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

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        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
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.

"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."
 ::= { dnsResConfigSbeltTable 1 }

DnsResConfigSbeltEntry ::= SEQUENCE {
   dnsResConfigSbeltAddr       IpAddress,
dnsResConfigSbeltName       DnsName,
dnsResConfigSbeltRecursion   INTEGER,
dnsResConfigSbeltPref       INTEGER,
dnsResConfigSbeltSubTree    IpAddress
}
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 persistent 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 persistent
 resolver state. When set to reset(2), any persistent
 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 }

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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 occurred when a parent zone
dealects 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 resolver’s cache. Rows may be created only by the resolver. SNMP SET requests may be used to delete rows."
INDEX { dnsResCacheRRName, dnsResCacheRRClass, dnsResCacheRRType, dnsResCacheRRIndex }
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
::= { 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,
           dnsResCounterByOpcodeRequests,
           dnsResCounterByOpcodeMessages,
           dnsResCounterByOpcodeReplies,
           dnsResCounterByOpcodeErrors,
           dnsResCounterByOpcodeRecursion,
           dnsResCounterByOpcodeRecursionQuery,
           dnsResCounterByOpcodeRecursionReply }
STATUS      current
DESCRIPTION  "An object that tracks the number of requests of the various types:
             queries, requests, messages, replies, errors, recursion.
             This group is intended to provide a more fine-grained
             view of the resolver's activity than the overall
             dnsResOptCounterGroup provides."
::= { dnsResMIBGroups 2 }

-- Network Management Information Base (MIB)
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 }


7. Security Considerations

Security issues are not discussed in this memo.

8. Authors’ Addresses

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