

Communication Switching Systems

Course Code: ETU07402

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Electronics & Telecommunication Engineering



Telecommunication

Networks

Management

Lecture 06

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Network Management Systems

6.1. Introduction

Effective network management *optimizes* a telecommunication network's operational capabilities. The key word here is *optimizes*.

- TNM keeps the network operating at peak performance.
- TNM informs the operator of impending deterioration.
- TNM provides easy alternative routing and work-arounds when deterioration and/or failure take place.
- TNM provides the tools for pinpointing cause/causes of performance deterioration or failure.
- TNM serves as the front-line command post for network survivability.

Main Function Network Management

6.2. Main Function Network Management

- There are five tasks traditionally involved with network management:
 - ➡ Fault management
 - ➡ Configuration management
 - ➡ Performance management
 - ➡ Security management
 - ➡ Accounting management

6.2. Main Function Network Management

■ Secondary Function

- ➡ TNM informs in quasi-real time regarding network performance.
- ➡ TNM maintains and enforces network security, such as link encryption and issuance and use of passwords.
- ➡ TNM gathers and files data on network usage.
- ➡ TNM performs a configuration management function.
- ➡ TNM also performs an administrative management function.

6.2.1. Tasks Traditionally Involved With Network Management

- **Fault management** provides information on the status of the network, *not only display faults (meaning failures) and their location*, but should also provide information on deteriorated performance.
- **Configuration Management** establishes an inventory of the resources to be managed; It includes resource provisioning.
 - ➔ Timely deployment of resources to satisfy an expected service demand
 - ➔ Service provisioning (assigning services and features to end-users).
 - ➔ **Configuration Management** deals with equipment and services, networks, and interfaces.

6.2.1. Tasks Traditionally Involved With Network Management

- **Performance Management** responsible for *monitoring network performance* to assure it *meets specified performance* as well as *growth management* in order to ensure *sufficient capacity* to support end-user communication requirements.
- **Security Management** controls access to and protects both the network and the network management subsystem against intentional or accidental abuse, unauthorized access, and communication loss.
 - ➔ *Security Management involves link encryption, changes in encryption keys, user authentication, passwords, firewalls, and unauthorized usage of telecom resources.*

6.2.1. Tasks Traditionally Involved With Network Management

- **Accounting Management** processes and records service and utilization information.
 - ➡ *Generates customer billing reports for services rendered.*
 - ➡ *Identifies costs and establishes charges for the use of services and resources in the network.*
 - ➡ *It is a repository for plant-in-place investment for telecommunications plant*
 - ➡ *Provides reports to upper management on return on that investment.*

6.2.2. Survivability Enhancement - Rapid Troubleshooting

- The NMS should, warn the operator in advance of an impending fault/faults.
- The *troubleshooter* should have available a number of units of test equipment, to aid in the pinpointing the cause of an event.
- Four steps to correct network faults in a Network. (S. M. Dauber, 1991)
 - *Observing symptoms*
 - *Developing an hypothesis*
 - *Testing the hypothesis*
 - *Forming conclusions*

6.2.3. Specific Characteristics of a Network Troubleshooter

■ **Network-specific characteristics** that the troubleshooter should have familiarity with or data on.

- ➡ *Network Utilization.*
- ➡ *Network Applications.*
- ➡ *Network Protocol Software.*
- ➡ *Network Hardware.*

6.2.3. Specific Characteristics of a Network Troubleshooter

■ Network Utilization.

- ➡ *The average network utilization; How does it vary through the work day*
- ➡ *Characteristics of congestion, if any, should be known, and where and under what circumstances might it be expected*

■ Network Applications

- ➡ *The dominant network applications on the network*
- ➡ *What version numbers is it running*

6.2.3. Specific Characteristics of a Network Troubleshooter

■ Network Protocol Software

- ➡ *Protocols are running on the network*
- ➡ *The performance characteristics of the software, and are these characteristics being achieved*

■ Inter-networking Equipment.

- ➡ *Manufacturers of repeaters, bridges, routers, and gateways on the network*
- ➡ *The Versions of software and firmware are they running*
- ➡ *What are the performance characteristics*

6.2.3. Specific Characteristics of a Network Troubleshooter

■ Network Hardware

- *Manufacturers of the network interface controllers; media attachment units, servers, hubs, and other connected hardware*
- *The versions of interface controllers; media attachment units, servers, hubs, and other connected*
- *Their Performance characteristics Expected and if they are Met*

Network Management from a PSTN Perspective

6.3.1. Network management

- **Network management** is “*Surveillance and control.*” The major objectives for network surveillance and control organizations are:
 - ➔ *Maintain a high level of network utilization.*
 - ➔ *Minimize the effects of network overloads.*
 - ➔ *Support Security Emergency Preparedness commitment.*
- **Main factors that contribute to attaining these objectives:**
 - ➔ *Network traffic management (NTM)*
 - ➔ *Network service*
 - ➔ *Service evaluation*

6.3.2. Network Management Centre

- NMC provides real-time surveillance and control of message
 - ➡ *The goal of an NMC is to increase call completions and optimize the use of available trunks and switching equipment. OSSs are employed to achieve this goal*
 - ➡ *optimize the call-carrying capacity of network.*
 - ➡ *The OSSs also enable the network interaction with the network to minimize of traffic overloads and failures.*

6.3.3. Network Traffic Management Principles

■ NMC decisions are guided by four principles, which apply regardless of switching technology, network structure, signaling characteristics, or routing techniques. All NMC control actions are based on at least one of the following principles:

1. *Keep All Trunks Filled with Messages.*
2. *Give Priority to Single Link Connections.*
3. *Use of Available Trunking.*
4. *Inhibit Switching Congestion.*

6.3.4. Network Traffic Management Functions

- The types overloads for which network traffic management controls can provide complete or partial relief.
 - ➡ *A general network overload*
 - ➡ *A focused overload*
 - ➡ *A switching system overload*
 - ➡ *A trunk-group overload*

6.3.4. Network Traffic Management Functions

■ The types overloads for which network traffic management controls can provide complete or partial relief.

