UNIT 5- APPLICATION LAYER SNMP

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28-2 SIMPLE NETWORK MANAGEMENT PROTOCOL (SNMP)

The Simple Network Management Protocol (SNMP) is a framework for managing devices in an internet using the TCP/IP protocol suite. It provides a set of fundamental operations for monitoring and maintaining an internet.

Topics discussed in this section:

Concept

Management Components

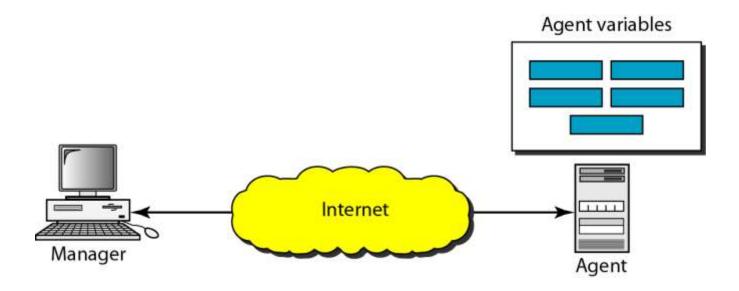
Structure of Management Information (SMI)

Management Information Base (MIB)

SNMP

- SNMP uses the concept of manager and agent.
- manager is host, controls and monitors a set of agents, usually routers
- SNMP is an application-level protocol in which a few manager stations control a set of agents.
- Manager runs the SNMP client program.
- A managed station, called an agent runs the SNMP server program.
- Management is achieved through simple interaction between a manager and an agent.

Figure 28.2 SNMP concept

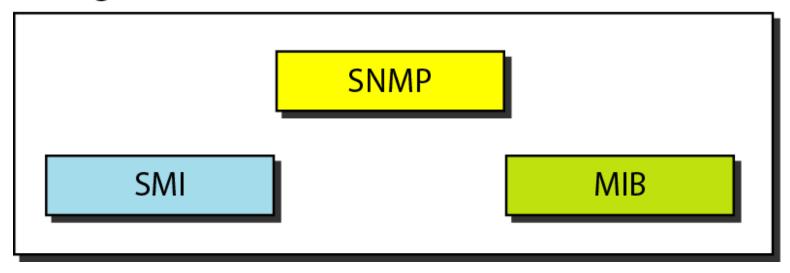


Management Components

- SNMP uses two other protocols: Structure of Management Information (SMI) and Management Information Base (MIB).
- SNMP defines the format of the packet to be sent from a manager to an agent and vice versa
- It also interprets the result and creates statistics.
- The packets exchanged contain the object (variable) names and their status (values).
- SNMP is responsible for reading and changing these values.

Figure 28.3 Components of network management on the Internet

Management



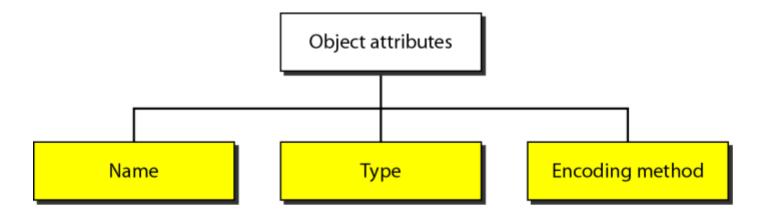
Structure of Management Information

The Structure of Management Information, version 2 (SMIv2) is a component for network management.

Its functions are

- 1. To name objects
- 2. To define the type of data that can be stored in an object
- 3. To show how to encode data for transmission over the network

