Internet
solutions

SNMP

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- MIB naming tree, MIB-II
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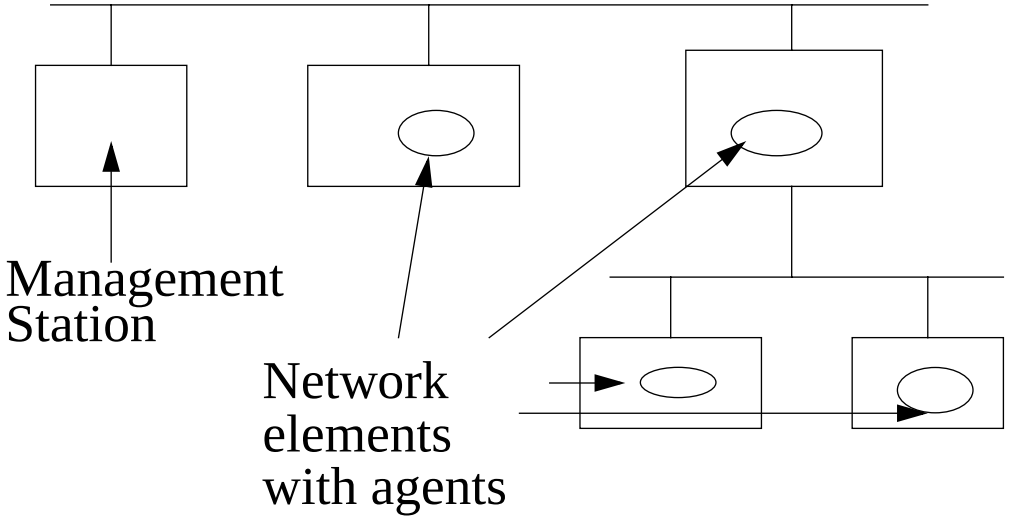
Network Management with SNMP

- Simple Network Management Protocol is defined in RFC-1157
- Network elements (routers, hosts, printers etc) have a SNMP agent
- Management station queries network elements for information
- Management Information Base (MIB) describes the information served by SNMP agents

. . . Network Management with SNMP



MIB

- Specifies what variables the network elements maintain
- Variables are the information that can be queried and set by the manager
- Specifies standardized object identifiers
- Variables are named using a scheme that is hierarchial and is unlimited in expansion, eg. iso.org.dod.internet.mgmt.mib-2.
- There is a branch in the naming tree for private enterprises (usualy manufacturers of network hardware) to locate their own MIBs.

