SNMPv1:

Organization and Information Models

Internet SNMP Management

- 1970　　Advanced Research Project Agency Network (ARPANET)
　　　　　Internet control Message Protocol (ICMP)
- Internet Engineering Task Force (IETF)
    - 1990　　　　SNMPv1
    - 1995　　　　SNMPv2
    - 1998　　　　SNMPv3
- Internet documents:
    - Request for Comments (RFC)
    - IETF STD Internet Standard
    - FYI For your information
- Source for RFCs
    - ftp://nic.mil/rfc
    - ftp://ftp.internic.net/rfc
    - http://nic/internet.net/

SNMPv1 & SNMPv2 Documents

SNMP Management Documents

RFC 1065 SMI RFC 1155 STD 16	RFC 1066 MIB I RFC 1156	RFC 10

oncise SMI
RFC 1212
STD 16

RFC 1098
SNMPv1
RFC 1157
STD 15

RFC 1158
MIB II
RFC 1213
STD 17

RFC 1443
SMIv2 Txt
Conventions
RFC 1903

RFC 1444
SMIv2
Conformances
RFC 1904

RFC 1448
SNMPv2
Protocol Ops
1905

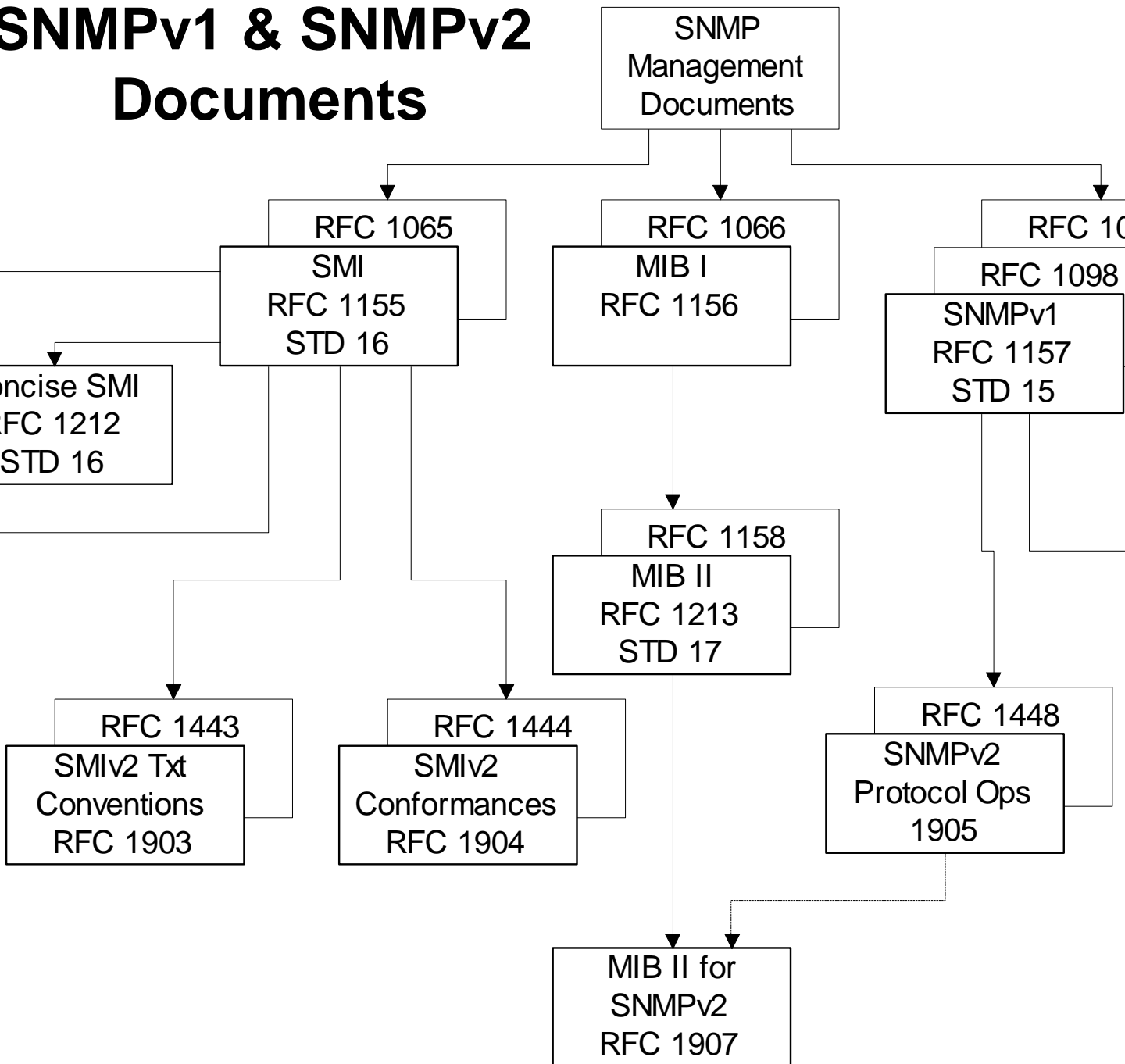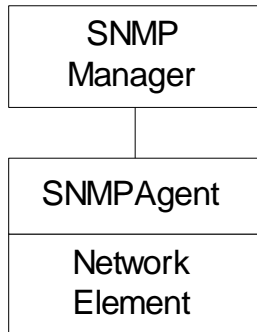MIB II for
SNMPv2
RFC 1907

