Transport Mappings for
the Simple Network Management Protocol (SNMP)

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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Abstract

This document defines the transport of Simple Network Management
Protocol (SNMP) messages over various protocols. This document
obsoletes RFC 1906.
1. Introduction

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP).

Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB

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module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

This document, Transport Mappings for the Simple Network Management Protocol, defines how the management protocol [RFC3416] may be carried over a variety of protocol suites. It is the purpose of this document to define how the SNMP maps onto an initial set of transport domains. At the time of this writing, work was in progress to define an IPv6 mapping, described in [RFC3419]. Other mappings may be defined in the future.

Although several mappings are defined, the mapping onto UDP over IPv4 is the preferred mapping for systems supporting IPv4. Systems implementing IPv4 MUST implement the mapping onto UDP over IPv4. To maximize interoperability, systems supporting other mappings SHOULD also provide for access via the UDP over IPv4 mapping.

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14, RFC 2119 [RFC2119].

2. Definitions

SNMPv2-TM DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-IDENTITY,
  snmpModules, snmpDomains, snmpProxys
  FROM SNMPv2-SMI
  TEXTUAL-CONVENTION
  FROM SNMPv2-TC;

snmpv2tm MODULE-IDENTITY
  LAST-UPDATED "200210160000Z"
  ORGANIZATION "IETF SNMPv3 Working Group"
  CONTACT-INFO
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DESCRIPTION
"The MIB module for SNMP transport mappings.

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"

REVISION "200210160000Z"
DESCRIPTION
"Clarifications, published as RFC 3417."

REVISION "199601010000Z"
DESCRIPTION
"Clarifications, published as RFC 1906."

REVISION "199304010000Z"
DESCRIPTION
"The initial version, published as RFC 1449."

::= { snmpModules 19 }

-- SNMP over UDP over IPv4

snmpUDPDomain OBJECT-IDENTITY
STATUS current
DESCRIPTION
"The SNMP over UDP over IPv4 transport domain. The corresponding transport address is of type SnmpUDPAddress."

::= { snmpDomains 1 }
SnmpUDPAddress ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "1d.1d.1d.1d/2d"
    STATUS       current
    DESCRIPTION
      "Represents a UDP over IPv4 address:
      octets   contents        encoding
      1-4     IP-address      network-byte order
      5-6     UDP-port        network-byte order
    "
    SYNTAX     OCTET STRING (SIZE (6))

-- SNMP over OSI

snmpCLNSDomain OBJECT-IDENTITY
    STATUS     current
    DESCRIPTION
      "The SNMP over CLNS transport domain.
      The corresponding transport address is of type
      SnmpOSIAddress."
    ::= { snmpDomains 2 }

snmpCONSDomain OBJECT-IDENTITY
    STATUS     current
    DESCRIPTION
      "The SNMP over CONS transport domain.
      The corresponding transport address is of type
      SnmpOSIAddress."
    ::= { snmpDomains 3 }

SnmpOSIAddress ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "*1x:/1x:"
    STATUS       current
    DESCRIPTION
      "Represents an OSI transport-address:
      octets   contents           encoding
      1     length of NSAP     'n' as an unsigned-integer
        (either 0 or from 3 to 20)
      2..(n+1)  NSAP                concrete binary representation
      (n+2)..m  TSEL                string of (up to 64) octets
    "
    SYNTAX     OCTET STRING (SIZE (1 | 4..85))
-- SNMP over DDP

snmpDDPDomain OBJECT-IDENTITY
STATUS     current
DESCRIPTION
"The SNMP over DDP transport domain. The corresponding
transport address is of type SnmpNBPAddress."
 ::= { snmpDomains 4 }

SnmpNBPAddress ::= TEXTUAL-CONVENTION
STATUS       current
DESCRIPTION
"Represents an NBP name:

<table>
<thead>
<tr>
<th>octets</th>
<th>contents</th>
<th>encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>length of object</td>
<td>'n' as an unsigned integer</td>
</tr>
<tr>
<td>2...(n+1)</td>
<td>object</td>
<td>string of (up to 32) octets</td>
</tr>
<tr>
<td>n+2</td>
<td>length of type</td>
<td>'p' as an unsigned integer</td>
</tr>
<tr>
<td>(n+3)...(n+2+p)</td>
<td>type</td>
<td>string of (up to 32) octets</td>
</tr>
<tr>
<td>n+3+p</td>
<td>length of zone</td>
<td>'q' as an unsigned integer</td>
</tr>
<tr>
<td>(n+4+p)...(n+3+p+q)</td>
<td>zone</td>
<td>string of (up to 32) octets</td>
</tr>
</tbody>
</table>