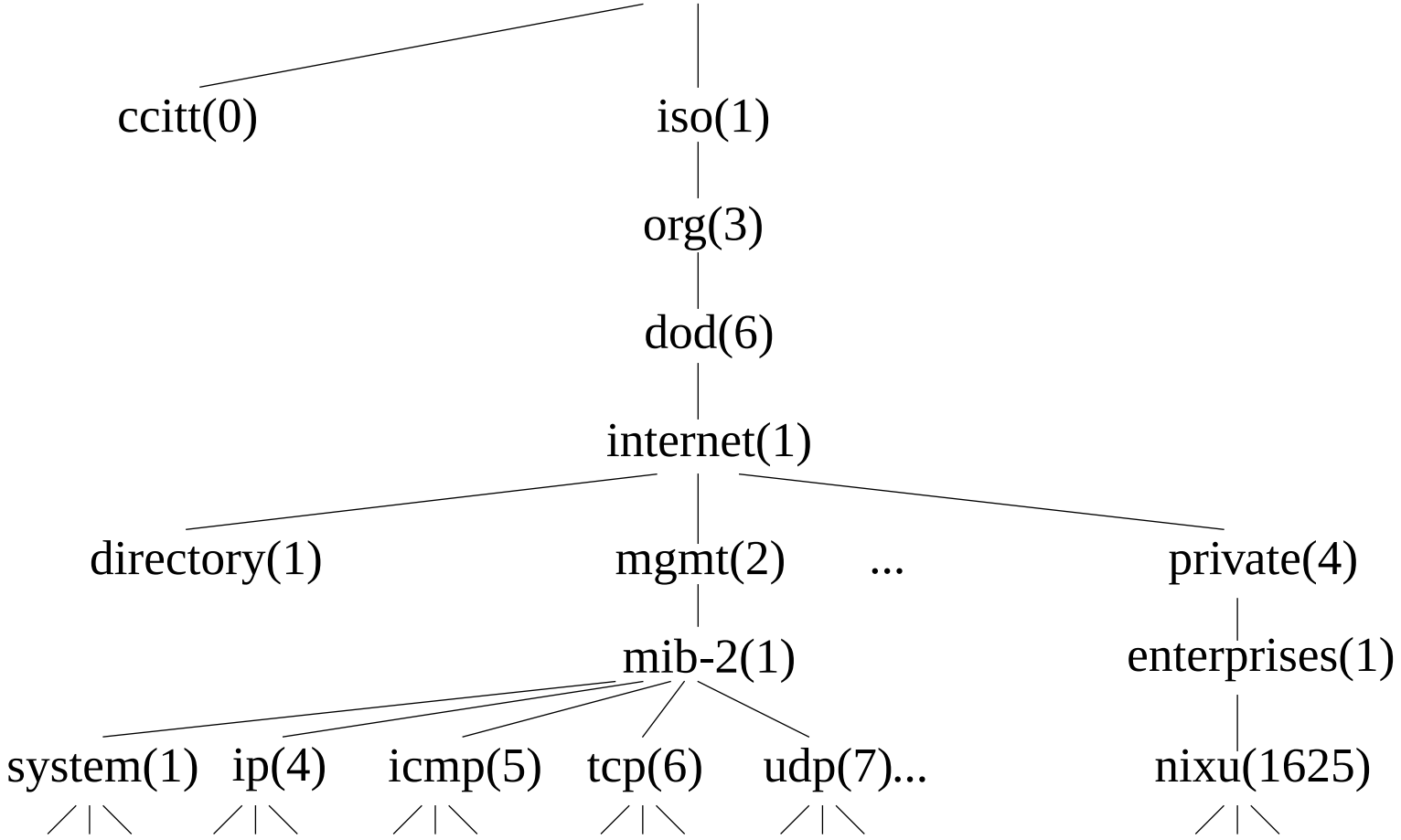
MIB example

```
sysUpTime OBJECT-TYPE
    SYNTAX      TimeTicks
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The time (in hundredths of a second) since
             the network management portion of the sys-
             tem was last re-initialized."
    ::= { system 3 }
```

- Data types: Integer, DisplayString, TimeTicks, ..
- More complex data types can be constructed using sequence and union