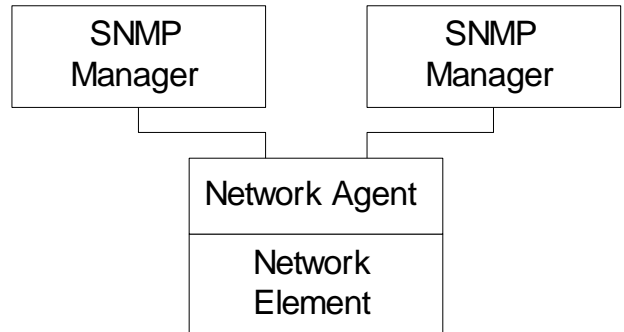**Figure 4.4 SNMP Document Evolution**

SNMP Model

- Organization Model
  - Relationship between network element, agent, and manager
  - Hierarchical architecture
- Information Model
  - Uses ASN.1 syntax
  - SMI (Structure of Management Information
  - MIB (Management Information Base)
- Communication Model
  - Transfer syntax
  - SNMP over TCP/IP
  - Communication services addressed by messages
  - Security framework community-based model

Two-Tier Organization Model

```
┌─────────────┐              ┌─────────────┐  ┌─────────────┐
│    SNMP     │              │    SNMP     │  │    SNMP     │
│   Manager   │              │   Manager   │  │   Manager   │
└──────┬──────┘              └──────┬──────┘  └──────┬──────┘
       │                           │                 │
┌──────┴──────┐              ┌──────┴─────────────────┴──┐
│  SNMPAgent  │              │      Network Agent        │
├─────────────┤              ├───────────────────────────┤
│   Network   │              │        Network            │
│   Element   │              │        Element            │
└─────────────┘              └───────────────────────────┘
```

(a) One Manager - One Agent Model   **(b) Multiple Managers - One Agent Model**
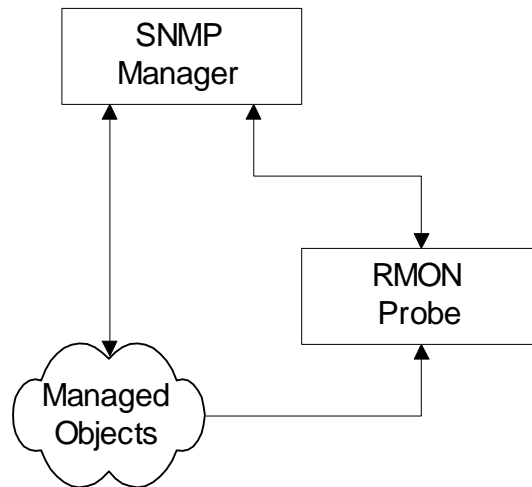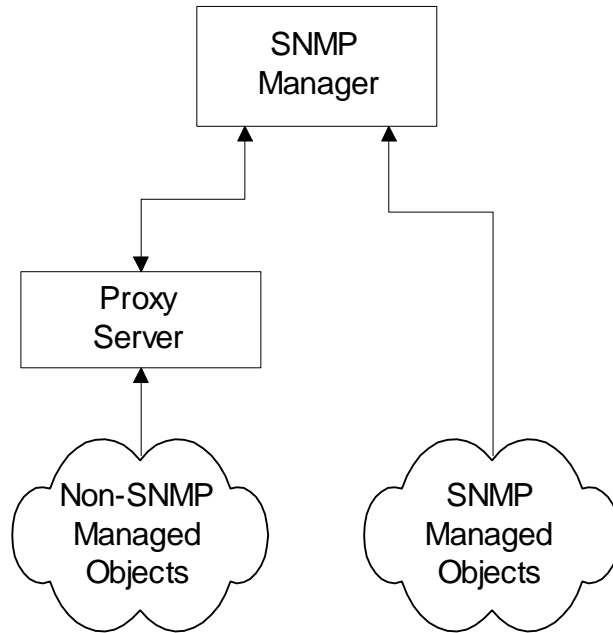
Notes