For comparison purposes, strings are
case-insensitive. All strings may contain any octet
other than 255 (hex ff)."
SYNTAX      OCTET STRING (SIZE (3..99))

-- SNMP over IPX

snmpIPXDomain OBJECT-IDENTITY
STATUS     current
DESCRIPTION
"The SNMP over IPX transport domain. The corresponding
transport address is of type SnmpIPXAddress."
 ::= { snmpDomains 5 }

SnmpIPXAddress ::= TEXTUAL-CONVENTION
DISPLAY-HINT "4x.1x:1x:1x:1x:1x:1x.2d"
STATUS       current
DESCRIPTION
"Represents an IPX address:

<table>
<thead>
<tr>
<th>octets</th>
<th>contents</th>
<th>encoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-4</td>
<td>network-number</td>
<td>network-byte order</td>
</tr>
<tr>
<td>5-10</td>
<td>physical-address</td>
<td>network-byte order</td>
</tr>
<tr>
<td>11-12</td>
<td>socket-number</td>
<td>network-byte order</td>
</tr>
</tbody>
</table>

"SYNTAX      OCTET STRING (SIZE (12))"
rfc1157Proxy OBJECT IDENTIFIER ::= { snmpProxys 1 }

rfc1157Domain OBJECT-IDENTITY
   STATUS deprecated
   DESCRIPTION
      "The transport domain for SNMPv1 over UDP over IPv4.
      The corresponding transport address is of type
      SnmpUDPAddress."
      ::= { rfc1157Proxy 1 }

-- ::= { rfc1157Proxy 2 } this OID is obsolete

3. SNMP over UDP over IPv4

   This is the preferred transport mapping.

   3.1. Serialization

   Each instance of a message is serialized (i.e., encoded according to
   the convention of [BER]) onto a single UDP [RFC768] over IPv4
   [RFC791] datagram, using the algorithm specified in Section 8.

   3.2. Well-known Values

   It is suggested that administrators configure their SNMP entities
   supporting command responder applications to listen on UDP port 161.
   Further, it is suggested that SNMP entities supporting notification
   receiver applications be configured to listen on UDP port 162.

   When an SNMP entity uses this transport mapping, it must be capable
   of accepting messages up to and including 484 octets in size. It is
   recommended that implementations be capable of accepting messages of
   up to 1472 octets in size. Implementation of larger values is
   encouraged whenever possible.

4. SNMP over OSI

   This is an optional transport mapping.

   4.1. Serialization

   Each instance of a message is serialized onto a single TSDU [IS8072]
   [IS8072A] for the OSI Connectionless-mode Transport Service (CLTS),
   using the algorithm specified in Section 8.
4.2. Well-known Values

It is suggested that administrators configure their SNMP entities supporting command responder applications to listen on transport selector "snmp-l" (which consists of six ASCII characters), when using a CL-mode network service to realize the CLTS. Further, it is suggested that SNMP entities supporting notification receiver applications be configured to listen on transport selector "snmpt-l" (which consists of seven ASCII characters, six letters and a hyphen) when using a CL-mode network service to realize the CLTS. Similarly, when using a CO-mode network service to realize the CLTS, the suggested transport selectors are "snmp-o" and "snmpt-o", for command responders and notification receivers, respectively.

When an SNMP entity uses this transport mapping, it must be capable of accepting messages that are at least 484 octets in size. Implementation of larger values is encouraged whenever possible.

5. SNMP over DDP

This is an optional transport mapping.

5.1. Serialization

Each instance of a message is serialized onto a single DDP datagram [APPLETALK], using the algorithm specified in Section 8.

5.2. Well-known Values

SNMP messages are sent using DDP protocol type 8. SNMP entities supporting command responder applications listen on DDP socket number 8, while SNMP entities supporting notification receiver applications listen on DDP socket number 9.

Administrators must configure their SNMP entities supporting command responder applications to use NBP type "SNMP Agent" (which consists of ten ASCII characters) while those supporting notification receiver applications must be configured to use NBP type "SNMP Trap Handler" (which consists of seventeen ASCII characters).

The NBP name for SNMP entities supporting command responders and notification receivers should be stable - NBP names should not change any more often than the IP address of a typical TCP/IP node. It is suggested that the NBP name be stored in some form of stable storage.