➡ *A general network overload caused by changes in traffic patterns and/or increased traffic load.*

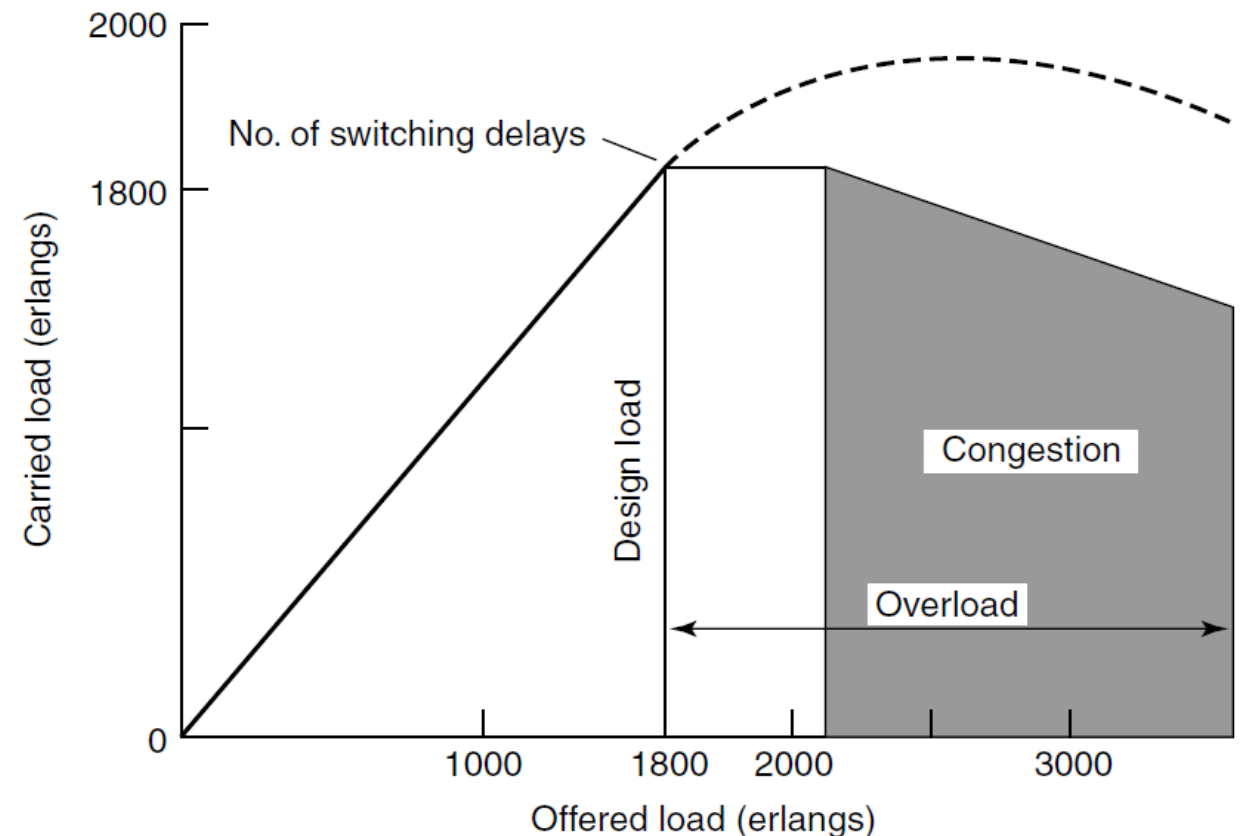


Fig 6.1. Network performance during overload conditions.

6.3.4. Network Traffic Management Functions

- ➡ *A focused overload is generally directed toward a particular location and may result from media stimulation (e.g., news programs, advertisements, call-in contests, telethons) or events that cause mass calling to government or public service agencies, or public utilities.*
- ➡ *A switching system overload occurs because each individual switch is engineered to handle a specific load which is known as engineered capacity. The engineered capacity is usually less than the total switching capacity. When the load is at or below engineered capacity, the switch handles calls in an efficient and reliable manner*

6.3.4. Network Traffic Management Functions

- ➡ *A trunk-group overload usually occurs during general or focused overloads and/or atypical busy hours. Some of the overload causes not discussed above are facility outages, inadequate trunk provisioning, and routing errors. The results of trunk-group overload can be essentially the same as those previously discussed for general overloads.*

6.3.5. Network Traffic Management Controls

Circuit-Switched Network Controls

- There are two broad categories of Network traffic management controls:
 - ➔ *Protective Controls* removes traffic from the network *during overload conditions*. Usually traffic close to its origin is removed as, thus making more of the network available to other traffic with a higher probability of completion.
 - ➔ *Expansive Controls* reroute traffic from *routes experiencing overflows or failures* to other parts of the network that are *lightly loaded* with traffic because of noncoincident trunk and switching system busy hours.