- Any host that could query an agent is a manager

Three-Tier Organization Model: RMON

```
          ┌──────────────┐
          │    SNMP      │
          │   Manager    │
          └──────────────┘
            ▲         ▲
            │         │
            │      ┌──────────────┐
            │      │    RMON      │
            │      │    Probe     │
            │      └──────────────┘
            │         ▲
         ┌──────┐     │
        ╭ Managed ╮   │
        │ Objects │───┘
         ╰────────╯
```

Notes

- Managed object comprises network element and management agent
- RMON acts as an agent and a manager
- RMON (Remote Monitoring) gathers data from MO, analyses the data, and stores the data
- Communicates the statistics to the manager

Three-Tier Organization Model: Proxy Server

```
                    +------------+
                    |    SNMP    |
                    |   Manager  |
                    +------------+
                     ^          ^
                     |          |
              +------+          +------+
              |                        |
              v                        |
        +------------+                 |
        |   Proxy    |                 |
        |   Server   |                 |
        +------------+                 |
              ^                        |
              |                        |
```

Non-SNMP Managed Objects   SNMP Managed Objects

Notes

• Proxy server converts non-SNMP data from non-SNMP objects to SNMP compatible objects and messages

System Architecture

SNMP Manager   SNMP Agent

Physical Medium
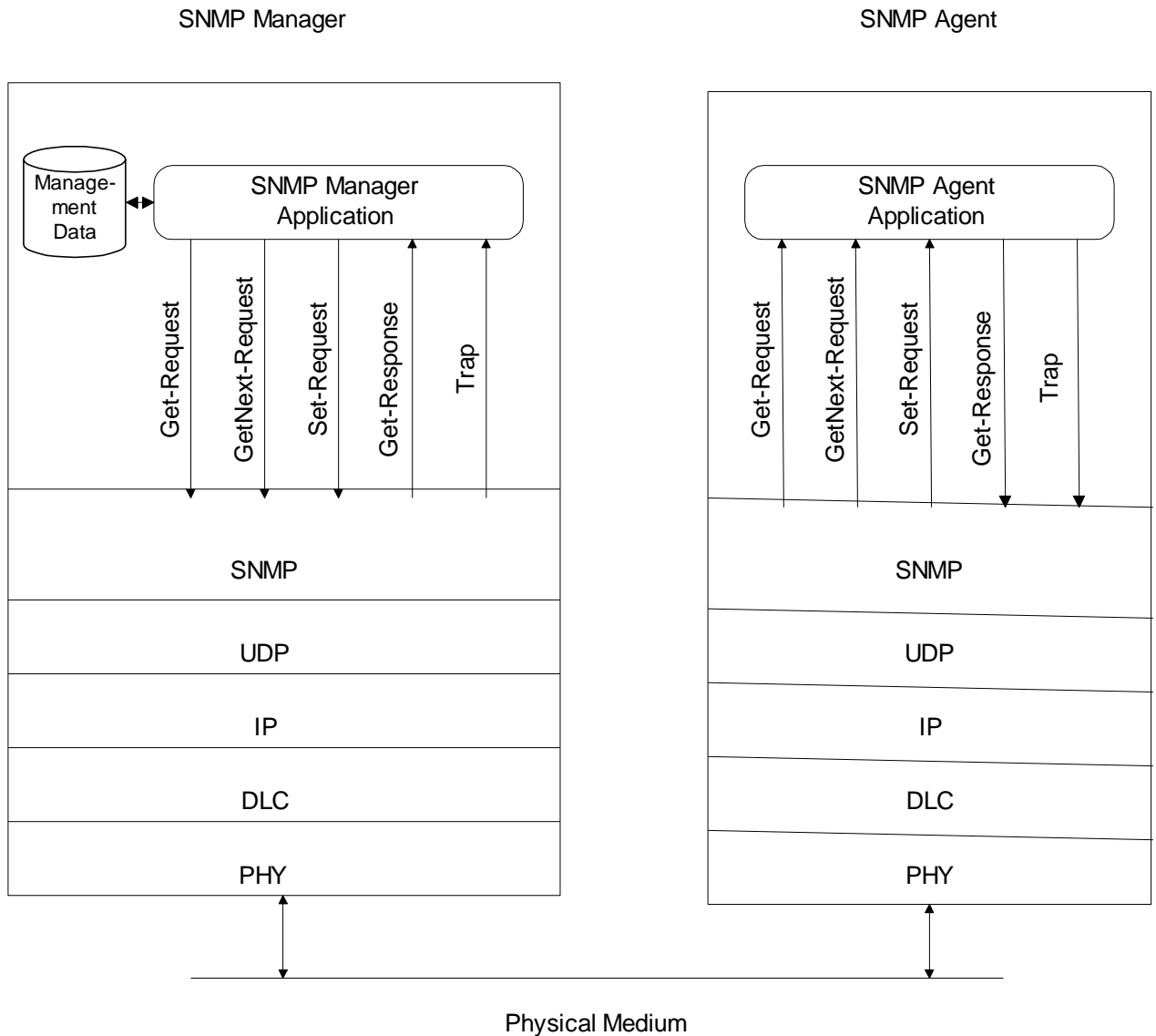
Figure 4.9 SNMP Network Management Architecture

