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Network Management

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Things a network manager needs to be able to do

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- Remotely:
  - Detect problems in network devices (NICs, routers, links…)
  - Monitor traffic for resource allocation
  - Monitoring performance vs. Service Level Agreements (SLAs)
  - Detect intrusions

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ISO's areas of network management

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- Performance management
- Fault management
- Configuration management
- Accounting management
- Security management

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Performance management

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- Objective: monitor and control performance of network devices and channels – Ensure that the network provides acceptable performance for the long-term
  - Utilization
  - Throughput
  - Congestion
  - …

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Fault management

- Objective: detect and respond to faults in the network
  - Detection / Isolation / Resolution
  - Router hardware failures
  - Router software errors
  - Link failures
  - Host failures (?)

Configuration management

- Objective: Allow the manager to track the devices in the network and their configurations
  - Hardware
  - Software

Accounting management

- Objective: Allows manager to control and track usage of network resources
  - Usage quotas
  - Charging
  - Privileges

Security management

- Objective: Control access to network resources
  - Security policy
  - Key distribution
  - Certification authorities
  - Firewalls
  - …

Components of a network management infrastructure

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- Managing entity – central control point
- Managed device – network hw/sw
  - Managed objects – individually-managed parts of a device
  - Management Information Base (MIB) – managed data (in a common db format)
  - Management agent – local management process
- Management protocol – defines the interaction between Managing Entity and Managed Devices

Simple Network Management Protocol (SNMP)

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- Most widely used network management protocol (Internet)
- RFC 2570
- First released in early ’90s

Elements of the SNMP operational model

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- Data definition language (SMI)
- Definitions of management information (MIB)
- Protocol definition (SNMP)
- Security and admin capabilities

SNMP operation

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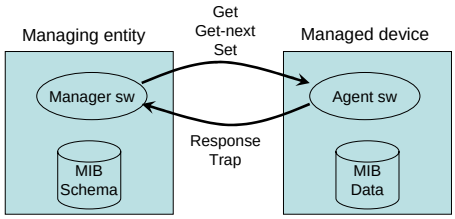


Get – retrieve a value from a specified variable
Get-Next -- retrieve the next value
Set -- set a variable to a specified value
Trap -- Alert from Agent

SNMP transport

- SNMP messages normally carried by UDP
- SNMP does not specify a re-transmission policy (although there is no prohibition on building one in)

Data definition language

- "Structure of Management Information" (SMI)
- Defines the management information residing in a managed entity

SMI data types

- Integer32 (32 bit integer)
- Unsigned32 (unsigned 23-bit integer)
- Octet String (byte string up to 64KB long)
- Object Identifier (structured name)
- IPaddress
- Counter32, Counter64 (wrapping counters)
- Guage32 (non-wrapping counter)
- TimeTicks (1/100ths of a sec since some event)

The SMI OBJECT-TYPE construct

- OBJECT-TYPE
  - Objects that contain the management data
  - Specifies data type, status and semantics of a managed object
  - Different OBJECT-TYPEs are standard, defined in RFCs
- Clauses of OBJECT-TYPE
  - SYNTAX – basic data type of the object
  - MAX-ACCESS – permissions
  - STATUS – validity of object definition
  - DESCRIPTION – plaintext describing the object

An example OBJECT-TYPE


```
ipInDelivers OBJECT-TYPE
    SYNTAX          Counter32
    MAX-ACCESS      read-only
    STATUS          current
    DESCRIPTION     "The total number of input
                    datagrams successfully delivered to
                    IP user protocols (including ICMP)"
    ::= {ip 9}
```

(from RFC 2011)

The SMI MODULE-IDENTITY construct

- Groups related objects together (e.g, all of the IP-related objects are in the "ipMIB" module – RFC 2011)
- Some module types:
  - IP (RFC 2011)
  - TCP (RFC 2012)
  - UDP (RFC 2013)

Management Information Base (MIB)

- A virtual database that holds the managed modules/objects at a managed device (collectively, for the entire network)

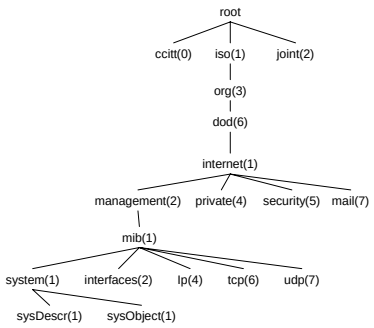
IDs for modules and objects

- Every module/object is assigned a hierarchical number
- Numbering defined by ISO Abstract Syntax Notation – One (ASN.1)

ASN.1

- An ISO framework intended to give a unique identifier to every object type in a network

ASN.1 hierarchy



sysDescr ID = 1.3.6.1.2.1.1.1

Example MIB objects

- 1.3.6.1.2.1.1.3 (sysUpTime) -- system up time in 1/100th of a sec
- 1.3.6.1.2.1.1.6 (sysLocation) – physical location of this node
- 1.3.6.1.2.1.7.4 (udpInErrors) – number of received UDP datagrams that could not be delivered

Web-based management

- The idea: HTTP carries the management information, user interfaces through a web browser
- Not (yet) a replacement for the entire SNMP operational model
  - SNMP = instrumentation and control
  - HTTP+browser = universally-available transport and display mechanism
- Advantages:
  - Accessibility from any point
  - Needs less proprietary SW
  - Platform independence
  - Easier deployment, maintenance, training…
- Examples:
  - Internet Traffic Report (www.internettrafficreport.com)
  - DNS response time (www.caida.org/cgi-bin/dns_perf/main.pl)
  - Quest IP Statistics (http://stat.qwest.net/index_flash.html)