Simple Network Management Protocol (SNMP)

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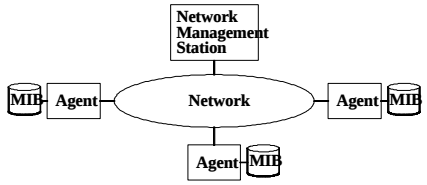
- Network Management
- SNMP
- Management information base (MIB)
- ASN.1 Notation
- RMON
- SNMP2
- Ref: Chap 25, Stallings: "SNMP, SNMPv2 and RMON", Addison Wesley

Network Management

- Management = Init, Monitoring, Control
  - Today: automated, reliable diagnosis, and automatic control are still in a primitive stage
- Architecture: Manager, Agents, and Management Information Base (MIB)



SNMP history

- Early: based upon ICMP messages (eg: ping, source routing, record routing)
- A lot of informal network debugging is done using tcpdump, netstat, ifconfig etc
- When the internet grew, Simple Gateway Management Protocol (SGMP) was developed (1987)
- Build single protocol to manage OSI and IP
  - CMIP (an OSI protocol) over TCP/IP {called CMOT}
  - Goal: Keep object level same for both OSI and IP
  - CMOT progressed very sluggishly
  - SNMP: parallel effort. Very simple => grabbed the market.

SNMP

- Based on SGMP
- Simple: only five commands

Command	Meaning
get-request	Fetch a value
get-next-request	Fetch the next value
get-response	Reply to a fetch operation
set-request	Set (store) a value
trap	Agent notifies manager

- Simple: handles only scalars. “get-next-request” used successively to get array values etc

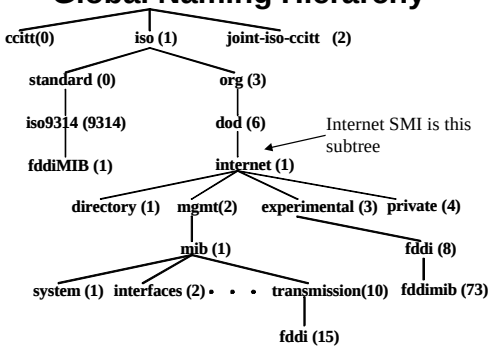
SNMP contd

- Simple: one management station can handle hundreds of agents
- Simple: Works as an application protocol running over UDP
- Agent and manager apps work on top of SNMP
- Proxy-SNMP can be used to manage a variety of devices (serial lines, bridges, modems etc).
  - Proxy (similar to bridge) is needed because these devices may not run UDP/IP
  - For each new device define a new MIB.

Management Information Base (MIB)

- Specifies what variables the agents maintain
- Only a limited number of data types are used to define these variables
- MIBs follow a fixed naming and structuring convention called "Structure of Management Information" (SMI). See next slide.
- Variables are identified by "object identifiers"
  - Hierarchical naming scheme (a long string of numbers like 1.3.6.1.2.1.4.3 which is assigned by a standards authority)
  - Eg: iso.org.dod.internet.mgmt.mib.ip.ipInReceives 1.3.6.1.2.1.4.3

Global Naming Hierarchy



MIB (contd)

- All names are specified using a subset of Abstract Syntax Notation (ASN.1)
- *Types*: INTEGER, OCTET STRING, OBJECT IDENTIFIER, NULL
- *Constructors*: SEQUENCE (like struct in C), SEQUENCE OF (table i.e. vector of structs), CHOICE (one of many choices)
- ASN.1 provides more types and constructors, but they are not used to define MIBs.

Standard MIBs

- **New device => write MIB for it and include it as a branch of MIB-II**
- **MIB-II (RFC 1213) a superset of MIB-I (RFC 1156)**
- **Contains only essential objects**
- **Only "weak" objects. Tampering => limited damage**
- **No limit on number of objects (unlike MIB-I)**
- **Avoid redundant objects, and implementation-specific objects.**

Variable	Category	Meaning
sysUpTime	system	Time since last reboot
ifNumber	interfaces	# of Interfaces
ifMTU	interfaces	MTU
ipDefaultTTL	ip	Default TTL
ipInReceives	ip	# of datagrams received
ipForwDatagrams	ip	# of datagrams forwarded
icmpInEchos	icmp	# of Echo requests received
tcpRtoMin	tcp	Min retrans time
tcpMaxConn	tcp	Max connections allowed

Instance Identification

- **How does the manager refer to a variable ?**
  - *Simple variables*: **append ".0" to variable's object identifier**
    - **Eg: udpInDatagrams.0 = 1.3.6.1.2.1.7.1.0**
    - **Only leaf nodes can be referred (since SNMP can only transfer scalars)**
  - *Table elements*:
    - **Each element in a table needs to be fetched separately.**
    - **Traverse MIB based upon lexicographic ordering of object identifiers using get-next**
    - **Column-by-column: Elements of each column first.**

SNMPv2

- Improved security: authentication and integrity using Data Encryption Standard (DES)
- More structure in the SMI to handle arbitrary resources, not just networks
- *inform request* ⇒ Multiple manager coordination
- *get bulk* ⇒ Better table handling
- Confirmation option for Traps
- Reference: RFC 1441

RMON

- Remote Network Monitoring
- Defines remote monitoring MIB that supplements MIB-II and is a step towards internetwork management
- It extends SNMP functionality though it is simply a specification of a MIB
- Problem w/ MIB-II
  - Can obtain info that is purely local to individual devices
  - Cannot easily learn about LAN traffic as a whole (eg like LANanalyzers or "remote monitors")

RMON (contd)

- Functionality added: Promiscously count, filter and store packets
- System that implements RMON MIB is called an RMON probe (or less frequently, an RMON agent).
  - No changes to SNMP protocol.
  - Enhance the manager and agents only.
- RMON MIB organization:
  - Control table: read-write. Configures what parameters should be logged and how often.
  - Data table: read-only (statistics etc logged)
- Other issues: shared probes, ownership of tables, concurrent table access...

Summary

- Management = Initialization, Monitoring, and Control
- SNMP = Only 5 commands
- Standard MIBs defined for each object
- Uses ASN.1 encoding
- RMON extends SNMP functionality through definition of a new MIB