Introduction to SNMP

Network Management Workshop

Kuala Lumpur
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Overview

- What is SNMP ?
- OIDs
- MIBs
- Polling and querying
- Traps

What is SNMP ?

- SNMP – Simple Network Management Protocol
  - Industry standard, hundreds of tools exist to exploit it
  - Present on any decent network equipment
- Query – response based
  - GET / SET
    - Mostly GET is used for monitoring
- Tree hierarchy
  - Query for ”Object Identifiers” (OIDs)
- Concept of MIBs (Management Information Base)
  - Standard and vendor-specific (Enterprise)

What is SNMP ?

- UDP protocol, port 161
- Different versions
  - Originally, 1988
  - v1 – RFC1155, RFC1156, RFC1157
    - Original specification
  - v2 – RFC1901 ... RFC1908 + RFC2578
    - Extends v1, new data types, better retrieval methods (GETBULK)
    - Really is version v2c (without security model)
  - v3 – RFC3411 ... RFC3418
- Typically we use SNMPv2
- Terminology:
  - Manager (the monitoring ”client”)
  - Agent (running on the equipment/server)

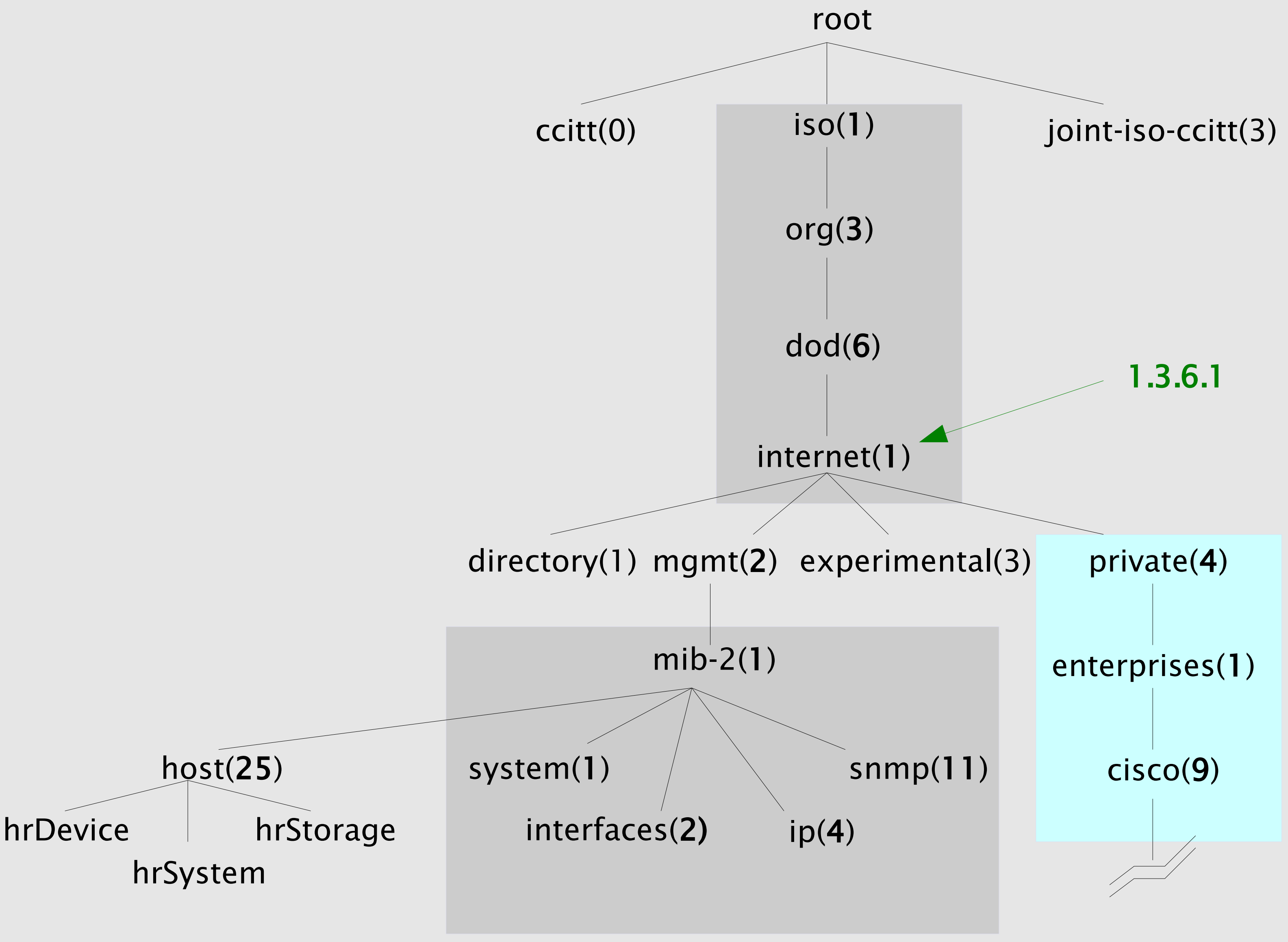
What is SNMP ?

