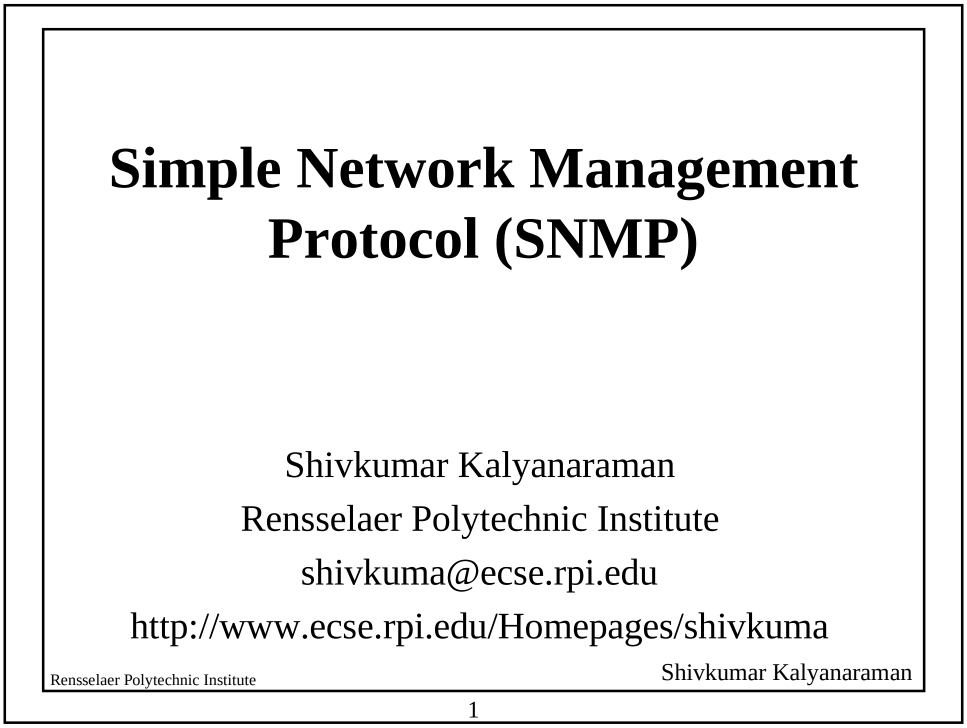
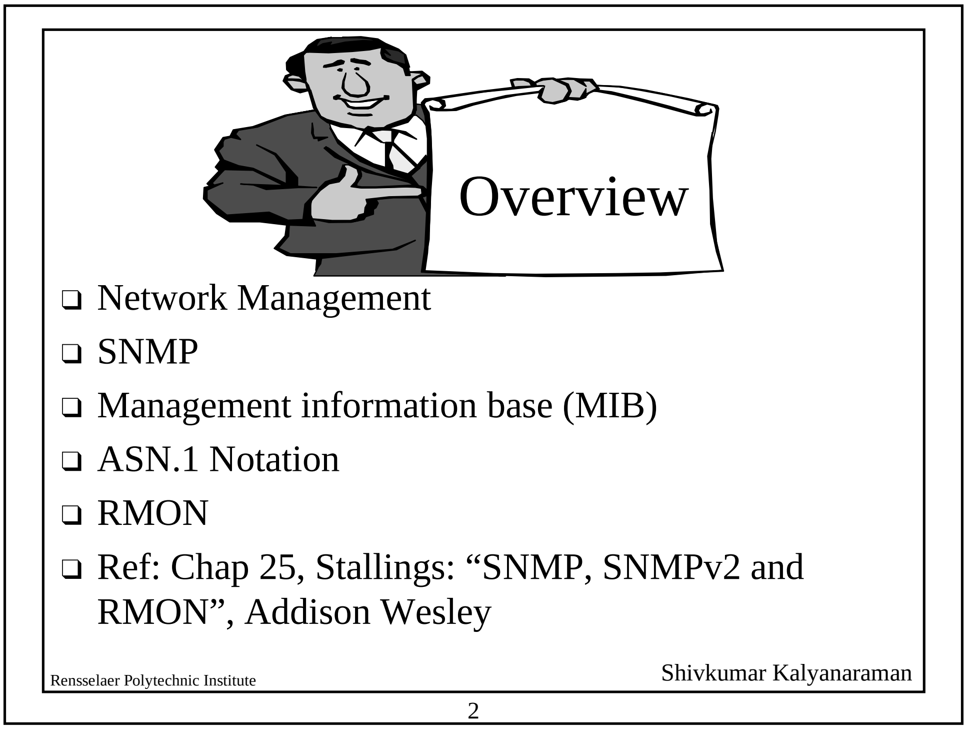