6.3.5. Network Traffic Management Controls

Automatic Controls in Modern Digital Switches

- Current computer based switches may include the following types
 - ➡ *Selective dynamic overload control (SDOC)*
 - ➡ *Selective trunk reservation (STR)*
 - ➡ *Dynamic overload control (DOC)*
 - ➡ *Trunk reservation*
 - ➡ *Selective incoming load control (SILC)*
- SDOC and STR are considered “selective” protective controls because they can selectively control traffic to hard-to-reach points more severely than other traffic

Network Management Systems in Enterprise Networks

6.4.1. What are Network Management Systems

- Ostensibly a network management system provides an automated means of remotely monitoring a network for:
 - *Quantification of performance (e.g., BER, loss of synchronization, etc.)*
 - *Equipment, module, subassembly, card failures; circuit outages*
 - *Levels of traffic, network usage*

6.4.2. Introduction to Network Management Protocols

- There are four Management Protocols.
- Two separate communities have been developing network management communication protocols:
 - *The TCP/IP (ARPANET) community: SNMP*
 - *The ISO/OSI community: CMIP*
 - *Telecommunication Management Network (TNM) – ITU*
 - *Interim Local Management Interface (ILMI) developed for ATM networks*

6.4.3. An Overview of Simple Network Management Protocol

- SNMP is probably the dominant method network management protocol for devices on a network to relay network management information to centralized management consoles which are designed to provide a comprehensive operational view of the network.
- There are three components of the SNMP protocol
 - *The management protocol itself*
 - *The management information base (MIB)*
 - *The structure management information (SMI)*

6.4.3. An Overview of SNMP

SNMP management architecture. SMI, structure of management information.

NOC, network operations center. MIB, management information base.

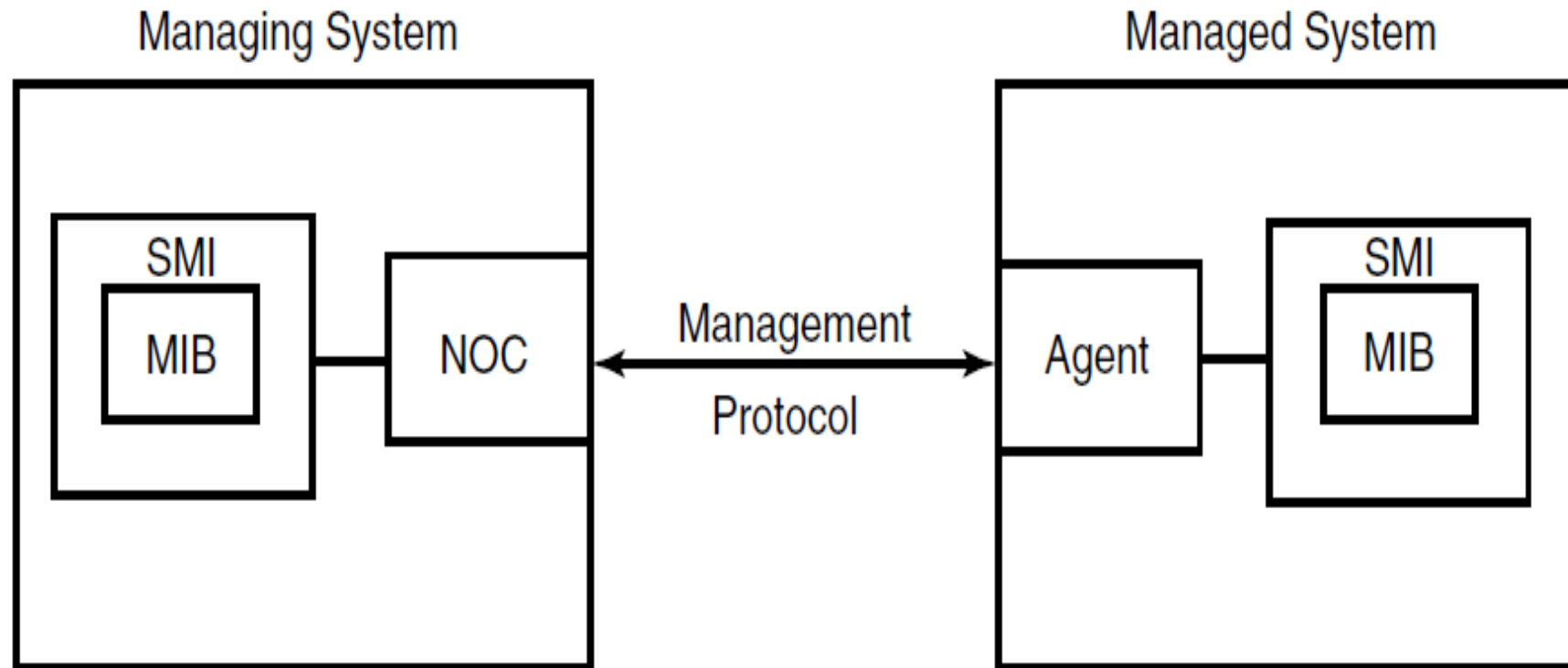


Fig 6.2. the classic client-server model.

