Chapter 5
SNMPv1:
Communication and Functional Models
Network Management

• Organization Model (ch. 4)
  – 2 tier
  – 3 tier

• Information Model (ch. 4)
  – SMI
  – MIB

• Communication Model (ch. 5)

• Functional Model (ch. 5)
SNMP Architecture

Figure 4.9 SNMP Network Management Architecture
SNMP Messages

- Get-Request
- Get-Next-Request
- Set-Request
- Get-Response
- Trap
  - Generic trap
  - Specific trap
  - Time stamp
Administrative Model

• Based on community profile and policy

• SNMP Entities:
  • SNMP application entities
    - Reside in management stations and network elements
    - Manager and agent

  • SNMP protocol entities
    - Communication processes (PDU handlers)
    - Peer processes that support application entities
SNMP Community

Figure 5.1 SNMP Community
Community Profile

Figure 5.2 SNMP Community Profile
Administration Model

- Administration model is SNMP access policy
- SNMP community paired with SNMP community profile is SNMP access policy
Access Policy
Generalized Administration Model

Figure 5.3 SNMP Access Policy
Proxy Access Policy

Figure 5.4 SNMP Proxy Access Policy
# Protocol Entities

<table>
<thead>
<tr>
<th>Data Link PDU</th>
<th>DLC Header</th>
<th>Network PDU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network PDU</td>
<td>IP Header</td>
<td>Transport PDU</td>
</tr>
<tr>
<td>Transport PDU</td>
<td>UDP Header</td>
<td>Application PDU</td>
</tr>
<tr>
<td>Application PDU</td>
<td>Version</td>
<td>Community</td>
</tr>
<tr>
<td>SNMP PDU</td>
<td>Data</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 5.5 Encapsulated SNMP Message**
Get and Set PDU

<table>
<thead>
<tr>
<th>PDU Type</th>
<th>RequestID</th>
<th>Error Status</th>
<th>Error Index</th>
<th>VarBind 1 name</th>
<th>VarBind 1 value</th>
<th>...</th>
<th>VarBind n name</th>
<th>VarBind n value</th>
</tr>
</thead>
</table>

Figure 5.8 Get and Set Type PDUs

- VarBindList: multiple instances of VarBind pairs

PDU Types: enumerated INTEGER

<table>
<thead>
<tr>
<th>PDU Types</th>
<th>Enumeration</th>
</tr>
</thead>
<tbody>
<tr>
<td>get-request</td>
<td>[0]</td>
</tr>
<tr>
<td>get-next-request</td>
<td>[1]</td>
</tr>
<tr>
<td>set-request</td>
<td>[2]</td>
</tr>
<tr>
<td>get-response</td>
<td>[3]</td>
</tr>
<tr>
<td>trap</td>
<td>[4]</td>
</tr>
</tbody>
</table>
Error in Response

Error Status ::= INTEGER {
  noError (0)
  tooBig (1)
  noSuchName (2)
  badValue (3)
  readOnly (4)
  genErr (5)
}

Error Index: No. of VarBind that the first error occurred (1 if error occurred in first VarBind, …)

VarBind - pairing of the variable and it's value
# Trap PDU

<table>
<thead>
<tr>
<th>Enterprise</th>
<th>Agent Address</th>
<th>Generic Trap Type</th>
<th>Specific Trap Type</th>
<th>Timestamp</th>
<th>VarBind 1 name</th>
<th>VarBind 1 value</th>
<th>...</th>
<th>VarBind n name</th>
<th>VarBind n value</th>
</tr>
</thead>
</table>

## Generic Trap Type

<table>
<thead>
<tr>
<th>Trap Type</th>
<th>Description (brief)</th>
</tr>
</thead>
<tbody>
<tr>
<td>coldStart(0)</td>
<td>Sending protocol entity is reinitializing itself; agent's configuration or protocol entity implementation may be altered</td>
</tr>
<tr>
<td>warmStart(1)</td>
<td>Sending protocol entity is reinitializing itself; agent configuration or protocol entity implementation not altered</td>
</tr>
<tr>
<td>linkDown(2)</td>
<td>Failure of one of the communication links</td>
</tr>
<tr>
<td>linkUp(3)</td>
<td>One of the links has come up</td>
</tr>
<tr>
<td>authFai(4)</td>
<td>Authentication failure</td>
</tr>
<tr>
<td>egpLoss(5)</td>
<td>Loss of EGP neighbor</td>
</tr>
<tr>
<td>enterpriseSpec(6)</td>
<td>Enterprise-specific trap</td>
</tr>
</tbody>
</table>
SNMP Operations

Manager Process

Agent Process

Figure 5.10 Get-Request Operation for System Group
Figure 5.12 MIB for Operation Sequences in Figures 5.13 and 5.15
Lexicographic Order

- Procedure for ordering:
  - Start with leftmost digit as first position
  - Before increasing the order in the first position, select the lowest digit in the second position
  - Continue the process till the lowest digit in the last position is captured
  - Increase the order in the last position until all the digits in the last position are captured
  - Move back to the last but one position and repeat the process
  - Continue advancing to the first position until all the numbers are ordered
- Tree structure for the above process

<table>
<thead>
<tr>
<th>Numerical Order</th>
<th>Lexicographic Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1118</td>
</tr>
<tr>
<td>3</td>
<td>115</td>
</tr>
<tr>
<td>9</td>
<td>126</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>34</td>
<td>22</td>
</tr>
<tr>
<td>115</td>
<td>250</td>
</tr>
<tr>
<td>126</td>
<td>2509</td>
</tr>
<tr>
<td>250</td>
<td>3</td>
</tr>
<tr>
<td>321</td>
<td>321</td>
</tr>
<tr>
<td>1118</td>
<td>34</td>
</tr>
<tr>
<td>2509</td>
<td>9</td>
</tr>
</tbody>
</table>
MIB Lexicographic Order

A  3.1
B  3.2
T  Z
E
  1.1
  1.2
  2.1
  2.2
  3.1
  3.2
Chapter 5

A More Complex MIB Example

Figure 5.14 MIB Example for Lexicographic Ordering
Get-Next-Request Operation

Figure 5.15 Get-Next-Request Operation for MIB in Figure 5.12
Get-Next-Request Operation

![Diagram of Get-Next-Request Example with Indices]

Figure 5.16 GetNextRequest Example with Indices

<table>
<thead>
<tr>
<th>atIFIndex</th>
<th>atPhysAddress</th>
<th>atNetAddress</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>00000000C3920B4</td>
<td>192.168.3.1</td>
</tr>
<tr>
<td>13</td>
<td>00000000C3920AC</td>
<td>172.16.46.1</td>
</tr>
<tr>
<td>16</td>
<td>00000000C3920AF</td>
<td>172.16.49.1</td>
</tr>
</tbody>
</table>
Sniffer Data

Figure 5.17 (a) Get-Request Message from Manager-to-Agent

Figure 5.17 (b) Get-Response Message from Agent-to-Manager (After)
Note: Most of the MIB objects were not used and hence deprecated in SNMPv2
5.2 Functional Model

• No formal specs of functions in SNMPv1
• OSI mode addresses
  – configuration
  – fault
  – performance
  – security
  – accounting