Notes
- Messages between manager and agent
- Direction of messages - 3 from manager and 2 from agent

SNMP Messages

- Get-Request
    - Sent by manager requesting data from agent
- Get-Next-Request
    - Sent by manager requesting data on the next MO to the one specified
- Set-Request
    - Initializes or changes the value of network element
- Get-Response
    - Agent responds with data for get and set requests from the manager
- Trap
    - Alarm generated by an agent

Notes

Information

- Structure of Management Information (SMI) (RFC 1155)
- Managed Object
    - Scalar
    - Aggregate or tabular object
- Management Information Base (RFC 1213)

Notes

- RFCs can be downloaded from ftp.internic.net/rfc

Managed Object

```
                        ┌──────────────┐
                        │    Object    │
                        └──────────────┘
                  ┌────────────┴─────────────┐
          ┌───────────────┐           ┌───────────────┐
          │    Object     │           │    Object     │
          │    Type       │           │   Instance    │
          └───────────────┘           └───────────────┘
       ┌─────────┼──────────┐
┌────────────┐ ┌──────────┐ ┌──────────┐
│   Name:    │ │ Syntax:  │ │Encoding: │
│  OBJECT    │ │  ASN.1   │ │   BER    │
│ IDENTIFIER │ │          │ │          │
└────────────┘ └──────────┘ └──────────┘
```
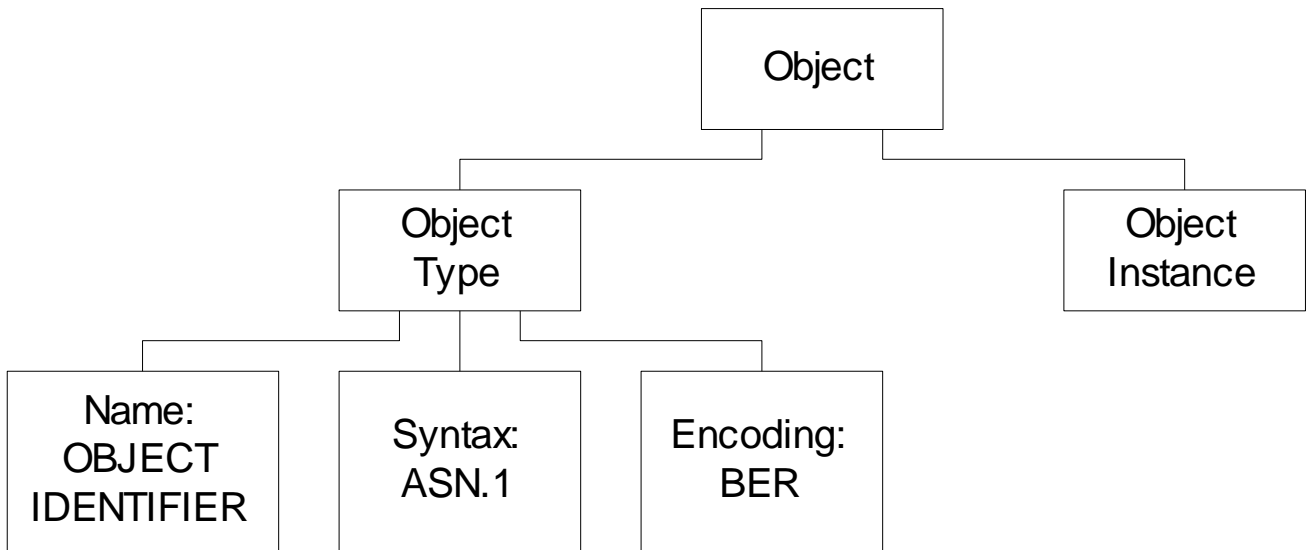
Figure 4.10 Managed Object : Type and Instance