6.4.3. An Overview of SNMP

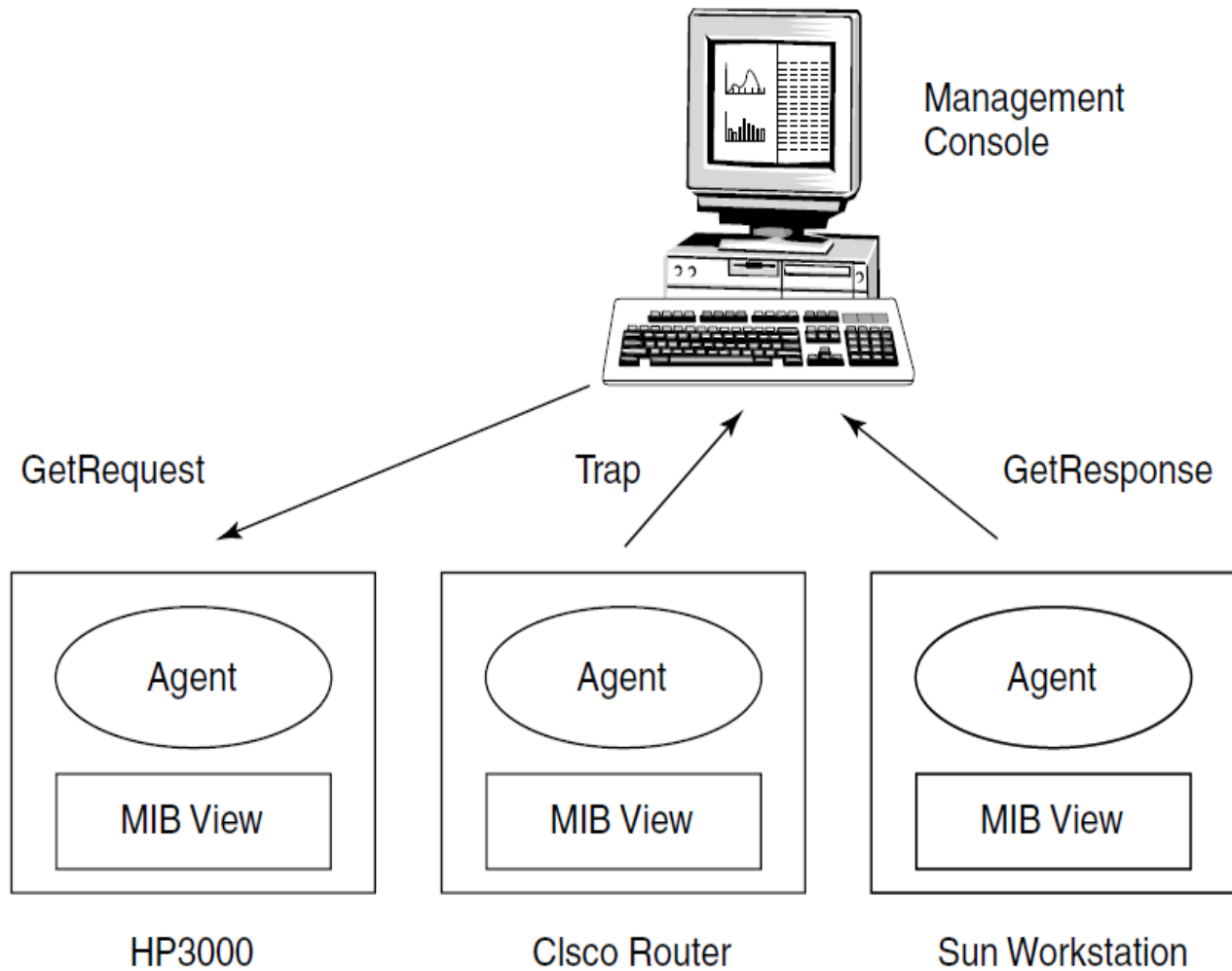


Fig 6.4. The network management console manages agents.