- Typical queries
  - Bytes In/Out on an interface, errors
  - CPU load
  - Uptime
  - Temperature
  - ...
- For hosts (servers or workstations)
  - Diskspace
  - Installed software
  - Running processes
  - ...
- Windows and UNIX have SNMP

How does it work ?

- Basic commands
  - GET (manager -> agent)
    - Query for a value
  - GET-NEXT (manager -> agent)
    - Get next value (list of values for a table)
  - GET-RESPONSE (agent -> manager)
    - Response to GET/SET, or error
  - SET (manager -> agent)
    - Set a value, or perform action
  - TRAP (agent -> manager)
    - Spontaneous notification from equipment (line down, temperature above threshold, ...)

The MIB tree



root

ccitt(0)

iso(1)

joint-iso-ccitt(3)

org(3)

dod(6)

1.3.6.1

internet(1)

directory(1)

mgmt(2)

experimental(3)

private(4)

mib-2(1)

enterprises(1)

host(25)

system(1)

snmp(11)

cisco(9)

hrDevice

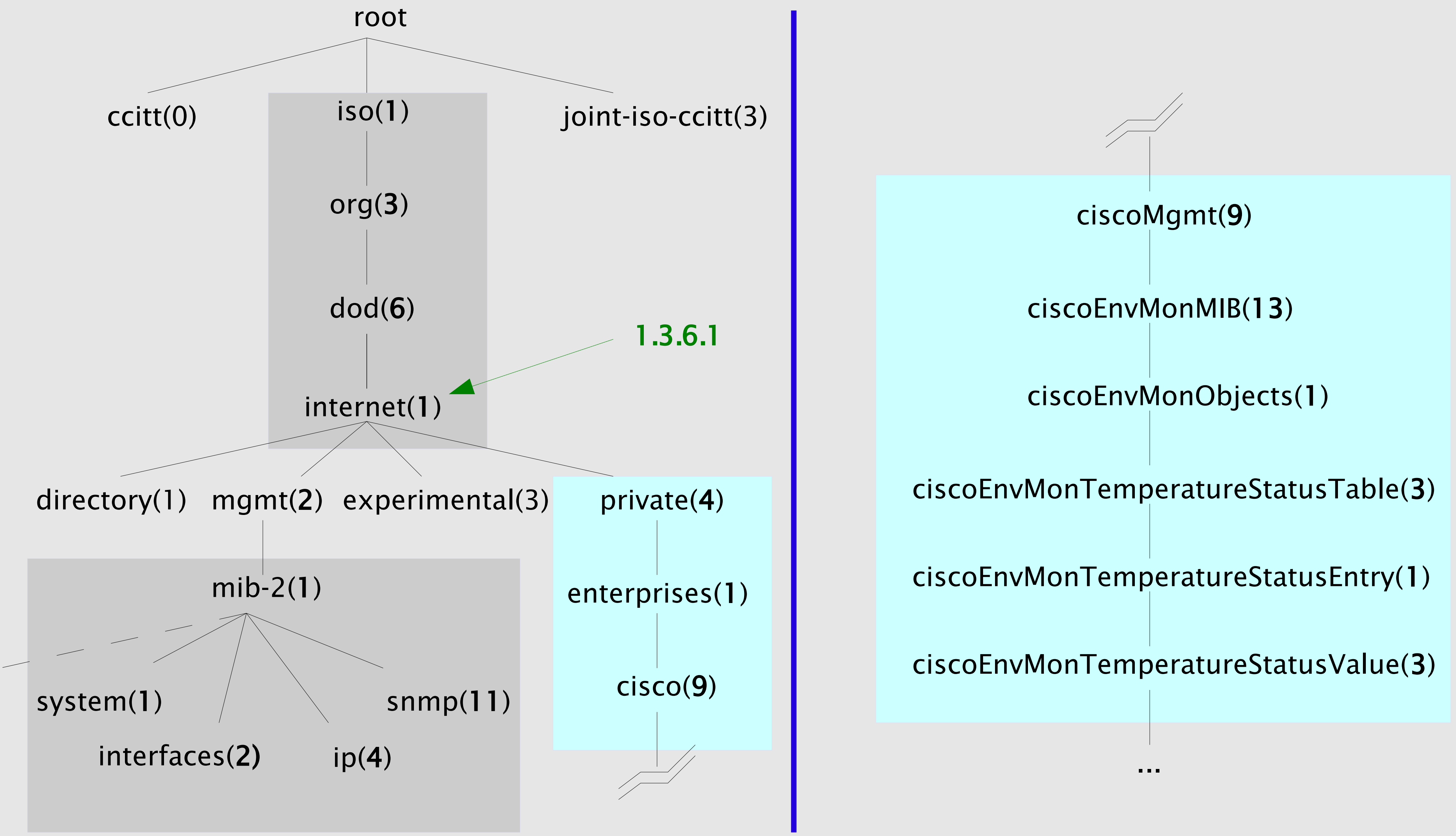
hrStorage

hrSystem

interfaces(2)

ip(4)

The MIB tree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mib-2(1)
enterprises(1)
system(1)
snmp(11)
cisco(9)
interfaces(2)
ip(4)
ciscoMgmt(9)
ciscoEnvMonMIB(13)
ciscoEnvMonObjects(1)
ciscoEnvMonTemperatureStatusTable(3)
ciscoEnvMonTemperatureStatusEntry(1)
ciscoEnvMonTemperatureStatusValue(3)
...

