



Qos Monitoring and Compliance





DAY 5



1. **NETWORK AND SERVICE MANAGEMENT**
2. **CALL CENTRE**



NETWORK AND SERVICE MANAGEMENT



Network and Service Management

- Justification of Network and Service Management
- Concept of Network and Service Management
- Measurement of Network and Service Management
- Performance Indicators of Network and Service Management





Justification of Network and Service Management

- Telephone network is highly interconnected and interactive and increasingly vulnerable to overload and congestion which can occur without advance or no warning.
- The demand for telephone service continues to increase substantially by more volume and new types of traffic, e.g. ISDN traffic, IN traffic, Internet traffic, Multimedia traffic.
- A number of events may arise which can have a serious effect on the international telephone service.



Events with possible serious effect Quality of Service

- Abnormal increases in traffic demand due to:
 - national or religious holidays,
 - international sporting events
- Unforeseen events:
 - natural disasters, political crises;
 - focused overloads, and, in particular, mass-calling;
- Congestion in connected networks;
- Difficulties in meeting the requirements of international traffic resulting, e.g., from delays in the provision of additional circuits/capacity/coverage or equipment;





Events with possible serious effect on telephone Service

- ❑ Failures of international or national exchanges/switches;
- ❑ planned outages of transmission systems and exchanges/switches;
- ❑ Failures of international or national transmission systems;
- ❑ Unreachable destinations for certain types of traffic like traffic demanding, e.g. specific transmission medium requirement;
- ❑ mass repeated events from ISDN terminals, mobile terminals, multimedia terminals;
- ❑ large influence on the network by the status of private LAN, WAN, MAN networks and their terminals.



Impact of events on QoS

- These events can lead to congestion which, if uncontrolled, may spread and seriously degrade the service in other parts of the international or national network .
- Prompt action must be taken to control the effect on service of such events.
- A failure or congestion in one network, or in the interface between networks, can have an adverse impact on the performance of the connected network(s).





Concept of Network and Service Management

- The "Network Management" encompasses all the activities necessary to reduce the effect on service of any situation affecting unfavourably the network performance.
- “Network Management” is the function of supervising the national or international network or both and taking action when necessary to control the flow of traffic.
- Network management requires real-time monitoring of current network status and performance and the ability to take prompt action to control the flow of traffic when necessary (ITU T E.410).





Objectives of Network Management

- The objective of network management is to enable as many calls as possible to be successfully completed.
- This objective is met by maximizing the use of all available equipment and facilities in any situation through the application of the principles given below.





Principles of Network Management

- In case of circuit switched networks
 - Utilize all available circuits
 - Keep all available circuits filled with traffic which has a high probability of resulting in effective calls
 - When all available circuits are in use, give priority to calls requiring a minimum number of circuits to form a connection
 - Inhibit switching congestion and prevent its spread
- Incase of packet-switched networks:





The Benefits of Network Management

- Increased revenue which is derived from an increase in successful calls.
- Improved service to the customer, which in turn lead to:
 - improved customer relations;
 - stimulation of customer calling rate;
 - increased customer acceptance of new services.
- More efficient use of the network which can result in:
 - an increased return on the capital invested in the network;
 - an improvement in the ratio of effective to ineffective calls.





The Benefits of Network Management

- Greater awareness of the actual status and performance of the network, which can lead to:
 - a basis by which network management and maintenance priorities can be established;
 - improved network planning information;
 - improved information on which future capital investment in the network can be decided;
 - improved public relations.
- Protection of revenue and important services, particularly during severe network situations.