6.4.3. An Overview of SNMP

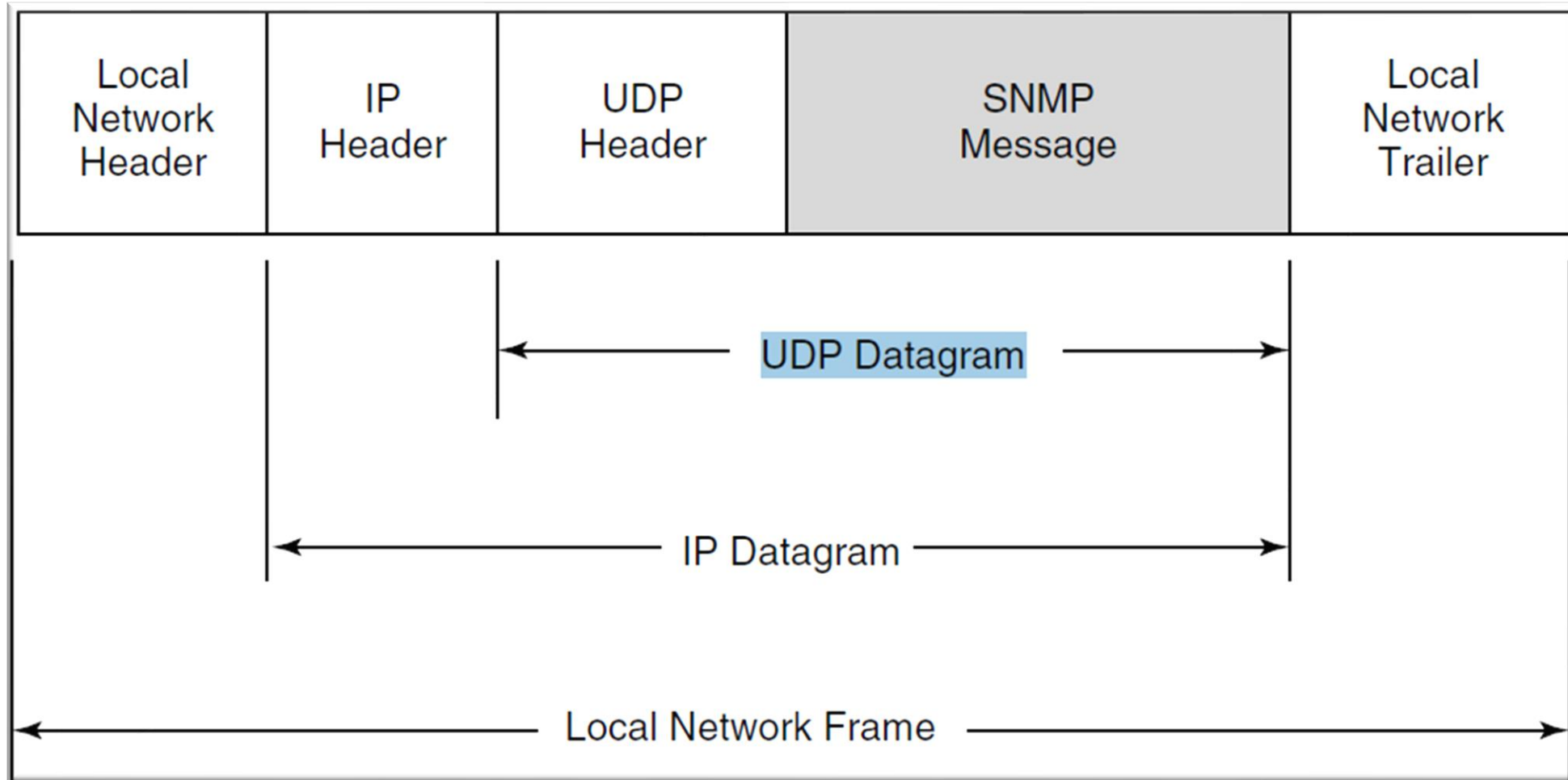
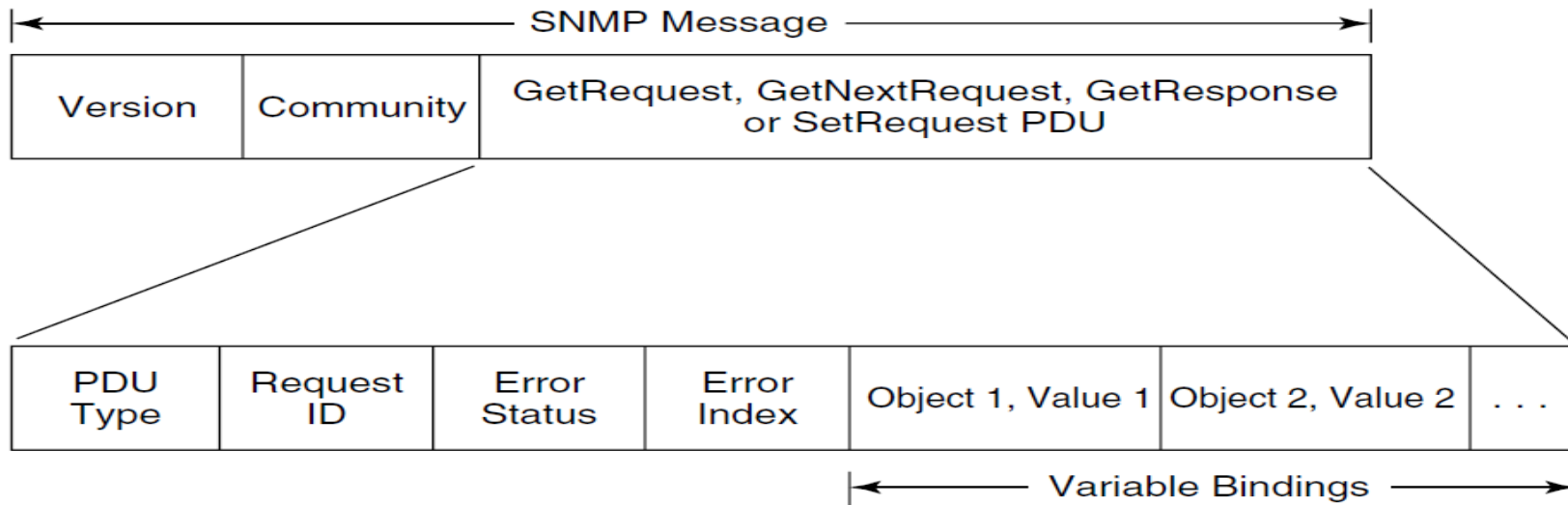
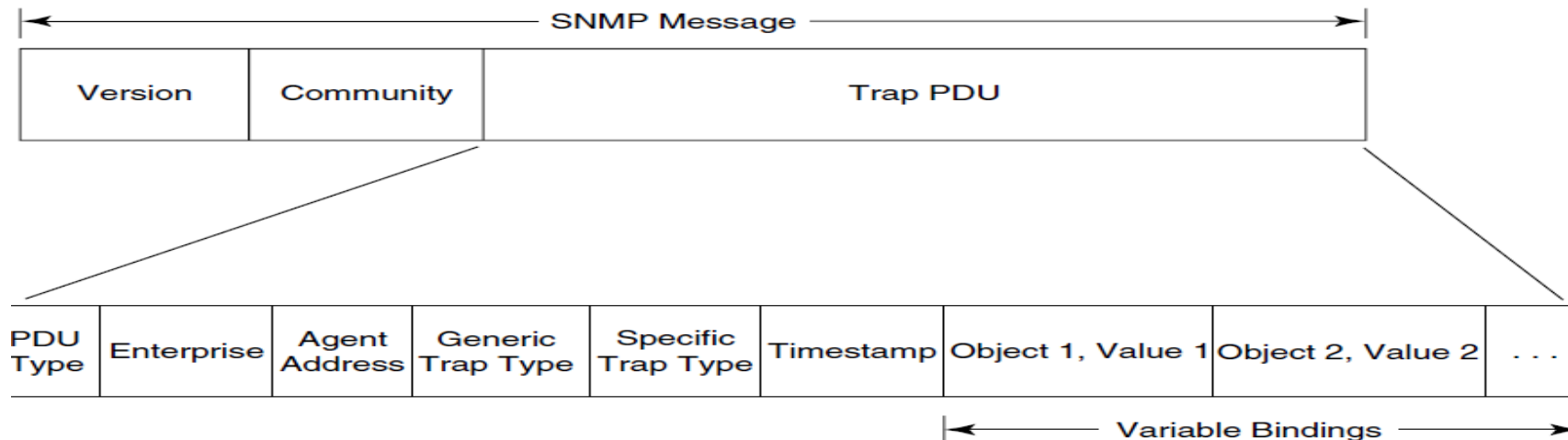


