    dnsResConfigSbeltStatus,
                    dnsResConfigUpTime,
                    dnsResConfigResetTime }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing basic configuration
                information for a DNS resolver implementation."
        ::= { dnsResMIBGroups 1 }

    dnsResCounterGroup OBJECT-GROUP
        OBJECTS   { dnsResCounterByOpcodeCode,
                    dnsResCounterByOpcodeQueries,
```

```
                    dnsResCounterByOpcodeResponses,
                    dnsResCounterByRcodeCode,
                    dnsResCounterByRcodeResponses,
                    dnsResCounterNonAuthDataResps,
                    dnsResCounterNonAuthNoDataResps,
                    dnsResCounterMartians,
                    dnsResCounterRecdResponses,
                    dnsResCounterUnparseResps,
                    dnsResCounterFallbacks }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing basic instrumentation
                of a DNS resolver implementation."
        ::= { dnsResMIBGroups 2 }

    dnsResLameDelegationGroup OBJECT-GROUP
        OBJECTS   { dnsResLameDelegationOverflows,
                    dnsResLameDelegationSource,
                    dnsResLameDelegationName,
                    dnsResLameDelegationClass,
                    dnsResLameDelegationCounts,
                    dnsResLameDelegationStatus }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing instrumentation of
                `lame delegation' failures."
        ::= { dnsResMIBGroups 3 }


    dnsResCacheGroup OBJECT-GROUP
        OBJECTS   { dnsResCacheStatus,
                    dnsResCacheMaxTTL,
                    dnsResCacheGoodCaches,
                    dnsResCacheBadCaches,
                    dnsResCacheRRName,
                    dnsResCacheRRClass,
                    dnsResCacheRRType,
                    dnsResCacheRRTTL,
                    dnsResCacheRRElapsedTTL,
                    dnsResCacheRRSource,
                    dnsResCacheRRData,
                    dnsResCacheRRStatus,
                    dnsResCacheRRIndex,
                    dnsResCacheRRPrettyName }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing access to and control
                of a DNS resolver's cache."
```

```
        ::= { dnsResMIBGroups 4 }

    dnsResNCacheGroup OBJECT-GROUP
        OBJECTS   { dnsResNCacheStatus,
                    dnsResNCacheMaxTTL,
                    dnsResNCacheGoodNCaches,
                    dnsResNCacheBadNCaches,
                    dnsResNCacheErrQName,
                    dnsResNCacheErrQClass,
                    dnsResNCacheErrQType,
                    dnsResNCacheErrTTL,
                    dnsResNCacheErrElapsedTTL,
                    dnsResNCacheErrSource,
                    dnsResNCacheErrCode,
                    dnsResNCacheErrStatus,
                    dnsResNCacheErrIndex,
                    dnsResNCacheErrPrettyName }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing access to and control
                of a DNS resolver's negative response cache."
        ::= { dnsResMIBGroups 5 }

    dnsResOptCounterGroup OBJECT-GROUP
        OBJECTS   { dnsResOptCounterReferals,
                    dnsResOptCounterRetrans,
                    dnsResOptCounterNoResponses,
                    dnsResOptCounterRootRetrans,
                    dnsResOptCounterInternals,
                    dnsResOptCounterInternalTimeOuts }
        STATUS      current
        DESCRIPTION
                "A collection of objects providing further
                instrumentation applicable to many but not all DNS
                resolvers."
        ::= { dnsResMIBGroups 6 }


    -- Compliances.

    dnsResMIBCompliances OBJECT IDENTIFIER ::= { dnsResMIB 3 }

    dnsResMIBCompliance MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
                "The compliance statement for agents implementing the DNS
                resolver MIB extensions."
        MODULE -- This MIB module
```

```
        MANDATORY-GROUPS { dnsResConfigGroup, dnsResCounterGroup }
        GROUP   dnsResCacheGroup
        DESCRIPTION
            "The resolver cache group is mandatory for resolvers that
            implement a cache."
        GROUP   dnsResNCacheGroup
        DESCRIPTION
            "The resolver negative cache group is mandatory for
            resolvers that implement a negative response cache."
        GROUP   dnsResLameDelegationGroup
        DESCRIPTION
            "The lame delegation group is unconditionally optional."
        GROUP   dnsResOptCounterGroup
        DESCRIPTION
            "The optional counters group is unconditionally
            optional."
        OBJECT  dnsResConfigMaxCnames
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResConfigSbeltName
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResConfigSbeltRecursion
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResConfigSbeltPref
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResConfigReset
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResCacheStatus
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResCacheMaxTTL
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
        OBJECT  dnsResNCacheStatus
        MIN-ACCESS      read-only
        DESCRIPTION
            "This object need not be writable."
```

```
            OBJECT  dnsResNCacheMaxTTL
            MIN-ACCESS      read-only
            DESCRIPTION
                "This object need not be writable."
        ::= { dnsResMIBCompliances 1 }

    END
```

5. Acknowledgements

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7. Security Considerations

Security issues are not discussed in this memo.

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