Network Management Functions

- Network management encompasses:
 - all the activities necessary to identify conditions which may adversely affect network performance and service to the customer and;
 - the application of network controls to minimize their impact.
- These functions include:
- monitoring the status and performance of the network on a real-time basis, which includes collecting and analysing relevant data;





Network Management Functions

- ☐ detecting abnormal network conditions;
- ☐ investigating and identifying the reasons for abnormal network conditions;
- ☐ initiating corrective action and/or control;
- ☐ cooperating and coordinating actions with other network management centres, both domestic and international, on matters concerned with network management and service restoration;



Network Management Functions

- ☐ cooperating and coordinating with other work areas (e.g. maintenance, operator services or planning) on matters which affect service;
- ☐ issuing reports of abnormal network situations, actions taken and results obtained to higher authority and other
- ☐ involved departments and administrations, as required;
- ☐ providing advance planning for known or predictable network situations.





Operational guidance to meet NM requirements

- Operational guidance to meet NM requirements, including a description of status and performance parameters, traffic controls and the criteria for their application(ITUT E. 411)
- The complete range of parameters and traffic controls are not necessary for the introduction of a limited network management capability
- A comprehensive selection network management parameters will bring substantial benefit (ITUT E.410).
- Develop a network management centre and use common channel signalling for network management purposes.



Network Management Organization

- as there is a need for coordination in planning and building the network, there also is a need for coordination in managing it.
- Effective network management depends on:
 - the prompt availability of information indicating when and where a problem is occurring, and;
 - a trained group working in cooperation with all parts of the telecommunications organization.;
 - both national and international cooperation to ensure satisfactory service
 - equipment malfunctions or overloads frequently produce unacceptable performance at a distance from the physical location of the problem., therefore requires.





Network Management Organization

- ☐ Network management is highly technical in nature, and depends on the skill and creativity of those who share an understanding of:
- ☐ network management philosophy,
- ☐ objectives,
- ☐ terminology,
- ☐ tools and techniques.





Measurement of Network and Service Management

- Network management controls
- Assessing the impact of resource discontinuity in transport networks on service availability





Network Management Controls

- Network management controls provide the means to alter the flow of traffic in the network in support of the network management entities.
- Most network management controls are taken by or in the exchange (ITU-T Q.542), but certain actions can be taken external to the exchange.
- A Network Management control may be specified by selecting the entities, traffic attributes and the operating parameters to be controlled.



The entities to which the control is applied can be:

- ☐ circuit groups;
- ☐ destinations;
- ☐ exchanges;
- ☐ intelligent network nodes.





The Traffic Attributes

- Traffic attributes: parameters that relate to the call which may be needed in the call process, and can include:
 - traffic type: e.g., direct/alternate routed, hard-to-reach/easy-to-reach, priority/non-priority;
 - service type: e.g., transmission medium requirements (see ITU-T E.172), ISUP preference indicator, calling party's category (ITU-T Q.763), bearer services;
 - traffic source: e.g. operator-originated, customer-originated, access indicator (ISDN or POTS), transit, rerouted, inbound from foreign network.





The operating parameters:

- ☐ The operating parameters can include:
- ☐ amount of traffic to be controlled: percentage or call rate;
- ☐ threshold(s) for control activation;
- ☐ disposition of controlled call attempts: skip/cancel where applicable;





The operating parameters:

- handling of blocked calls: busy tone, special recorded announcement.
- Only some of the entities, traffic attributes and operating parameters may be valid for a particular control.
- It would be convenient to have the maximum flexibility for the above parameters in the implementation of NM controls
- But only some of the parameters are strictly required for each control.





Methods of specifying traffic to be controlled

- **Call percentage control:** affect specific percentage of traffic, 10%, 25%, 50%, 75% or 100%
- **Call rate control:** an upper limit on the rate that calls are allowed to access the network is established, e.g. 4 calls per/min.
 - *Continuous timer:* time and the number of call attempts
 - *Asynchronous timer:* a timer with a specified duration is started when a call attempt is allowed, e.g. one call/15 sec.
 - *Leaky bucket:* a dynamic counter is used, call is rejected when the bucket is full.