Fig. 6.5 An SNMP “message” embedded in a local network frame.

6.4.3. An Overview of SNMP



➤ *An SNMP PDU structure for GetRequest, GetNext-Request, GetResponse, and SetResponse.*



➤ *SNMP trap PDU format.*

Telecommunication Network Management (TNM)

6.5.1. Introduction

- A telecommunication network contains a large number of links (Transmission/last mile/backhaul) Connecting Nodes/Equipment.
- Telecommunication network include transmission system (i.e., terrestrial, microwave, optical fiber or satellite communications), switching system (to identity and connect calling and called subscriber) and signalling system.
- A telecom network represents a significant investment for any company, from the original purchase and installation of hardware and software, to the ongoing monthly carrier services costs.

6.5.1. Introduction

- These Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) must be met through Subscribers. Therefore, *Billing and charging* subscriber Voice calls or/and data is a vital part of the Network System.
- In addition, introducing or upgrading Switch/exchange, changing *sales strategy* due to competition, addition of new services, O&M, acquiring of skill labor or training, meeting government policies or the telephone company's business strategies.
- **Network management** is an important part of any telecommunication network organization.

6.5.2. Introduction Telecommunication Network Management

How can you make sure that your network is ahead of the curve rather than falling behind? Regular network maintenance is the simplest way to comprehensively check your network's capabilities. Consistent, thorough network maintenance and management administered by support specialists give the Telecom Company opportunity to stay ahead of potential roadblocks and avoid issues that might hamper productivity and increase downtime.

6.5.2. Basic Goal of TNM

- The basic goal of the network management is to *maintain efficient operations* during *equipment failures* and *traffic overloads*.
- Controlling the flow of call requests during network overload.
- The study of various services provided by the network, such as *offered load* of the network, *classification of services offered*, *interconnection of different types of networks* and *network planning* is very important for the effective network management.

6.5.3. Network Management System

- **Network Management System:** Helps to analyze, control and manage network and service infrastructure in order to ensure its configuration correctness, robustness, performance quality and security. The
- **Telecommunication Network Management (TNM)** is designed in the same way as the **layered network model**. Each layer above builds on the functions of the layer below and is considered an abstraction of the lower layer. Furthermore, the layers from network management up are considered vendor-independent.

6.5.4. Telecommunication Network Management

- **Element management:** provides a view on the collection of network elements, usually forming a subnetwork. Also mediates data between the network element and the network manager. It is device and network technology specific.
- **Network Management:** provides end-to-end network view of the managed resources and devices. It is device neutral.
- **Service management:** provides contacts with customers and service providers. Quality of service assurances, service orders, billing information and trouble ticketing.
- **Business management:** product and human resource planning. Business level view of the services and financial concerns