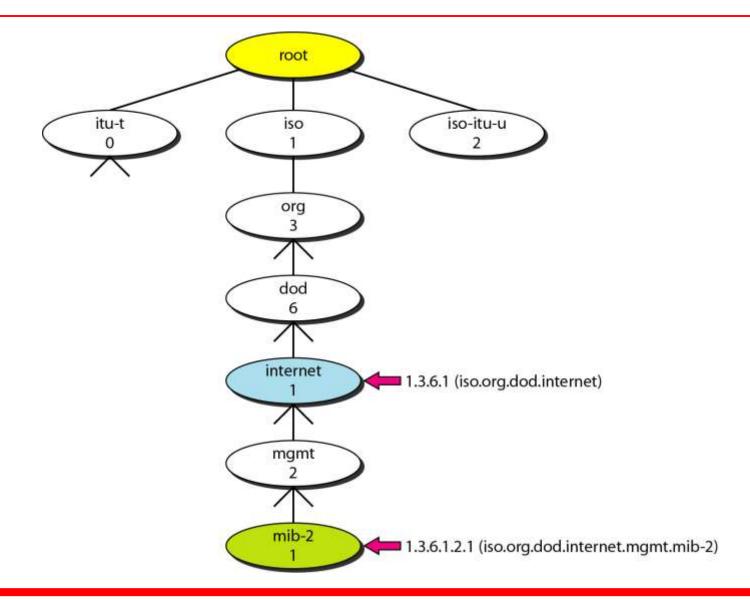
Figure 28.5 Object attributes



Structure of Management Information

1. Name- SMI requires that each managed object (such as a router, a variable in a router, a value) have a unique name.
To name objects globally, SMI uses an object identifier, which is a hierarchical identifier based on a tree structure

Figure 28.6 Object identifier





Note

All objects managed by SNMP are given an object identifier.

The object identifier always starts with 1.3.6.1.2.1.

Structure of Management Information

2. Type- The second attribute of an object is the type of data stored in it.

To define the data type, SMI uses fundamental Abstract Syntax Notation 1 (ASN.I) definitions and adds some new definitions.

Figure 28.7 Data type

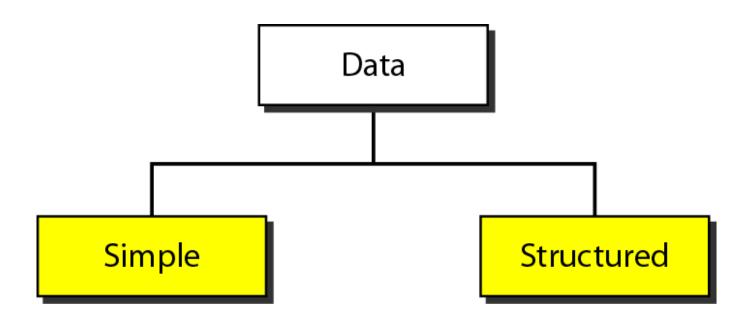
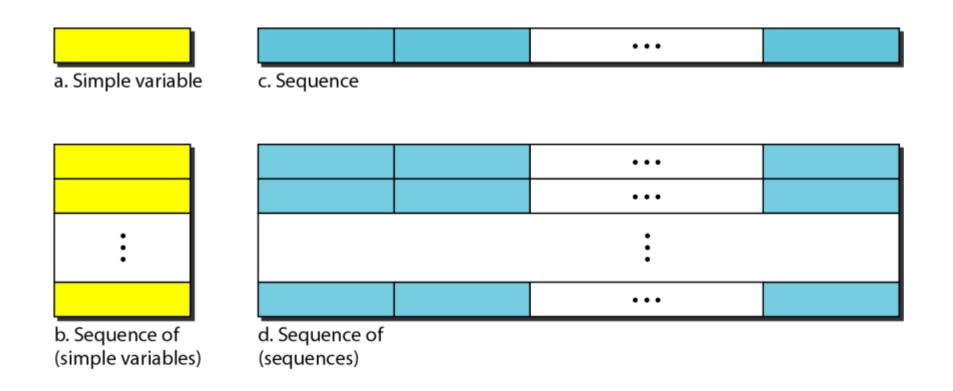


Table 28.1 Simple Data types

Туре	Size	Description		
INTEGER	4 bytes	An integer with a value between -2^{31} and 2^{31} -		
Integer32	4 bytes	Same as INTEGER		
Unsigned32	4 bytes	Unsigned with a value between 0 and $2^{32} - 1$		
OCTET STRING	Variable	Byte string up to 65,535 bytes long		
OBJECT IDENTIFIER	Variable	An object identifier		
IPAddress	4 bytes	An IP address made of four integers		
Counter32	4 bytes	An integer whose value can be incremented from 0 to 2 ³² ; when it reaches its maximum value, it wraps back to 0.		
Counter64	8 bytes	64-bit counter		
Gauge32	4 bytes	Same as Counter32, but when it reaches its maximum value, it does not wrap; it remains there until it is reset		
TimeTicks	4 bytes	A counting value that records time in $\frac{1}{100}$ s		
BITS		A string of bits		
Opaque	Variable	Uninterpreted string		

Figure 28.8 Structured Conceptual data types



Structure of Management Information

3. Encoding Method-

SMI uses another standard, Basic Encoding Rules (BER), to encode data to be trans- mitted over the network. BER specifies that each piece of data be encoded in triplet format: tag, length, and value.