Notes

- Object type and data type are synonymous
- Object identifier is data type, not instance
- Object instance IP address (See Figure 4.2)

Managed Object: Multiple Instances
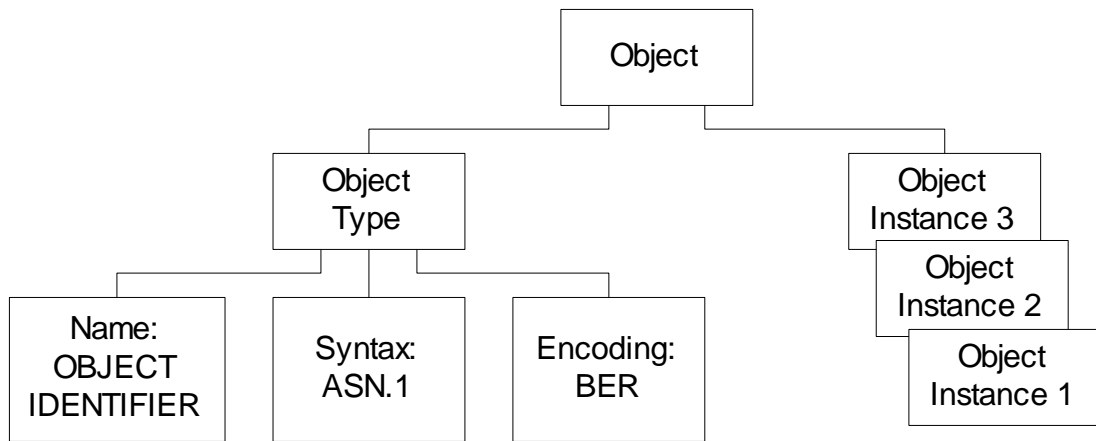
Figure 4.11 Managed Object : Type with Multiple Instances

Notes

- All 3 Com hubs of the same version have identical identifier; they are distinguished by the IP address
- Each IP address is an instance of the object

Name

Uniquely defined by
- DESCRIPTOR AND
- OBJECT IDENTIFIER

internet OBJECT IDENTIFIER ::=
                    {iso org(3) dod(6) 1 }.

internet OBJECT IDENTIFIER ::= {iso(1) standard(3) dod(6) internet(1)}
internet OBJECT IDENTIFIER ::= {1 3 6 1}
internet OBJECT IDENTIFIER ::= {iso standard dod internet }
internet OBJECT IDENTIFIER ::= { iso standard dod(6) internet(1) }
internet OBJECT IDENTIFIER ::= { iso(1) standard(3) 6 1 }

Notes

Internet Subnodes
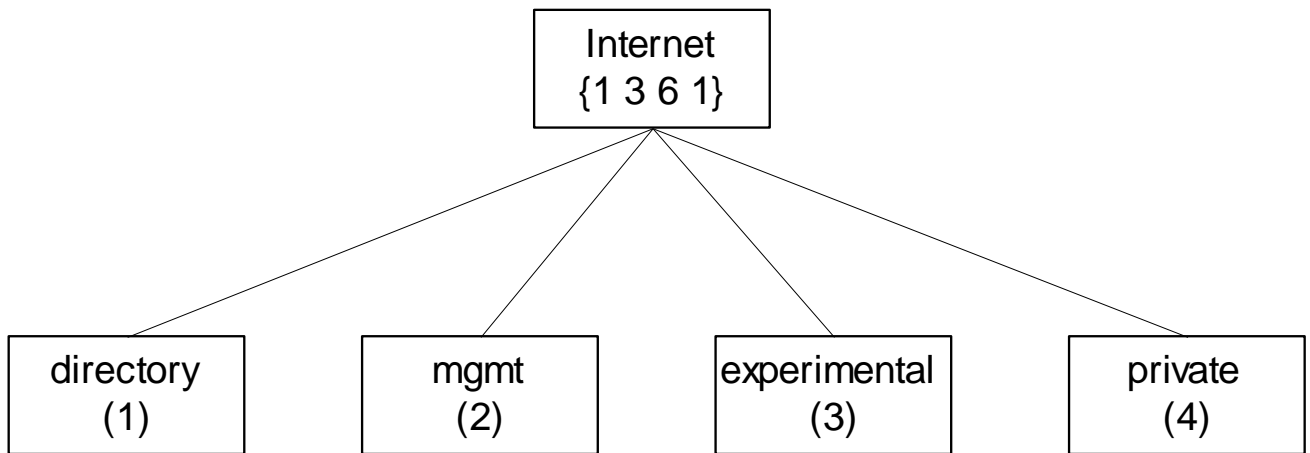
Figure 4.13 Subnodes under Internet Node in SNMPv1