Simple Network Management Protocol (SNMP)

Shivkumar Kalyanaraman
Rensselaer Polytechnic Institute
shivkuma@ecse.rpi.edu
http://www.ecse.rpi.edu/Homepages/shivkuma

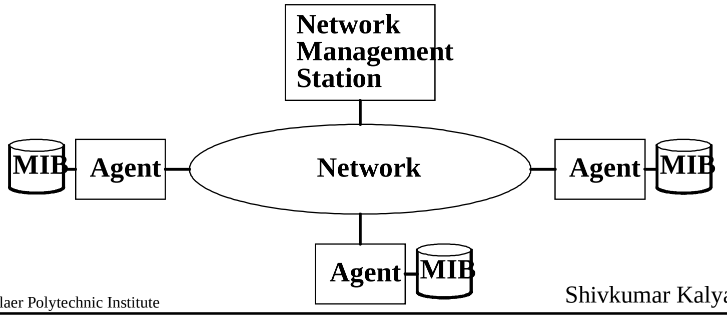


Overview

- ❑ Network Management
- ❑ SNMP
- ❑ Management information base (MIB)
- ❑ ASN.1 Notation
- ❑ RMON
- ❑ 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

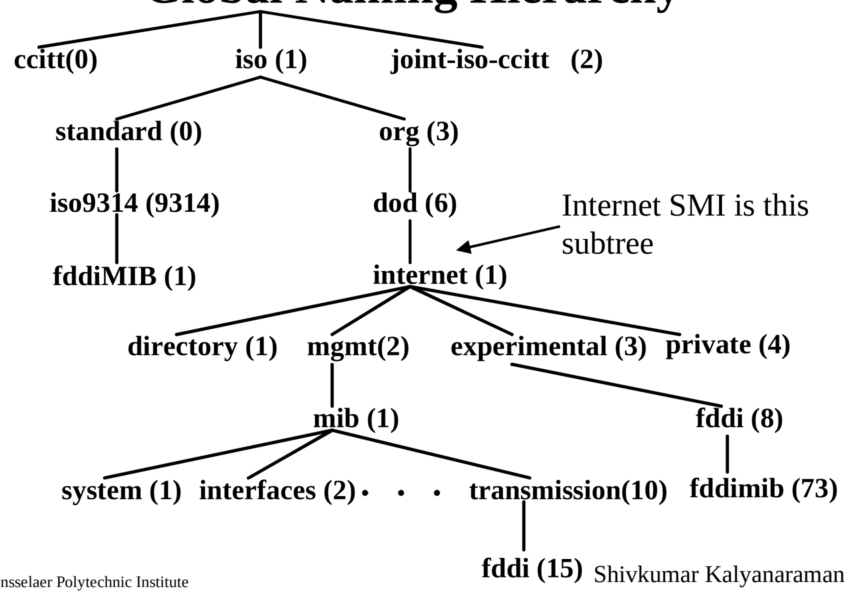
SNMP contd

- ❑ 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



ccitt(0)
iso (1)
joint-iso-ccitt (2)
standard (0)
org (3)
iso9314 (9314)
dod (6)
fddiMIB (1)
internet (1)
directory (1)
mgmt(2)
experimental (3)
private (4)
mib (1)
fddi (8)
system (1)
interfaces (2) • • •
transmission(10)
fddimib (73)
fddi (15)