Figure 28.9 Encoding format

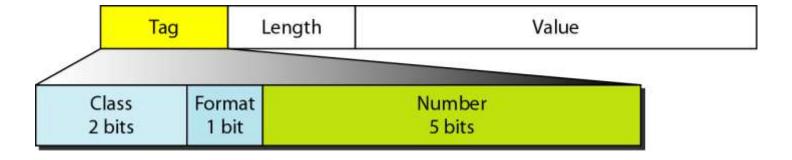


Table 28.2 Codes for data types

Data Type	Class	Format	Number	Tag (Binary)	Tag (Hex)
INTEGER	00	0	00010	00000010	02
OCTET STRING	00	0	00100	00000100	04
OBJECT IDENTIFIER	00	0	00110	00000110	06
NULL	00	0	00101	00000101	05
Sequence, sequence of	00	1	10000	00110000	30
IPAddress	01	0	00000	01000000	40
Counter	01	0	00001	01000001	41
Gauge	01	0	00010	01000010	42
TimeTicks	01	0	00011	01000011	43
Opaque	01	0	00100	01000100	44

Management Information Base(MIB)

- The Management Information Base, version 2 (MIB2) is the second component used in network management.
- Each agent has its own MIB2, which is a collection of all the objects that the manager can manage.
- The objects in MIB2 are categorized under different groups: system, interface, address translation, ip, icmp, tcp, udp, egp, transmission, and snmp

Figure 28.15 *mib-2*

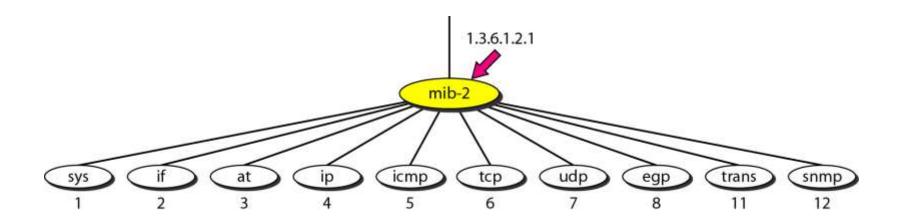
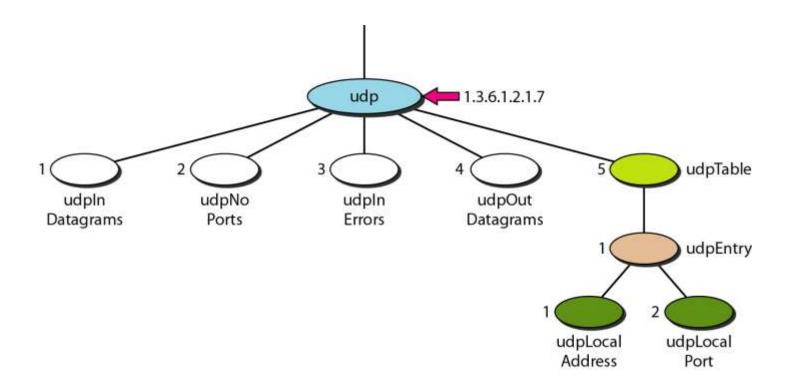


Figure 28.16 udp group



SNMP

- SNMP uses both SMI and MIB in Internet network management. It is an application program that allows
 - 1. A manager to retrieve the value of an object defined in an agent
 - 2. A manager to store a value in an object defined in an agent
 - 3. An agent to send an alarm message about an abnormal situation to the manager