Notes

- directory OBJECT IDENTIFIER ::= {internet 1}
  mgmt OBJECT IDENTIFIER ::= {internet 2}
  experimental OBJECT IDENTIFIER ::= {internet 3}
  private OBJECT IDENTIFIER ::= {internet 4}

Private MIB Example
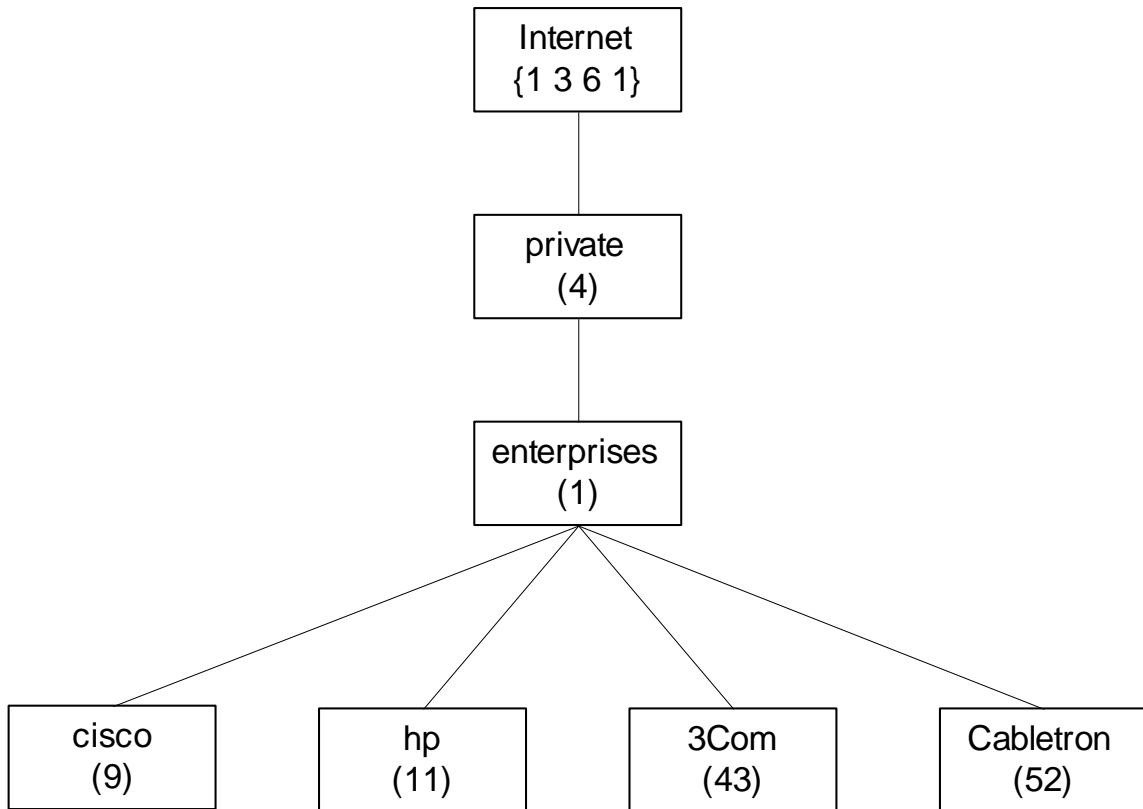
Figure 4.14 Private Subtree for Commercial Vendors

