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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.

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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

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"
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DESCRIPTION

"The MIB module for SNMP transport mappings.

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 version of this MIB module is part of RFC 3417;
 see the RFC itself for full legal notices.

"

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 }

```

SnmppUDPAAddress ::= 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 }

SnmppOSIAddress ::= 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 SnmpNBPAAddress."

::= { snmpDomains 4 }

SnmpNBPAAddress ::= TEXTUAL-CONVENTION

STATUS current

DESCRIPTION

"Represents an NBP name:

octets	contents	encoding
1	length of object	'n' as an unsigned integer
2..(n+1)	object	string of (up to 32) octets
n+2	length of type	'p' as an unsigned integer
(n+3)..(n+2+p)	type	string of (up to 32) octets
n+3+p	length of zone	'q' as an unsigned integer
(n+4+p)..(n+3+p+q)	zone	string of (up to 32) octets

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:

octets	contents	encoding
1-4	network-number	network-byte order
5-10	physical-address	network-byte order
11-12	socket-number	network-byte order

"

SYNTAX OCTET STRING (SIZE (12))

```
-- for proxy to SNMPv1 (RFC 1157)

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

END
```

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.,

- o the NBP FwdReq (forward NBP lookup onto local attached network) mechanism might be broken at a router on the other entity's network; or,
- o the NBP BrRq (NBP broadcast request) mechanism might be broken at a router on the entity's own network; or,
- o NBP might be broken on the other entity's node.

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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The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

10. Acknowledgments

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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

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Standard Management Framework", RFC 3410, December 2002.
- [RFC3419] Daniele, M. and J. Schoenwaelder, "Textual Conventions
for Transport Addresses", RFC 3419, November 2002.

14. Changes from RFC 1906

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

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