Network Management Basics

MSI

Special Thanks to Rab Nawaz

Institute of Information Technology

Welcome in the Course of

Telecom Network Management

Network management

- Network consists of many heterogeneous, multi-vendor resources:
  - Routers, bridges, hosts, terminal servers, modems, links, interfaces etc.
- Main Goal of Network Management
  - Identification and correction of hardware/software failure or malfunction.
  - Performance monitoring and tuning.

Intro

- Telecommunication management is a fundamental factor in successfully operating networks and services.
  - It provides various functions such as
    - operation & maintenance (O&M),
    - administration,
    - performance,
    - provisioning,
    - accounting and security.
  - Without it, neither a user can enjoy the benefits of any services nor can the business keep running smoothly.

Fundamentals

- In the late 1980s, the International Telecommunications Union (ITU) and the International Organization for Standardization (OSI) jointly published a set of network and system management standards under the X.700 series,
  - [X701, 1989] [X710, 1991] [X711, 1991] [X720, 1992].
    - This has since been known as the OSI Reference Model.
      - The Telecommunication Management Network (TMN) [M3010, 1996] is a framework established based on the OSI Reference Model, and has become a prominent reference framework for network and system management.

Network Management System

- NMS is an application.
  - A network management system (NMS) is a set of hardware and/or software tools that allow an IT professional to supervise the individual components of a network within a larger network management framework.
    - Its aim is to analyze, control and manage network and service infrastructure in order to ensure its
      - configuration correctness,
      - robustness,
      - performance quality and
      - security.

Main functions of NMS

- Network device discovery
  - identifying what devices are present on a network.
- Network device monitoring
  - monitoring at the device level to determine the
    - health of network components and
    - the extent to which their performance matches capacity plans and intra-enterprise service-level agreements (SLAs).
- Network performance analysis
  - tracking performance indicators such as,
    - bandwidth utilization, packet loss, latency, availability and uptime of routers, switches and other Simple Network Management Protocol (SNMP) -enabled devices.

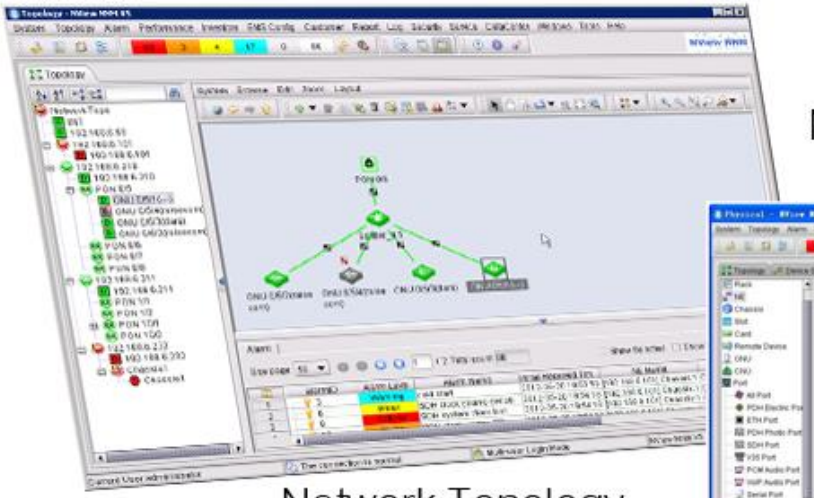
Cont…

- Intelligent notifications
  - configurable alerts that will respond to specific network scenarios by paging, emailing, calling or texting a network administrator.
- For Example,
  - OpenNMS
    - Itis the first enterprise-grade network management platform developed under the open source model.
    - It was designed to manage tens of thousands of devices from a single server as well as manage unlimited devices using a cluster of servers.

Cont…

- OpenNMS includes a discovery engine to automatically configure and manage network devices without operator intervention.
- It is written in Java and is published under the GNU General Public License.
- OpenNMS is listed as one of the top 400 projects on Sourceforge and won the Best Systems Management Tool at Linux World Expo in August of 2005.

