Internet NM RFCs

- **RFC 1052 (1988/4)**
  - IAB Recommendations for the Development of Internet Network Management Standards
  - A simple Network Management Protocol
- **RFC 1065 (1988/8), RFC 1155 (1990/5)**
  - Structure and Identification of Management Information for TCP/IP-based Internets
Internet NM RFCs

- RFC 1066 (1988/8), RFC 1156 (1990/5)
  - Management Information Base for Network Management of TCP/IP-based Internet
- RFC 1212 (1991/3)
  - Concise MIB Definitions
- RFC 1213 (1991/3)
  - Management Information Base for Network Management of TCP/IP-based Internets: MIB-II

SNMP Architecture

- Sub-Contents
  - Manager, Agent and Managed Objects
  - Identification of Object Instances
    - Object Identifier
  - PDUs of SNMP
SNMP Architecture

- Manager, Agent and Managed Objects

- Object Identifier
Example of Object Identifier.

SNMP Architecture

Identification of Object Instances

(Object ID).(Key)

Registration ID

0: for non-aggregate objects

Index: for Table, Entry objects

Example 1

Identifies ......system.sysLocation.0
SNMP Architecture

Example 2

Identifies ...ifTable.ifEntry.ifSpeed.2

SNMP Architecture

- **PDUs of SNMP**
  - Receive messages at UDP port 161
  - Receive traps (notification) at UDP port 162
  - Messages length is no larger than 484 octets

- PDU types
  - GetRequest
  - GetNextRequest
  - SetRequest
  - GetResponse
  - Trap
User Datagram Protocol (UDP) over Internet Protocol (IP)

<table>
<thead>
<tr>
<th>0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>source IP address</td>
</tr>
<tr>
<td>destination IP address</td>
</tr>
<tr>
<td>empty</td>
</tr>
<tr>
<td>Source port</td>
</tr>
</tbody>
</table>
| User-data

General format:

<table>
<thead>
<tr>
<th>version</th>
<th>community</th>
<th>data</th>
</tr>
</thead>
</table>

Messages ::= SEQUENCE {
  version INTEGER { version-1 (0) },
  community OCTET STRING,
  data ANY
}

INTEGER = 32 bits using two’s-complement arithmetic
Example:

Community name

For GetRequest, GetNextRequest, SetRequest, and GetResponse

<table>
<thead>
<tr>
<th>version</th>
<th>community</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Request ID</td>
<td>ErrorStatus</td>
<td>ErrorIndex</td>
</tr>
<tr>
<td>ID.key</td>
<td>value</td>
<td>ID.key</td>
</tr>
</tbody>
</table>
For GetRequest, GetNextRequest, SetRequest, and GetResponse (continue)

RequestID ::= INTEGER
ErrorStatus ::= INTEGER {
  noError(0),
  tooBig(1),
  noSuchName(2),
  badValue(3),
  readOnly(4),
  getErr(5)
} 
ErrorIndex ::= INTEGER

for Trap:

<table>
<thead>
<tr>
<th>version</th>
<th>community</th>
<th>data</th>
</tr>
</thead>
<tbody>
<tr>
<td>enterprise</td>
<td>agent-addr</td>
<td>generic-trap</td>
</tr>
</tbody>
</table>

| ID.key | value | ID.key | value | .... |
for Trap:

- enterprise: OBJECT IDENTIFIER,
- agent-addr: NetworkAddress
- generic-trap: INTEGER {
  coldStart(0),
  warmStart(1),
  linkDown(2),
  linkUp(3),
  authenticationFailure(4),
  egpNeighborLoss(5),
  enterpriseSpecific(6)
},
- specific-trap: INTEGER,
- time-stamp: TimeTicks

MIB Examples

IEEE 802.11 Management Information Base

IEEE802dot11-MIB DEFINITION ::= BEGIN
IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE,
  NOTIFICATION-TYPE, ObjectName, Integer32
FROM SNMPv2-SMI
  DisplayString
  FROM SNMPv2-TC
  RowStatus
FROM SNMPv2-TC
  MODULE-COMPLIANCE, OBJECT-GROUP
FROM SNMPv2-CONF;
Importing Macro Definitions

<table>
<thead>
<tr>
<th>module</th>
<th>macros</th>
<th>Object syntaxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNMPv2-SMI</td>
<td>MODULE-IDENTITY</td>
<td>IpAddress, Opaque</td>
</tr>
<tr>
<td></td>
<td>OBJECT-IDENTITY</td>
<td>Counter32, NsapAddress</td>
</tr>
<tr>
<td></td>
<td>OBJECT-TYPE</td>
<td>Gauge32, Counter64</td>
</tr>
<tr>
<td></td>
<td>NOTIFICATION-TYPE</td>
<td>TimeTicks, Uinteger32, etc.</td>
</tr>
<tr>
<td>SNMPv2-TC</td>
<td>TEXTUAL-CONVENTION</td>
<td>DisplayString, AutonomousType</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PhysAddress, InstancePointer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MacAddress, RowStatus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TruthValue, TimeStamp</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TestAndIncr, TimeInterval, DateAndTime, etc</td>
</tr>
<tr>
<td>SNMPv2-CONF</td>
<td>OBJECT-GROUP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MODULE-COMPLIANCE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AGENT-CAPABILITIES</td>
<td></td>
</tr>
</tbody>
</table>