Methods of specifying traffic to be controlled

□ **Exchange controls:**

- Traffic volume controls: e.g. destination control,
- Circuit turndown/busying/blocking
- Automatic Congestion Control (ACC)
- Handover controls for PLMN

□ **Routing controls:**

- cancellation of direct routing,
- establishment of temporary alternative routing





Assessing transport networks on service availability

- Two indexes for assessing the impact of resource discontinuities in transport networks on the availability of services for users (ITU T E.412.1):
 - the "service outage index (SOI)" and
 - the "service affected index (SAI)"
- Guide a network operator to arrange the OAM resources so that better services can be provided.
- The word "service" is used in its normal sense and not as a defined term or defined ITU service).
- Transport network [ITU-T G.805]: The functional resources of the network which conveys user information between locations.





Assessing transport networks on service availability

- The service outage index (SOI) and service affected index (SAI) are defined based on service lost or potential service lost,
- The two indexes together can be used to assess the operational status of a transport network from the viewpoint of service lost,
- SOI indicates the percentage of service lost compared to the total service;





Assessing transport networks on service availability

- SAI indicates the percentage of affected service (due to protection degradation) compared to the total service.
- The two indexes can be used when an operator wants to know the overall operational quality of a transport network,
- These two indexes together can quantitatively express the healthy condition of the transport network.
- Based on the values of these two indexes, the operator can take measures to provide more reasonable transport resources to provide better services.





Assessing transport networks on service availability

- The two indexes can also be used for early warnings.
- By calculating the two indexes with the assumption of each line failure, the operator can find out which line(s) will cause more service loss than others, when there are limited backup resources for a transport network.
- If some lines with the $\langle \text{SOI}, \text{SAI} \rangle$ values exceed a predefined threshold, an early warning message will be sent to the operator to provide a higher priority to be provided with backup measures.
- The two indexes are mainly calculated based on a network management system, from which the network topology, fault information and service information can be obtained.
- The two indexes are applicable for all kinds of network topologies,



Service Outage Index

- Service outage index, considers the extent of a transport network being destroyed
- is a metric to measure actual service losses for a certain failure.
- SOI represents the weight ratio of lost services over total services.





Service Affected Index (SAI)

- ☐ considers the extent of a transport network being affected,
- ☐ is a metric to measure potential service risks for a certain failure.
- ☐ SAI represents the weight ratio of affected services over total services.
- ☐ SAI index is not applicable for transport networks that do not provide protection mechanisms.
- ☐ A transport network without any protection schemes will have a constant value of SAI.



Network Performance Indicators

□ Network accessibility

- The probability that the user of a service after a request (to a network) receives the proceed-to-select signal within specified conditions.
- The proceed-to-select signal is that signal inviting the user to select the desired destination.





Network Performance Indicators

□ **Connection accessibility**

- The probability that a connection can be established within specified tolerances and other given conditions following receipt by the exchange of a valid code.

□ **Connection establishment error probability**

- Ratio of the number of connection establishment attempts that result in an error in connection establishment to the total number of connection establishment attempts in a measurement period (ITU-T Y.1560)

□ **Connection establishment failure probability**

- Ratio of the number of connection establishment attempts that fail to establish a connection to the total number of connection establishment attempts in a measurement period (ITU-T Y.1560)





Network Performance Indicators

□ **Trafficability performance**

- The ability of an item to meet a traffic demand of a given size and other characteristics, under given internal conditions.

- Given internal conditions refer, for example, to any combination of faulty and not faulty sub-items.





Network Performance Indicators

□ Transmission performance

- An indication of the performance of a communication signal at the egress of a network compared to its performance at the ingress to the network.
- The indication of performance is expressed by a choice of pertinent parameters for the application or service in question.
- For voice communication over analogue connections, the transmission performance would be expressed by loss, distortion (various types), noise (various types), etc.
- For voice over IP networks, the performance would be expressed by delay (latency), jitter and packet loss.