When an SNMP entity uses this transport mapping, it must be capable of accepting messages that are at least 484 octets in size. Implementation of larger values is encouraged whenever possible.
5.3. Discussion of AppleTalk Addressing

The AppleTalk protocol suite has certain features not manifest in the TCP/IP suite. AppleTalk’s naming strategy and the dynamic nature of address assignment can cause problems for SNMP entities that wish to manage AppleTalk networks. TCP/IP nodes have an associated IP address which distinguishes each from the other. In contrast, AppleTalk nodes generally have no such characteristic. The network-level address, while often relatively stable, can change at every reboot (or more frequently).

Thus, when SNMP is mapped over DDP, nodes are identified by a "name", rather than by an "address". Hence, all AppleTalk nodes that implement this mapping are required to respond to NBP lookups and confirms (e.g., implement the NBP protocol stub), which guarantees that a mapping from NBP name to DDP address will be possible.

In determining the SNMP identity to register for an SNMP entity, it is suggested that the SNMP identity be a name which is associated with other network services offered by the machine.

NBP lookups, which are used to map NBP names into DDP addresses, can cause large amounts of network traffic as well as consume CPU resources. It is also the case that the ability to perform an NBP lookup is sensitive to certain network disruptions (such as zone table inconsistencies) which would not prevent direct AppleTalk communications between two SNMP entities.

Thus, it is recommended that NBP lookups be used infrequently, primarily to create a cache of name-to-address mappings. These cached mappings should then be used for any further SNMP traffic. It is recommended that SNMP entities supporting command generator applications should maintain this cache between reboots. This caching can help minimize network traffic, reduce CPU load on the network, and allow for (some amount of) network trouble shooting when the basic name-to-address translation mechanism is broken.

5.3.1. How to Acquire NBP names

An SNMP entity supporting command generator applications may have a pre-configured list of names of "known" SNMP entities supporting command responder applications. Similarly, an SNMP entity supporting command generator or notification receiver applications might interact with an operator. Finally, an SNMP entity supporting command generator or notification receiver applications might communicate with all SNMP entities supporting command responder or notification originator applications in a set of zones or networks.
5.3.2.  When to Turn NBP names into DDP addresses

When an SNMP entity uses a cache entry to address an SNMP packet, it should attempt to confirm the validity mapping, if the mapping hasn't been confirmed within the last T1 seconds. This cache entry lifetime, T1, has a minimum, default value of 60 seconds, and should be configurable.

An SNMP entity supporting a command generator application may decide to prime its cache of names prior to actually communicating with another SNMP entity. In general, it is expected that such an entity may want to keep certain mappings "more current" than other mappings, e.g., those nodes which represent the network infrastructure (e.g., routers) may be deemed "more important".

Note that an SNMP entity supporting command generator applications should not prime its entire cache upon initialization - rather, it should attempt resolutions over an extended period of time (perhaps in some pre-determined or configured priority order). Each of these resolutions might, in fact, be a wildcard lookup in a given zone.

An SNMP entity supporting command responder applications must never prime its cache. When generating a response, such an entity does not need to confirm a cache entry. An SNMP entity supporting notification originator applications should do NBP lookups (or confirms) only when it needs to send an SNMP trap or inform.

5.3.3.  How to Turn NBP names into DDP addresses

If the only piece of information available is the NBP name, then an NBP lookup should be performed to turn that name into a DDP address. However, if there is a piece of stale information, it can be used as a hint to perform an NBP confirm (which sends a unicast to the network address which is presumed to be the target of the name lookup) to see if the stale information is, in fact, still valid.

An NBP name to DDP address mapping can also be confirmed implicitly using only SNMP transactions. For example, an SNMP entity supporting command generator applications issuing a retrieval operation could also retrieve the relevant objects from the NBP group [RFC1742] for the SNMP entity supporting the command responder application. This information can then be correlated with the source DDP address of the response.

5.3.4.  What if NBP is broken

Under some circumstances, there may be connectivity between two SNMP entities, but the NBP mapping machinery may be broken, e.g.,
An SNMP entity supporting command generator applications which is
dedicated to AppleTalk management might choose to alleviate some of
these failures by directly implementing the router portion of NBP.
For example, such an entity might already know all the zones on the
AppleTalk internet and the networks on which each zone appears.
Given an NBP lookup which fails, the entity could send an NBP FwdReq
to the network in which the SNMP entity supporting the command
responder or notification originator application was last located.
If that failed, the station could then send an NBP LkUp (NBP lookup
packet) as a directed (DDP) multicast to each network number on that
network. Of the above (single) failures, this combined approach will
solve the case where either the local router’s BrRq-to-FwdReq
mechanism is broken or the remote router’s FwdReq-to-LkUp mechanism
is broken.