Figure 28.20 SNMP PDUs

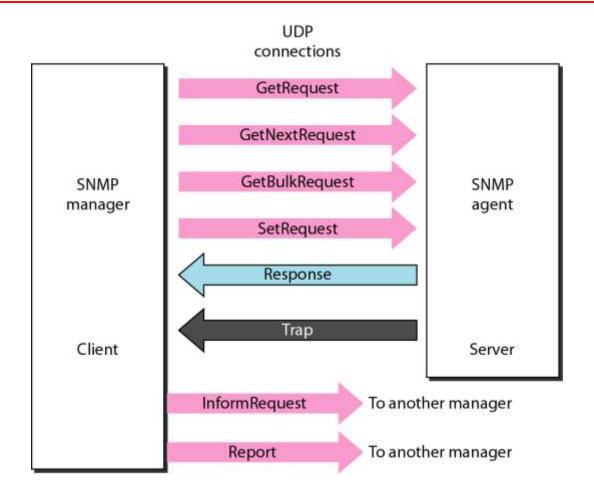
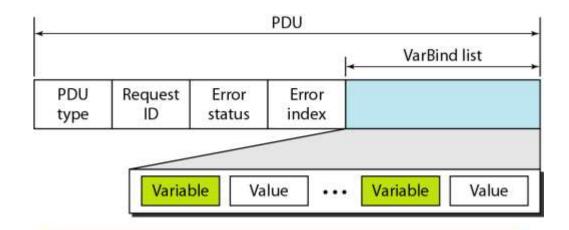


Figure 28.21 SNMP PDU format



Differences:

- Error status and error index values are zeros for all request messages except GetBulkRequest.
- Error status field is replaced by nonrepeater field and error index field is replaced by max-repetitions field in GetBulkRequest.

SNMP PDU FORMAT

The fields are listed below:

- 1. PDU type. This field defines the type of the POD
- 2. Request ID. This field is a sequence number used by the manager in a Request POD and repeated by the agent in a response. It is used to match a request to a response
- **3. Error status.** This is an integer that is used only in Response PDUs to show the types of errors reported by the agent. Its value is 0 in Request PDUs

- 4. Nonrepeaters. This field IS used only in GetBulkRequest and replaces the error status field, which is empty in Request PDUs.
- 5. Error index. The error index is an offset that tells the manager which variable caused the error.
- 6. Max-repetition. This field is also used only in GetBulkRequest and replaces the error index field, which is empty in Request PDUs.
- 7. VarBind list. This is a set of variables with the corresponding values the manager wants to retrieve or set. The values are null in GetRequest and GetNextRequest

Table 28.3 Types of errors

Status Name		Meaning		
0	noError	No error		
1	tooBig	Response too big to fit in one messa		
2	noSuchName	Variable does not exist		
3	badValue	The value to be stored is invalid		
4	readOnly	The value cannot be modified		
5	genErr	Other errors		

SNMP Messages

SNMP does not send only a PDU, it embeds the PDU in a message.

A message in SNMPv3 is made of four elements: version, header, security parameters, and data

Figure 28.22 SNMP message

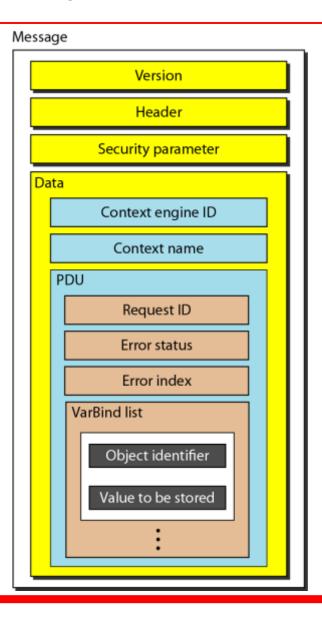


 Table 28.4
 Codes for SNMP messages

Data	Class	Format	Number	Whole Tag (Binary)	Whole Tag (Hex)
GetRequest	10	1	00000	10100000	A0
GetNextRequest	10	1	00001	10100001	A1
Response	10	1	00010	10100010	A2
SetRequest	10	1	00011	10100011	A3
GetBulkRequest	10	1	00101	10100101	A5
InformRequest	10	1	00110	10100110	A6
Trap (SNMPv2)	10	1	00111	10100111	A7
Report	10	1	01000	10101000	A8