Network Performance Indicators

☐ **Bit transparency**

- The ability of a telecommunication system to transport a signal offered to an ingress point and to
- reproduce it without any change at an egress point within a given period of time.

☐ **Bit error ratio (BER)**

- The ratio of the number of bit errors to the total number of bits transmitted in a given time interval.

☐ **Error free seconds ratio**

- ☐ The ratio of the number of one-second intervals during which no bits are received in error to the total number of one-second intervals in the time interval.
- ☐ The length of the time interval needs to be specified.
- ☐ This ratio is usually expressed as a percentage.



Network Performance Indicators

□ Propagation performance

- The ability of a propagation medium, in which a wave propagates without artificial guide, to transmit a signal within the given tolerances.
- Radio Wave Propagation suffers atmospheric attenuation and interference from other systems

□ End-to-end IP network

- The set of EL (exchange link) and NS (network section) that provide the transport of IP packets transmitted from SRC to DST.
- The MP (measurement point)s that bind the end-to-end IP network are the MPs at the SRC (source host) and the DST (destination host). ([ITU-T Y.1540])





Network Performance Indicators

- **Time between interruptions**
 - The time duration between the end of one interruption and the beginning of the next.
- **Interruption duration**
 - The time duration of an interruption.
- **Mean time between interruptions (MTBI)**
 - The expectation of time between interruptions computed from a statistically significant number of samples usually expressed as the arithmetic mean.
- **Mean time to restoration (MTTR); Mean time to recovery; Mean time to repair**
 - The expectation of repair time for a statistically significant number of repairs carried out from the instant a fault has been reported to the instant the service restored for use by the customer and usually expressed as the arithmetic mean.





Network Performance Indicators

☐ **Fault coverage**

- The proportion of faults of an item that can be recognized under given conditions.

☐ **Repair coverage**

- The ability of a maintenance organization, under given conditions, to provide upon demand the resources required to maintain an item, under a given maintenance policy.
- The given conditions are related to the item itself and to the conditions under which the item is used and maintained.

☐ **Fault**

- The inability of an item to perform a required function, excluding that inability due to preventive maintenance, lack of external resources or planned actions.
- A fault is often the result of a failure of the item itself, but may exist without prior failure.





Network Performance Indicators

□ **Corrective maintenance; repair**

- The maintenance carried out after fault recognition and intended to restore an item to a state in which it can perform a required function.

□ **Reliability performance**

- The ability of an item to perform a required function under given conditions for a given time interval.
- It is generally assumed that the item is in a state to perform this required function at the beginning of the time interval.
- The term reliability is used as a measure of reliability performance.
- For this performance concept, the MTTF, MTBF, measures are used





Network Performance Indicators

- **Mean time to first failure (MTTFF)**
 - The expectation of time to first failure computed from a statistically significant number of samples usually expressed as the arithmetic mean.
- **Mean time to failure (MTTF)**
 - The expectation of time to failure computed from a statistically significant number of samples usually expressed as the arithmetic mean.
- **Mean time between failures (MTBF)**
 - The expectation of the time between failures computed from a statistically significant number of samples usually expressed as the arithmetic mean.





Network Performance Indicators

□ **Failure rate acceleration factor**

- The ratio of the accelerated testing failure rate to the failure rate under stated reference test conditions.
- Both failure rates refer to the same time period in the life of the tested items.

□ **Disaster recovery, Business continuity**

- All activities associated with the restoration of a network provided service after disasters.
- Examples of such disasters are fire, earthquakes, vandalism, bombings, or software malfunctioning.





Charging and Billing

□ Charging

- The set of functions needed to determine the price assigned to the service utilization (ITU-T Q.825)

□ Incorrect charging or accounting probability

- The probability of a call attempt receiving incorrect charging or accounting treatment.
- Results in undercharging or overcharging the services

□ Undercharging probability

- The probability that a call attempt will be undercharged for any reason.