NMS Snapshot



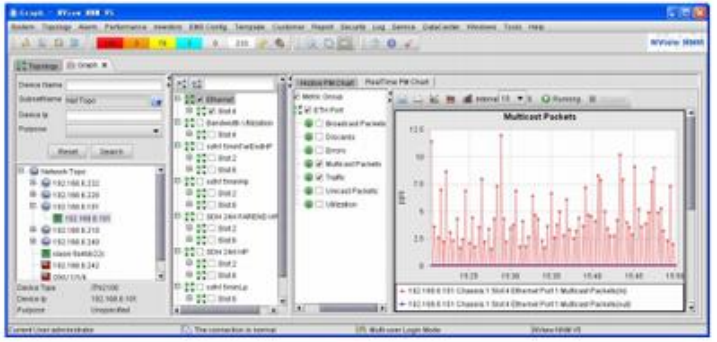
Network Topology

NMS

Network Management System

Inventory Management

Alarm Management

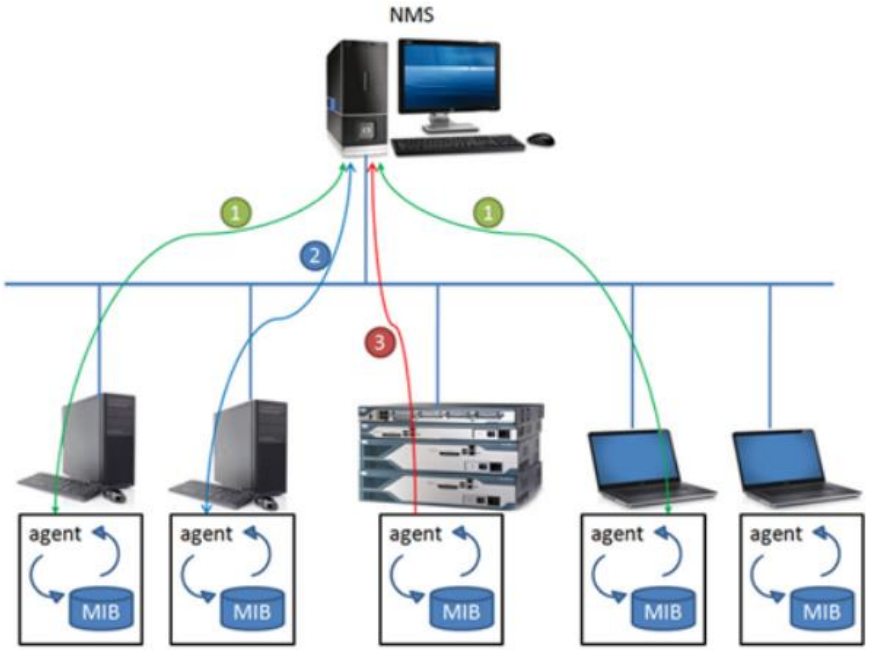


Performance Management

NMS Entities

- OSI reference Model defines two types of entities in this system,
  - Managing Entity
    - has "big picture" view of network
  - Managed / Agent Entity
    - Representatives of the network resources or
    - End systems under management
    - These provides mgt. info to the network managers and the
    - Managers monitors the agents and make management and control decisions accordingly.
      - In such a model, the management intelligence is solely placed on the network managers.
      - This is the principle model of computation at the time.

Normal working of NMS



1. **The NMS may want to know some information about the node (for example, the status of its network interfaces or what amount of traffic was produced by that node). In order to do this, the NMS sends a request message and will get a response (this is labeled with a green "1" on the figure).**
2. **Sometimes the NMS wants to change some settings on the managed device, therefore it sends a "set request" and will get a response about it also. This communication is labeled with a blue "2."**
3. **Sometimes an unwanted event (most likely an error) can occur; than the node itself sends a message about it. That's called a trap and is labeled with a red "3."**

The communication takes place with SNMP messages such as GetRequest/GetResponse, SetRequest, or Trap.