Notes
- *private* MIB intended for vendor equipment
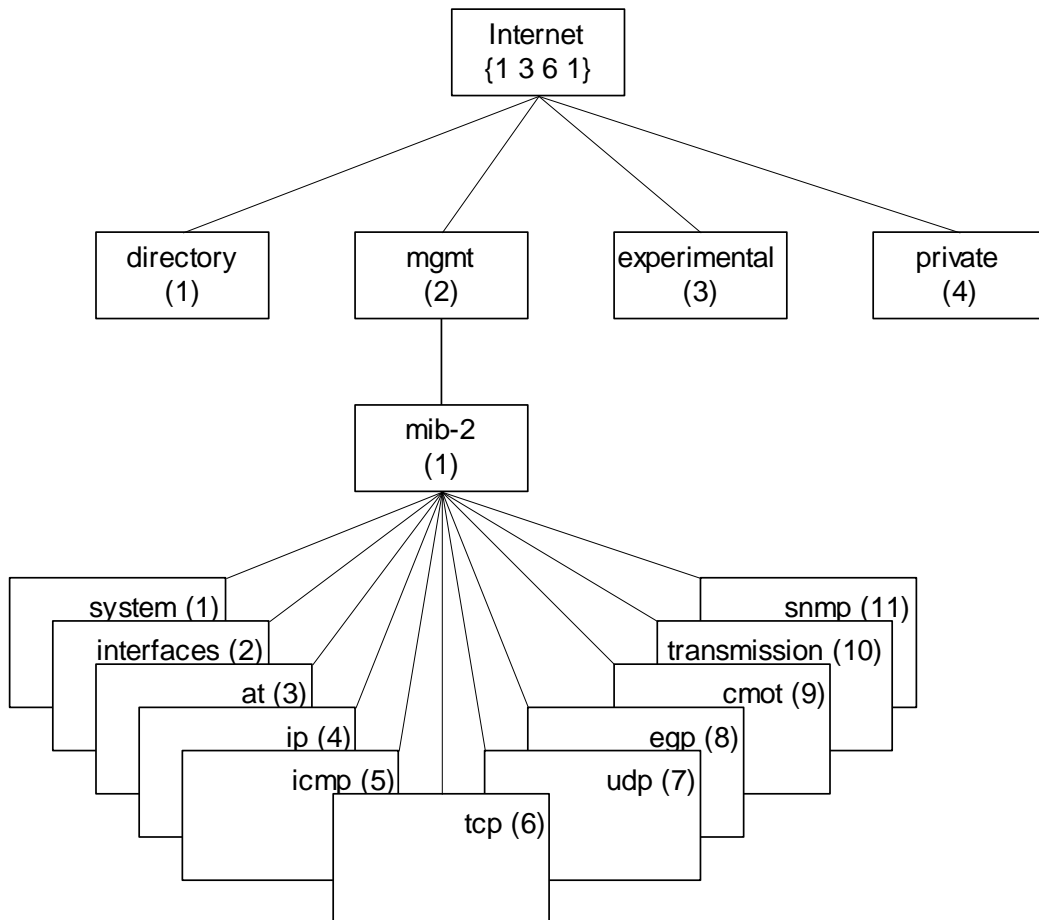- IANA (Internet Assigned Numbers Authority) assigns identifiers

MIB

Figure 4.26 Internet MIB-II Group

Notes
- MIB-II (RFC 1213) is superset of MIB-I
- Objects that are related grouped into object groups
- MIB module comprises module name, imports from other modules, and definitions of current module
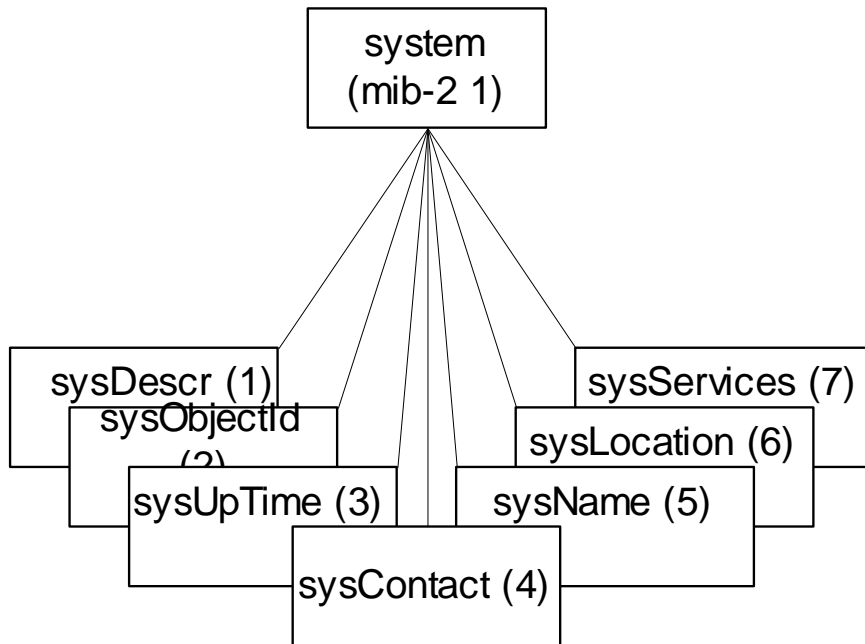- RFC 1213 defines eleven groups; expanded later