6. SNMP over IPX

This is an optional transport mapping.

6.1. Serialization

Each instance of a message is serialized onto a single IPX datagram
[NOVELL], using the algorithm specified in Section 8.

6.2. Well-known Values

SNMP messages are sent using IPX packet type 4 (i.e., Packet Exchange
Protocol).

It is suggested that administrators configure their SNMP entities
supporting command responder applications to listen on IPX socket
36879 (900f hexadecimal). Further, it is suggested that those
supporting notification receiver applications be configured to listen
on IPX socket 36880 (9010 hexadecimal).

When an SNMP entity uses this transport mapping, it must be capable
of accepting messages that are at least 546 octets in size.
Implementation of larger values is encouraged whenever possible.
7. Proxy to SNMPv1

Historically, in order to support proxy to SNMPv1, as defined in [RFC2576], it was deemed useful to define a transport domain, rfc1157Domain, which indicates the transport mapping for SNMP messages as defined in [RFC1157].

8. Serialization using the Basic Encoding Rules

When the Basic Encoding Rules [BER] are used for serialization:

(1) When encoding the length field, only the definite form is used; use of the indefinite form encoding is prohibited. Note that when using the definite-long form, it is permissible to use more than the minimum number of length octets necessary to encode the length field.

(2) When encoding the value field, the primitive form shall be used for all simple types, i.e., INTEGER, OCTET STRING, and OBJECT IDENTIFIER (either IMPLICIT or explicit). The constructed form of encoding shall be used only for structured types, i.e., a SEQUENCE or an IMPLICIT SEQUENCE.

(3) When encoding an object whose syntax is described using the BITS construct, the value is encoded as an OCTET STRING, in which all the named bits in (the definition of) the bitstring, commencing with the first bit and proceeding to the last bit, are placed in bits 8 (high order bit) to 1 (low order bit) of the first octet, followed by bits 8 to 1 of each subsequent octet in turn, followed by as many bits as are needed of the final subsequent octet, commencing with bit 8. Remaining bits, if any, of the final octet are set to zero on generation and ignored on receipt.

These restrictions apply to all aspects of ASN.1 encoding, including the message wrappers, protocol data units, and the data objects they contain.
8.1. Usage Example

As an example of applying the Basic Encoding Rules, suppose one wanted to encode an instance of the GetBulkRequest-PDU [RFC3416]:

```
[5] IMPLICIT SEQUENCE {
    request-id      1414684022,
    non-repeaters   1,
    max-repetitions 2,
    variable-bindings {
        ( name sysUpTime,
          value { unSpecified NULL } ),
        ( name ipNetToMediaPhysAddress,
          value { unSpecified NULL } ),
        ( name ipNetToMediaType,
          value { unSpecified NULL } )
    }
}
```

Applying the BER, this may be encoded (in hexadecimal) as:

```
[5] IMPLICIT SEQUENCE          a5 82 00 39
  INTEGER                    02 04 54 52 5d 76
  INTEGER                    02 01 01
  INTEGER                    02 01 02
  SEQUENCE (OF)              30 2b
    SEQUENCE               30 0b
      OBJECT IDENTIFIER  06 07 2b 06 01 02 01 01 03
      NULL               05 00
    SEQUENCE               30 0d
      OBJECT IDENTIFIER  06 09 2b 06 01 02 01 04 16 01 02
      NULL               05 00
    SEQUENCE               30 0d
      OBJECT IDENTIFIER  06 09 2b 06 01 02 01 04 16 01 04
      NULL               05 00
```

Note that the initial SEQUENCE in this example was not encoded using the minimum number of length octets. (The first octet of the length, 82, indicates that the length of the content is encoded in the next two octets.)

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11. IANA Considerations

The SNMPv2-TM MIB module requires the allocation of a single object identifier for its MODULE-IDENTITY. IANA has allocated this object identifier in the snmpModules subtree, defined in the SNMPv2-SMI MIB module.
12. Security Considerations

SNMPv1 by itself is not a secure environment. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change) the objects accessible through a command responder application.

It is recommended that the implementors consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model STD 62, RFC 3414 [RFC3414] and the View-based Access Control Model STD 62, RFC 3415 [RFC3415] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to a MIB is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change) them.

13. References

13.1. Normative References


[RFC3417]  Transport Mappings for SNMP          December 2002


13.2.  Informative References


14. Changes from RFC 1906

This document differs from RFC 1906 only in editorial improvements. The protocol is unchanged.

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