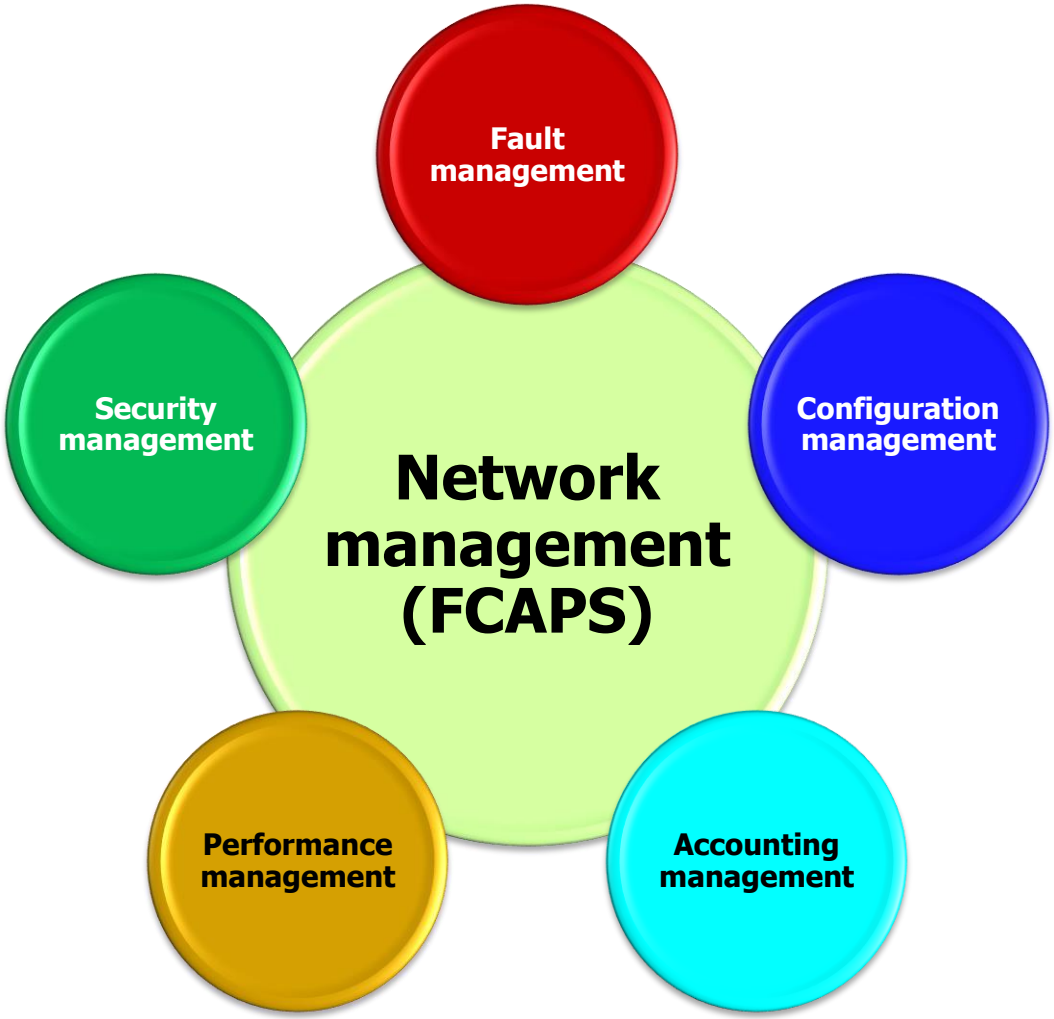
What is Network Management?

- Traffic on Network = Data + Control + Management
  - Data:
    - Bytes/Messages sent by users
  - Control:
    - Bytes/Messages added by the system to properly transfer the data(e.g routing messages)
  - Management:
    - Optional Messages to ensure that the network functions properly and to handle the issues arising from malfunctioning of any component.

Cont…

- If all component function properly, control is still required but management is optional.
- Examples:
  - Detecting failures of an interface card at a host or a router
  - Monitoring traffic to aid in resource deployment
  - Intrusion Detection