□ Overcharging probability

- The probability that a call attempt will be overcharged for any reason.





Management related Measures

□ QoS resource management

- Network functions which include class-of-service identification, routing table, derivation, connection admission, bandwidth allocation, bandwidth protection, bandwidth reservation, priority routing, and priority queuing (ITU-T E.360.1)
- In allocating resources, the resource management system has to consider not only resource availability and resource control policy, but also an application's QoS requirements, measured in terms of the QoS parameters.





Management related Measures

□ Class of service

- A group of end-to-end quality performance values (or range) for a service is denoted 'class of service'.
- A service offering may have around three to five classes of services with specified performance limits for the various parameters.
- These classes of services are usually provided to accommodate different tariffs to the customer.

□ Customer relationship management (CRM)

- Identification and resolution of the issues in the contractual relationship between the service provider and the user in the provision and consumption of a service.
- Examples of issues are customization of bills, tariff options, variants of service, negotiated repair arrangements, etc.





Service Level Agreement (SLA)

- A service level agreement is a formal document listing a set of performance characteristics and target values (or range) to be delivered for a service or portfolio of services by the service provider.
- A SLA include statements about performance, tariffing and billing, service delivery compensations and escalation procedures in cases of disagreement.
- **SLA/service quality**
- The metrics in this category measure the quality of the services performed by the service provider, and include such areas as MTTR statistics, call-out-intervals, trouble escalation statistics, trouble resolution statistics.





Faults Categories

Failure category	Definition	Network components
Major (considerable) influence fault	Degradation of network component(s) lasts for some period of time, owing to large scale failure of equipment, and a subscriber cannot be assured of normal service	Subscribers line, subscriber terminal, exchange, transmission line, service centre
Minor (less important) influence fault	Small scale fault wherein a connection access attempt is handled incorrectly and encounters no signal (e.g. dial tone, ring-back tone), no connection, low level speech signal, etc., i.e. less important service degradation is experienced	MSC, BSC, BTS





Network Management Planning

- ☐ For known or predictable events, predetermined network management plans should be developed
- ☐ The degree of detail of any plan will depend on the type of situation to be covered.
- ☐ For example, a recurring event such as Christmas or New Year's Day may be planned in great detail.
- ☐ The lack of real-time network management facilities should not prelude planning activities.





Network Management Planning

- When unforeseen situations arise for which predetermined plans do not exist, ad hoc arrangements will be needed at the time.
- Whether network management actions result from a plan, or an ad hoc arrangement, it is essential that agreement be reached between Administrations concerned before such actions are implemented.
- Network management planning can be used for long-range planning for the development and introduction of new network management techniques and capabilities for new or improved controls necessary for new services or new technologies.



CALL CENTRE



CALL CENTRE

- Call Centre Mechanism
- Performance Indicators of Call Centre





Call Centre Mechanism

- ☐ Customer Interfacing
- ☐ OoS Offered
- ☐ QoS Offered
- ☐ QoS Delivered
- ☐ Quality of Experience





Call Centre Organization

- ☐ Call Centre Manager
- ☐ Front-office Functions
- ☐ Back-office Functions
- ☐ Automatic Voice Response Systems
- ☐ Problem Escalation
- ☐ Coordination





Call Centre Activities

- ☐ Customer Service Offering
- ☐ Customer Support Offerings:
 - National services and
 - International services
 - Roaming Services
- ☐ Billing complaints





Performance Indicators of Call Centre

- ☐ Call Centre Activity Process Time
- ☐ Call Centre Answer Success Ratio
- ☐ Call Centre Answer Time





Call Centre Parameters

Parameter	Target
Interactive Voice Response Time The duration of the entire IVR options before a customer can make a choice.	Not more than 15 seconds
Customer Assistance Operator Access Time The duration of waiting after the option to a Customer Care Assistant has been chosen	Not more than 3 minutes



End of Workshop



Q & A