MIB naming tree

- Every SNMP variable has a place in the global MIB tree



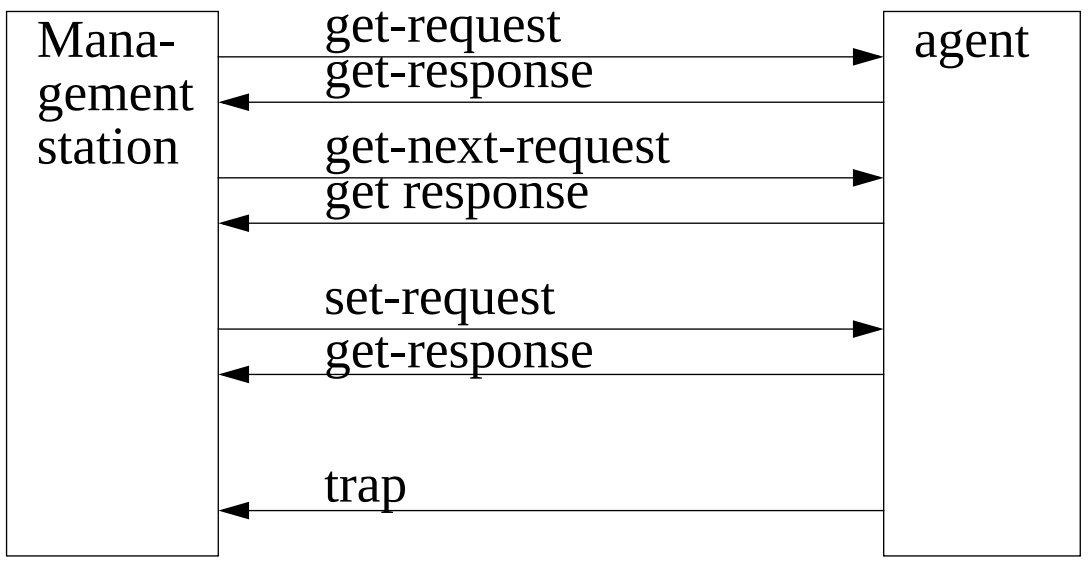
Example: MIB-II

- The Internet MIB-II database (RFC-1213) defines a MIB which contains most information needed to manage an Internet network element
- iso.org.dod.internet.mgmt.mib or 1.3.6.1.2.1 is the name of the MIB
  - For example iso.org.dod.internet.mgmt.mib-2.udp.udpInDatagrams is a counter of the number of datagrams the network interface has delivered to the user programs in that network element.
  - iso.org.dod.internet.mgmt.mib-2.system.sysName is a string for domain name for the network element, while the IP address for the host is held in the iso.org.dod.internet.mgmt.mib-2.ip.ipAddrTable table (one host may have many addresses).
- The MIB-II database has also variables for IP, TCP, ICMP etc. statistics.

SNMP

- UDP-based protocol, defined in RFC-1098
- Five message types
  - `get-request` – fetching the value of some variables
  - `get-next-request` – fetch the next value (often useful)
  - `set-request` – set the value of some variables
  - `get-response` – return message from queries above
  - `trap` – notify the manager

. . . SNMP



SNMPv1 Message Format

version	community	PDU type (0-3)	request ID	error status (0--5)	error index	name	value	name	value	...

PDU type (4)	enterprise	agent addr	trap type (0--6)	specific code	time stamp	name	value	...

- Message is encapsulated in a UDP/IP datagram
- Community is a character string (a cleartext password between the manager and agent)
- PDU and ID fields identify the message

Traps

- A SNMP agent can send traps to the SNMP manager.
- Trap is sent when something happened in the agent that the manager may want to know about.
- Six pre-defined traps, plus one vendor specific
  - ColdStart
  - WarmStart
  - linkDown
  - linkUp
  - authenticationFailure
  - egpNeighborLoss
  - enterpriseSpecific

Network Management in action

- Network manager software is configured with the network layout and the MIBs of different network elements.
- Network manager regularily queries the network elements and displays the information to human supervisor.
- When the management software finds something wrong, for example a router does not reply to queries for a while, the software alerts the human supervisor.
- Network manager may set variables in a network element, eg. the address of a DNS server.
- A network element may send a trap, for example a printer may signal that it is out of paper.

SNMPv2

- Extended version of the original SNMP
- Specification in 1993
- Implements two new packet types and two new MIBs
- Security enhancements. Can provide authentication and privacy between managers and agents. Original SNMP has no security provisions.
- The future of SNMPv2 doesn't look good, SNMPv3 is under work

CMIP

- Complex Management Information Protocol
- The OSI protocol comparable to SNMP
- Addresses many of the shortcomings of SNMP, is also more complicated and requires more resources.
- In many cases agents might be too heavy for practical use as compared to SNMP.
- Currently should be considered only if network management is of serious importance.

Java and WWW

- Network entities can include a WWW-server and Java applets for management instead of simpler protocol interfaces.
- SNMP managers written in Java are available.
- The Java language was originally written for embedded systems, SNMP agents written in Java are a possibility.