The Internet MIB

directory(1)	OSI directory
mgmt(2)	RFC standard objects
experimental(3)	Internet experiments
private(4)	Vendor-specific
security(5)	Security
snmpV2(6)	SNMP internal

OIDs and MIBs

- Navigate tree downwards
- OIDs separated by '.'
  - 1.3.6.1.4.1.9. ...
- OID corresponds to a label
  - .1.3.6.1.2.1.1.5 => sysName
- The complete path:
  - .iso.org.dod.internet.mgmt.mib-2.system.sysName
- How do we convert from OIDs to Labels (and vice versa ?)
  - Use of MIBs files!

MIBs

- MIBs are files defining the objects that can be queried, including:
  - Object name
  - Object description
  - Data type (integer, text, list)
- MIBS are structured text, using ASN.1
- Standard MIBs include:
  - MIB-II – (RFC1213) – a group of sub-MIBs
  - HOST-RESOURCES-MIB (RFC2790)

MIBs - 2

- MIBs also make it possible to interpret a returned value from an agent
  - For example, the status for a fan could be 1,2,3,4,5,6 – what does it mean ?

MIBs - SAMPLE

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

`sysUpTime OBJECT-TYPE`

This defines the object called `sysUpTime`.

`SYNTAX TimeTicks`

This object is of the type `TimeTicks`. Object types are specified in the SMI we mentioned a moment ago.

`ACCESS read-only`

This object can only be read via SNMP (i.e., `get-request`); it cannot be changed (i.e., `set-request`).

`STATUS mandatory`

`This object must be implemented in any SNMP agent.`

`DESCRIPTION`

`A description of the object`

`::= { system 3 }`

The `sysUpTime` object is the third branch off of the system object group tree.

MIBs - SAMPLE

```
CiscoEnvMonState ::= TEXTUAL-CONVENTION
        STATUS  current
        DESCRIPTION
                "Represents the state of a device being monitored.
                 Valid values are:

                 normal(1):         the environment is good, such as low
                                    temperature.

                 warning(2):        the environment is bad, such as temperature
                                    above normal operation range but not too
                                    high.

                 critical(3):       the environment is very bad, such as
                                    temperature much higher than normal
                                    operation limit.

                 shutdown(4):       the environment is the worst, the system
                                    should be shutdown immediately.

                 notPresent(5):     the environmental monitor is not present,
                                    such as temperature sensors do not exist.

                 notFunctioning(6): the environmental monitor does not
                                    function properly, such as a temperature
                                    sensor generates a abnormal data like
                                    1000 C.
                 ”
```

Querying SNMP agent

- Some typical commands for querying:
  - snmpget
  - snmpwalk
  - snmpstatus

- Syntax:

```
snmpXXX -c community -v1 host [oid]
snmpXXX -c community -v2c host [oid]
```

- Let's take an example
  - `snmpstatus -c pacn0g2k9 -v1 192.168.1.221`
  - `snmpget -c pacn0g2k9 -v1 192.168.1.223 .iso.org.dod.internet.mgmt.mib-2.interfaces.ifNumber.0`
  - `snmpwalk -c pacn0g2k9 -v1 192.168.1.222 ifDescr`

Querying SNMP agent

- Community:
  - A ”security” string (password) to define whether the querying manager will have RO (read only) or RW (read write) access
  - This is the simplest form of authentication in SNMP
- OID
  - A value, for example, .1.3.6.1.2.1.1.5.0, or it's name equivalent
  - .iso.org.dod.internet.mgmt.mib-2.system.sysName.0
- Let's ask for the system's name (using the OID above)
  - Why the .0 ? What do you notice ?

Coming up...

- Using snmpwalk, snmpget
- Configuring SNMPD
- Loading MIBs

References

- Basic SNMP at Cisco
  http://www.cisco.com/warp/public/535/3.html
  http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/snmp.htm
- Wikipedia:
  http://en.wikipedia.org/wiki/Simple_Network_Management_Protocol
- IP Monitor MIB Browser
  http://support.ipmonitor.com/mibs_byoidtree.aspx
  Cisco MIB browser:
  http://tools.cisco.com/Support/SNMP/do/BrowseOID.do
- Open Source Java MIB Browser
  http://www.kill-9.org/mbrowse
  http://www.dwipal.com/mibbrowser.htm (Java)
- SNMP Link – collection of SNMP resources
  http://www.snmplink.org/
- Net-SNMP Open Source SNMP tools
  http://net-snmp.sourceforge.net/