System Group

Figure 4.27 System Group

Notes

Entity	OID	Description (brief)
sysDescr	system 1	Textual description
sysObjectID	system 2	OBJECT IDENTIFIER of the entity
sysUpTime	system 3	Time (in hundredths of a second since last reset)
sysContact	system 4	Contact person for the node
sysName	system 5	Administrative name of the system
sysLocation	system 6	Physical location of the node
sysServices	system 7	Value designating the layer services provided by the entity

Interfaces Group
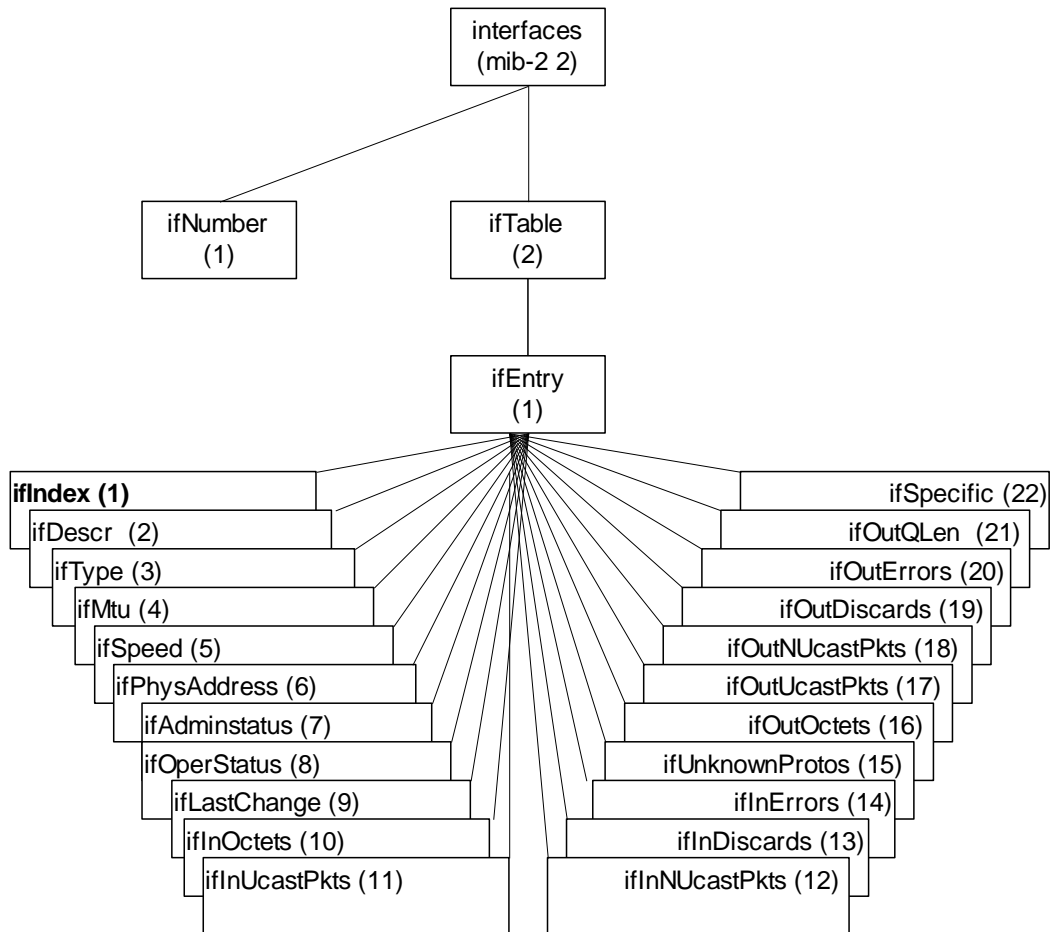
Legend: INDEX in bold

Figure 4.28   Interfaces Group

Notes