Components of Network Management

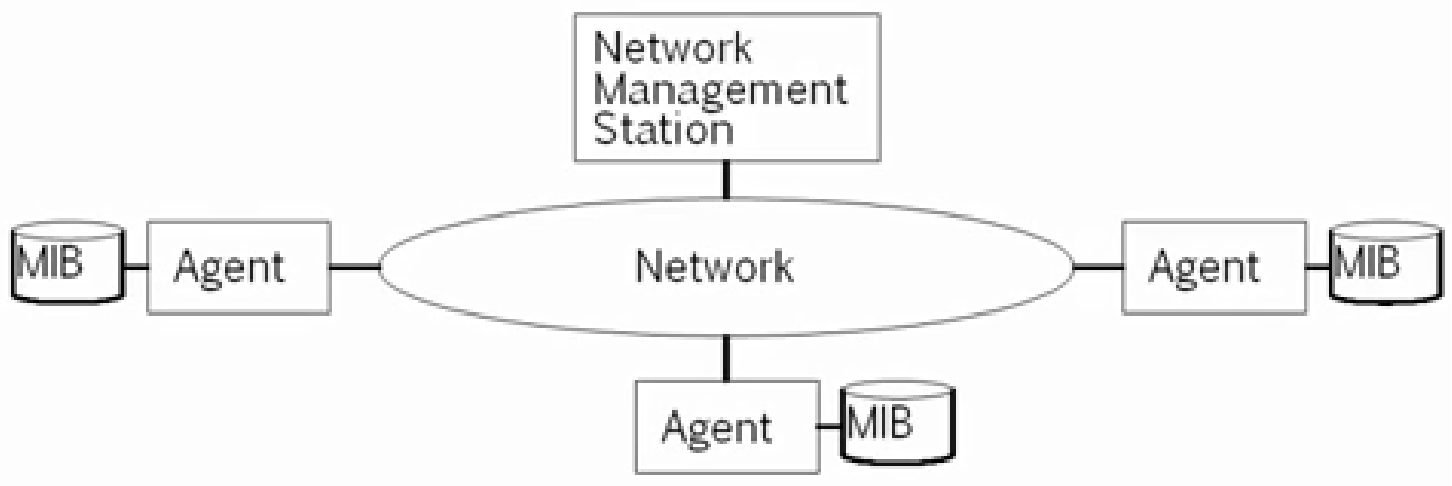


Components of Network Management

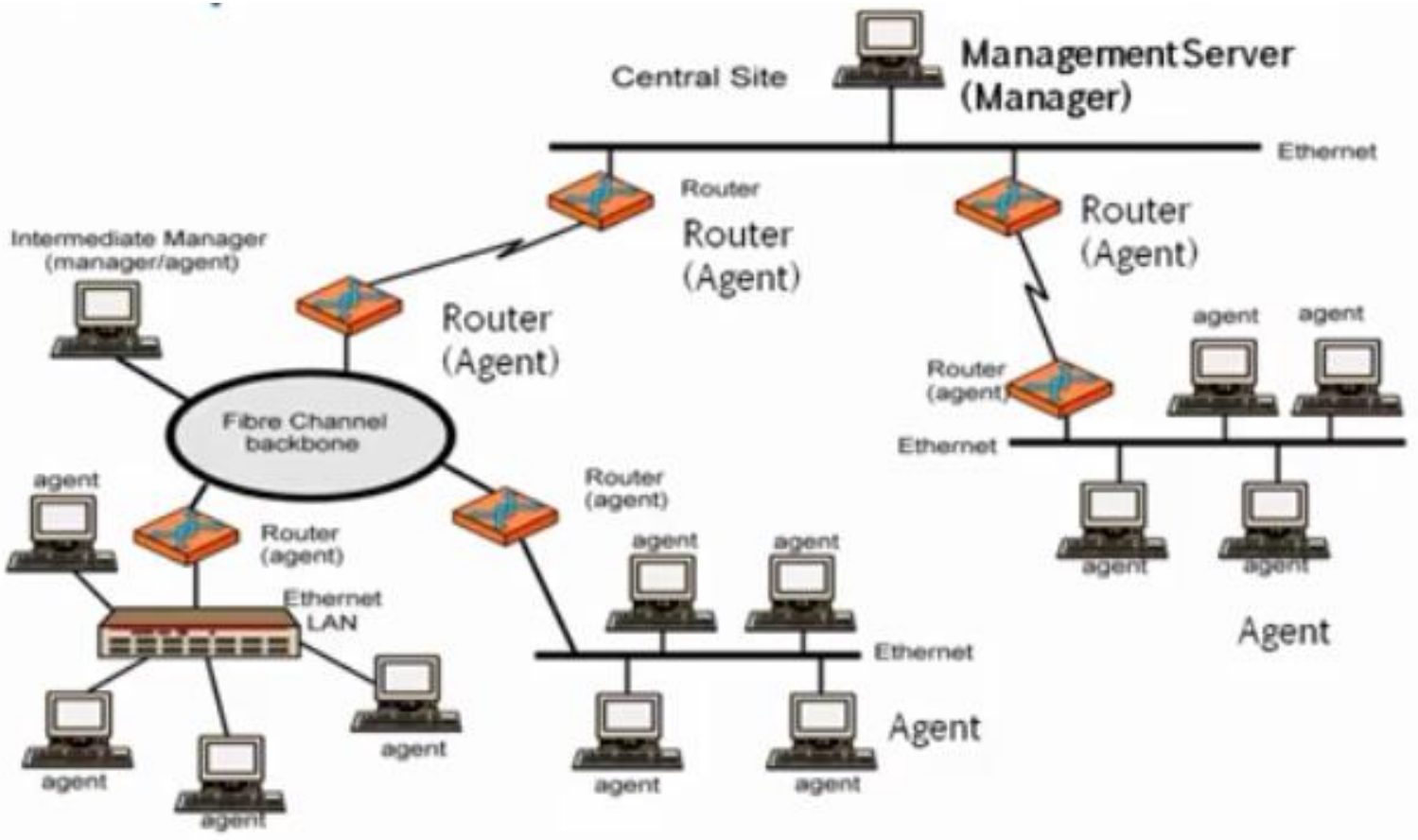
Performance Management	• Measure, report, analyze, and control traffic messages
Fault Management	• Detect, log, and respond to fault conditions
Configuration management	• Track and control which devices are on or off
Accounting management	• Monitor resource usage for records and billing
Security management	• Enforce policy for access control, authentication, and authorization.