6.23. Telecommunication Network Management

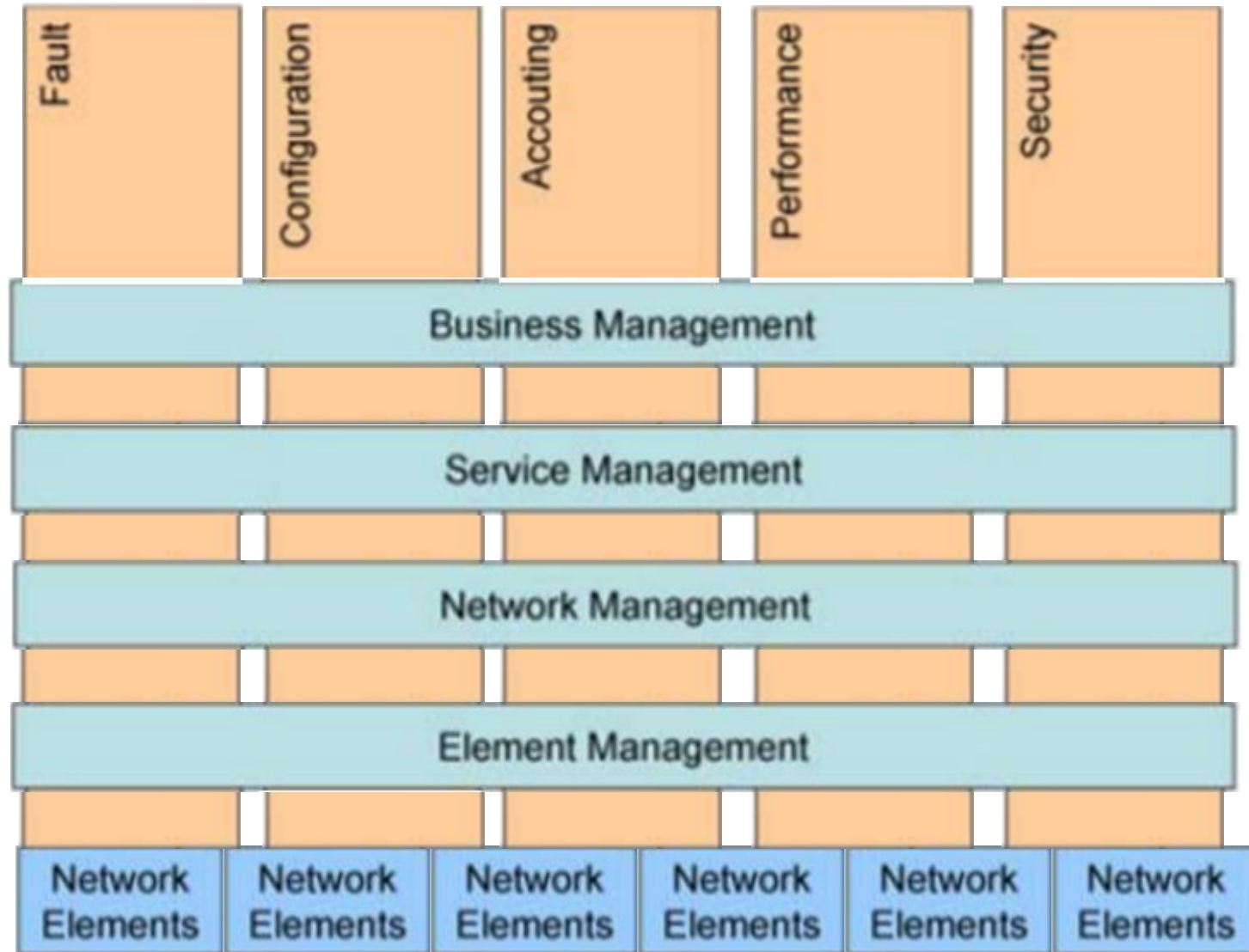


Figure 6.4: Telecommunication Network Management Architecture

Different Levels of Network Management

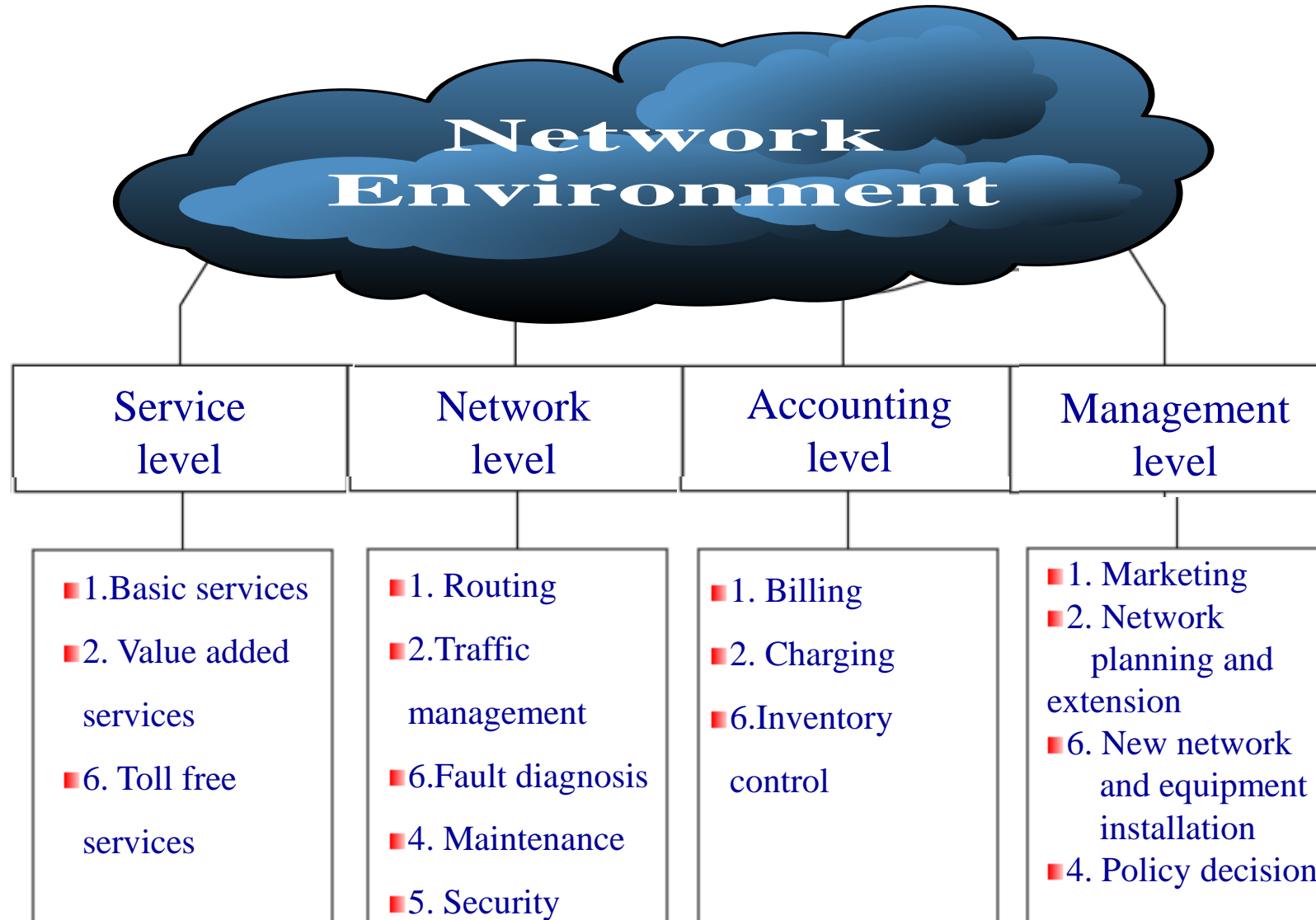


Figure 6.5: Different levels of network management.

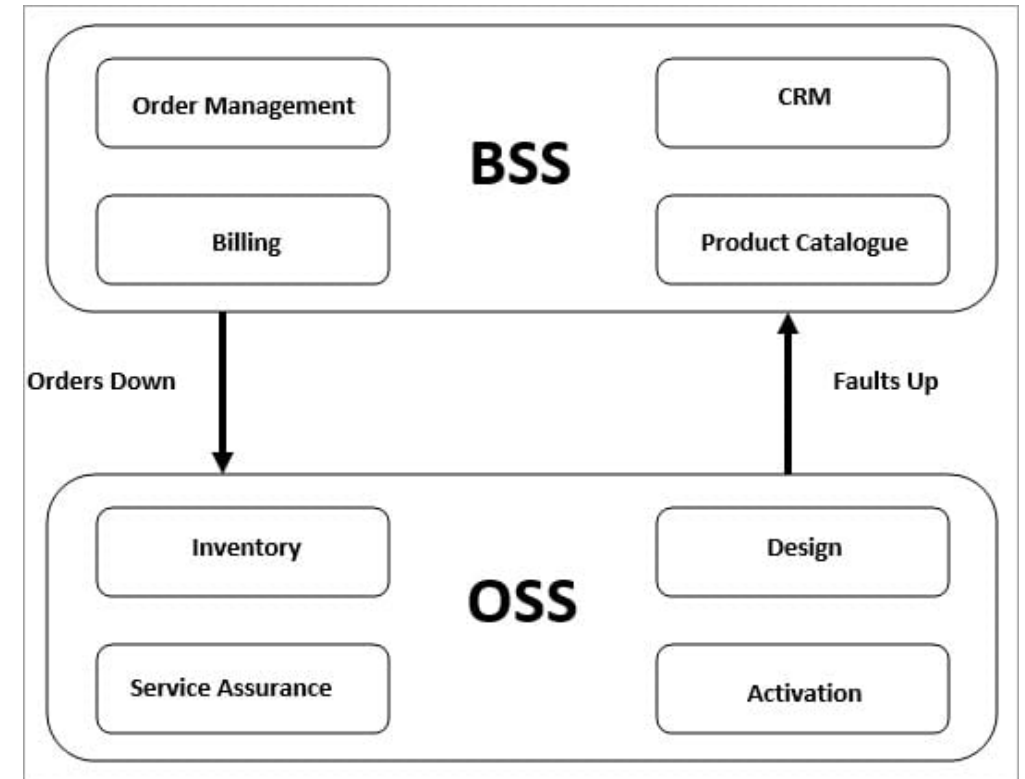
6.2.4. Telecommunication Network Management

TNM is further grouped into two main category Business Support Systems (BSS) and Operational Support Systems (OSS).

- **BSS:** Describes the business and/or customer-facing functionality. these tools allows a Telco to interact with customers (e.g. Customer Relationship Management or CRM), create offers for them (e.g. Products / Services), issue customers with bills (e.g. Billing and rating) and cross-carrier transactions (settlements, point-of-interconnect).
- **OSS** Describes network-facing or network-operations-facing functionality.

6.2.4. Telecommunication Network Management

- ➔ OSS is the information processing systems that assist an operator (Technician/Engineer) to manage Telecommunication Networks.
- ➔ This includes fault and performance (assurance), customer activations (fulfillment), configuration, network security etc.
- ➔ These tools assist in coordinate resources, processes and activities to Plan/design, build, operate and maintain communications networks.



*Figure 6.6: Telecommunication
Network Management Architecture*

Reference book

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End of Lecture 05

Any Questions ?

Thank you Class for your Attention