Definition of Object-type Macro

OBJECT-TYPE MACRO ::= BEGIN
  TYPE NOTATION ::= "SYNTAX" type(Syntax) UnitsPart
  "MAX-ACCESS" Access
  "STATUS" Status
  "DESCRIPTION" Text ReferPart
  IndexPart
  DefValPart
  VALUE NOTATION ::= value(VALUE ObjectName)
  UnitsPart ::= "UNITS" Text | empty
  Access ::= "non-accessible"
  | "read-only"
  | "read-write"
  | "read-create"
  Status ::= "current" | "deprecated"
  | "obsolete"
  ReferPart ::= "REFERENCE" Text | empty
  IndexPart ::= "INDEX" "{" IndexTypes "}" | "AUGMENTS" "{" IndexTypes "}" | empty
  IndexTypes ::= IndexType | IndexTypes "," IndexType
Definition of Object-type Macro

IndexType ::= "IMPLIED" Index | Index
Index ::= value(Indexobject ObjectName)
  -- use the SYNTAX value of the
  -- correspondent OBJECT-TYPE invocation
Entry ::= value(Entryobject ObjectName)
  -- use the INDEX value of the
  -- correspondent OBJECT-TYPE invocation
DefValPart ::= "DEFVAL" "{" value(Defval Syntax) "}" | empty
Text ::= "" "" string "" ""
END

Examples

snmpStatePackets OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total number of packets received by the
SNMPv2 entity from the transport service."
REFERENCE
"Derived from RFC1213-MIB.snmpInPkts."
::= {snmpStats 1}
Ieee802dot11 MODULE-IDENTITY
LAST-UPDATED "9703050000Z"
ORGANIZATION "IEEE 802.11"
CONTACT-INFO "XXXXXXXX"
DESCRIPTION
"The MIB module for IEEE 802.11 entities.
 Iso(1).member-body(2).us(840).ieee802dot11(10036)"
 ::= {1 2 840 10036}
smt OBJECT IDENTIFIER ::= {ieee802dot11 1}
mac OBJECT IDENTIFIER ::= {ieee802dot11 2}

res OBJECT IDENTIFIER ::= {ieee802dot11 3}
resAttribute OBJECT IDENTIFIER ::= {res 8}
phy OBJECT IDENTIFIER ::= {ieee802dot11 4}
agStationIDTable OBJECT IDENTIFIER ::= {ieee802dot11 5}

...
Examples

- IEEE 802.11 Management Information Base

- Examples

- Examples

- Examples
agStationConfigGroup OBJECT-TYPE
SYNTAX SEQUENCE OF TypeagStationConfigGroupEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Station Configuration attributes. In tabular form to allow for multiple instances on an agent"
 ::= {smt 1}

agStationConfigGroupEntry OBJECT-TYPE
SYNTAX TypeagStationConfigGroupEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An entry in the agStationConfigGroup table."
INDEX {atStationTableIndex}
 ::= {agStationConfigGroup 1}
TypeAgStationConfigGroupEntry ::= SEQUENCE {
  aStationTableIndex          Integer32,
  aStationID                   MacAddress,
  aMediumOccupancyLimit        Integer32,
  aReceiveDTIMs                INTEGER,
  aCFPollable                  INTEGER,
  aAuthenticationType          INTEGER,
  agStationConfigGroupRowStatus RowStatus,
  aCFPPeriod, aCFPMaxDuration,  
  RowStatus aAuthenticationResponseTimeOut Integer32
}

Examples

aStationID OBJECT-TYPE
SYNTAX       MacAddress
MAX-ACCESS   read-only
STATUS       current
DESCRIPTION
  “The purpose of aStationID is to allow a manager to rename a station for its own purposes. This attribute provides for eventuality while keeping the true MAC address independent. Its syntax is MAC address and default value is the station’s assigned unique MAC address.”
::= {agStationConfigGroupEntry 2 }
Examples

```
root
  |   iso
  |   member-body
  |   org
  |   us
  |   ieee802dot11
  |   smi
  |   mac
  |   res
  |   phy
  |   agStationIDTable
  |   agStationConfigGroup
  |   agStationConfigGroupEntry
  |   agStationID

...agStationID.agStationTableIndex
```

MIB compiler

MIB files → MIB compiler → MIB internal form → SNMP console or MIB browser → Managed objects → SNMP Agent

Network connections
Get, GetNext
Set, Trap
Limitation of SNMP

- Limitation of SNMP v1
  - Paradigm not good to the monitoring of large network
  - Inefficient & slow for retrieving large amount data
  - Trap (event) are unacknowledged and unreliable
  - Trivial authentication is not useful for monitoring
  - No manager to manager communication

Features of SNMP V2

- Bulk Retrieval Mechanism
- Manager-to-Manager Communication
- Multiple Transport Mappings Support
- Security
SNMP V2

- Multiple Transport Mappings Support

- SNMP V2 -REF Specifications
- RFC 1441 - Protocol Overview
- RFC 1442 - MIB Structures
- RFC 1443 - Textual Conventions
- RFC 1444 - Conformance Statements
- RFC 1445 - Administrative Model
- RFC 1446 - Security Protocols
- RFC 1447 - Party MIB
- RFC 1448 - Protocol Operation
- RFC 1449 - Transport Mappings
- RFC 1450 - MIB Definitions
- RFC 1451 - management Station MIB
- RFC 1452 - Coexistence with SNMP Version 1