How is network managed?

- Management = Initialization, Monitoring, Control
- Manager, Agents and Management information Base (MIB)



Example


Central Site
Management Server
(Manager)
Ethernet
Router
Router
(Agent)
Router
(Agent)
Intermediate Manager
(manager/agent)
Router
(Agent)
Fibre Channel
backbone
agent
agent
Router
(agent)
Router
(agent)
Ethernet
agent
agent
Router
(agent)
Ethernet
agent
agent
agent
agent
Agent
Ethernet
LAN
agent
agent
agent
agent
agent
Agent

Internet Management Framework

- Structure of Management Information (SMI)
  - Data definition language for objects
  - ASN.1 was defined by ISO and is used in SNMP
- Management Information Base
  - Distributed network management data
- SNMP Protocol
  - Manager → Managed object communication
- Security, administration capabilities
  - Major addition in SNMP v3

ASN.1

- Stands for Abstract Syntax Notation One
- Joint ISO and ITU-T standard, Original 1984, latest 2002.
- Used to specify protocol data structures
  - X.400 electronic mail, X.500 and LDAP directory services, H.323 VOIP, SNMP, etc use ASN.1
- Pre-Defined
  - 1=Boolean, 2=Integer, 3=Bit String, 4=Octet String, 5=NULL, 6=Object Identifier, 9=Real
- Constructed
  - SEQUENCE (structure), SEQUENCE OF(lists), CHOICE, ….

ASN.1 Example

- Home address
  - Address type:: = SEQUENCE{
  - Name OCTET STRING,
  - Number INTEGER
  - Street OCTET STRING,
  - City OCTET STRING,
  - State OCTET STRING,
  - ZipCode INTEGER,
  - }

Encoding Rules

- ASN.1 only specifies the structure.
- Encoding rules indicate how to encode the structure into bits on the wire.
- Examples
  - Basic Encoding Rules (BER)
    - were the original **rules** for taking an ASN.1 data type, and turning it into a sequence of bits and bytes.
  - Packet Encoding Rules (PER)
    - Instead of using a generic style of encoding that encodes all types in a uniform way, the PER specialize the encoding based on the data type to generate much more compact representations.

Cont…

- XML Encoding Rules (XER),
  - the element tags are derived from the ASN.1 type names and identifiers present in an ASN.1 specification.
- Distinguished Encoding Rules (DER)
  - These are used for both encoding and decoding purpose.
  - These defines constraints on BER.

Management Information Base (MIB)

- A **management information base** (**MIB**) is a database used for **managing** the entities in a communication network.
  - MIBs follows a fixed naming and structuring convention
    - Structure of Management Information (SMI)
    - These conventions were adopted from Common Management Information Protocol (CMIP) designed by ISO.
    - The format of the **MIB** is defined as part of the SNMP.
  - All names are globally unique.
    - Every device has MIB
      - TV, router, Switch, network server, computer etc defined for that device, designed for vender of that device.


Thanks