Internet SMI is this subtree

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

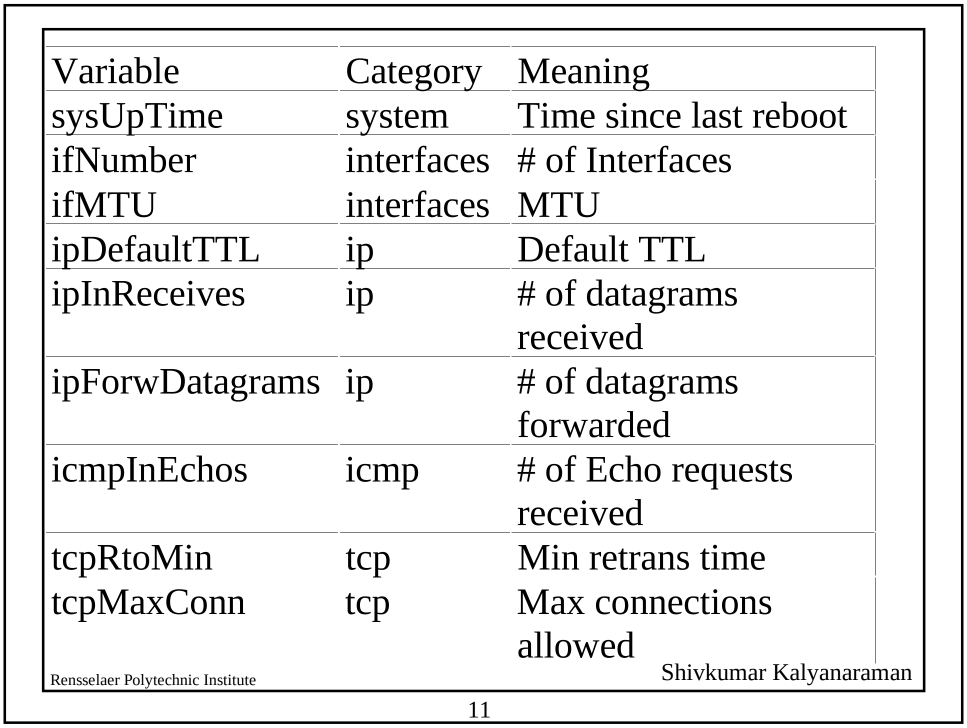
❑ MIB-II (RFC 1213) a superset of MIB-I (RFC 1156)

❑ Contains only essential objects

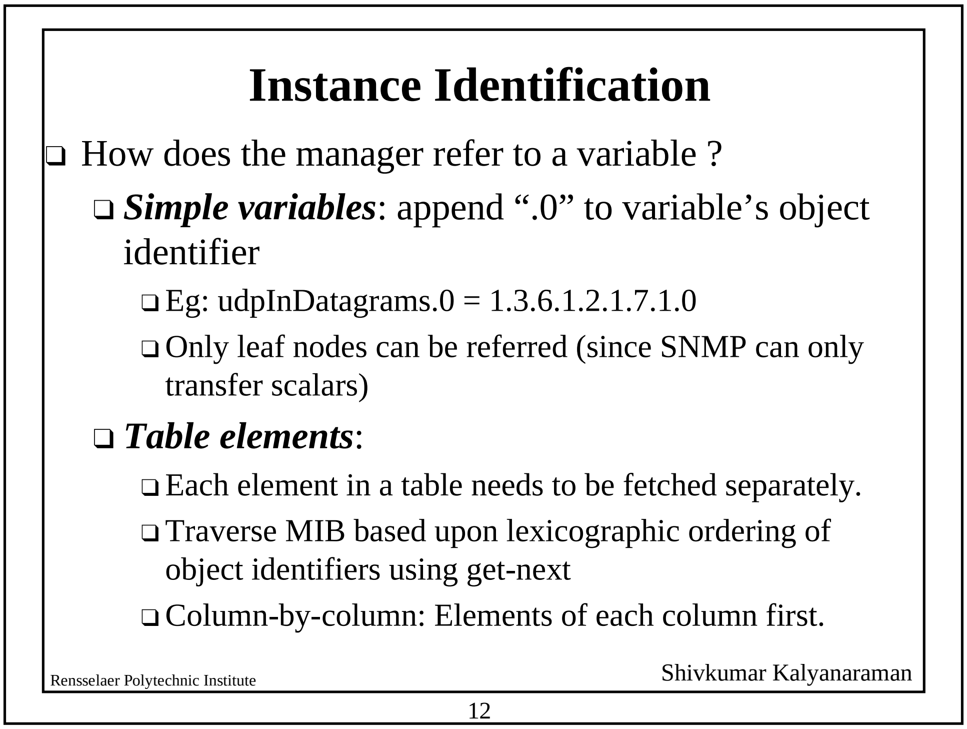
❑ Only “weak” objects. Tampering => limited damage

❑ 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.

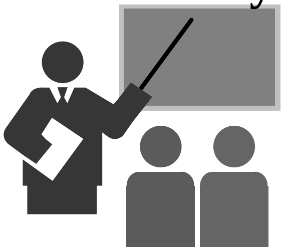
RMON

- ❑ 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