



परीक्षण मार्गदर्शिका

टीईसी ४८१०१:२०२६

(सं: टीईसी/जी आर/आई टी/एनएम एस -००१/०१/ अक्टूबर २०१५ को अधिक्रमित करता है)

TEST GUIDE

TEC 48101:2026

(Supersedes No.: TEC/GR/IT/NMS-001/01/OCT 2015)

for

नेटवर्क प्रबंधन प्रणाली (एनएमएस)

Network Management Systems (NMS)

(जीआर सं: टीईसी ४८१००:२०२५)

(Standard No.: TEC 48100:2025)



ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र  
खुर्शीदलालभवन, जनपथ, नई दिल्ली-११०००१, भारत  
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www.tec.gov.in Division: IT

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**TEST SCHEDULE & TEST PROCEDURE**  
**No. : TSTP/ GR/IT/ NMS-003/01/OCT 2015**

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**NETWORK MANAGEMENT SYSTEMS [NMS]**

(GRNo.: TEC/GR/IT/NMS-003/01/OCT 2015)

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Release 02: Feb, 2026

TEC Test Guide No: 48101:2026

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## FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

## ABSTRACT

This Test Guide of testing pertains to Test Schedule and Test procedures for **Network Management Systems (NMS)**.

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## A. HISTORY SHEET

<u>Sl. No.</u>	<u>TSTP No.</u>	<u>Equipment/Interface</u>	<u>Issue</u>
1.	TEC/GR/IT/NMS-001/01/OCT 2015	Network Management System	1 <sup>st</sup> <del>1st</del> Issue
2	TEC 48101:2026	Network Management System	2 <sup>nd</sup> Issue

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## B. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance/functionality/ requirements/ performance of Network Management System. The NMS provides Fault, Configuration, Accounting, Performance, Security (FCAPS) and other functionalities for the management of a Telecommunication network as per GR No.

TEC/~~GR/IT/NMS-001/01/OCT 2015~~ 48100:2026

## C. HISTORY SHEET

<u>Sl. No.</u>	<u>TSTP No.</u>	<u>Equipment/Interface</u>	<u>Issue</u>
1.	TEC/GR/IT/NMS-001/01/OCT 2015	Network Management System	1 <del>st</del> Issue

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**D. General information:**

Sl. No.	General Information	Details <i>(to be filled by testing team)</i>	
1	Name and Address of the Applicant		
2	Date of Registration		
3	Name and No. of GR/IR/Applicant's Spec. against which the approval sought		
4	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5	Any other relevant Information:-		

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**E. Testing team:** *(to be filled by testing team)*

S No.	Name	Designation	Organization	Signature
1.				
2.				

**F. List of the Test Instruments:**

S No.	Name of the test instrument	Make /Model <i>(to be filled by testing team)</i>	Validity of calibration <i>(to be filled by testing team)</i>
1			dd/mm/yyyy
2			
3			
4			
5			
6			
7			
8			

**G. Equipment Configuration Offered:** *(to be filled by testing team)*

**(a) <Equipment/product name> Configuration:**

S No.	Item	Details	Remarks

*Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product*

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**(b) <Other equipment name> Configuration:**

S No.	Item	Details	Remarks

*Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product*

**H. Equipment/System Manuals:** *(to be filled by testing team)*

*Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc.(Y/N)*

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**I. Clause-wise Test Type and Test No.:-**

<i>Clause No.</i>	<i>Clause</i>	<i>Type of Test / Test No. etc. *</i>
1	<b>Introduction</b>	Information
1.1	<del>The</del> Telecommunication networks consist of multi-vendor and multi-technology equipments. In this environment <del>there is</del> a need to manage diverse equipment's from a central location enables effective utilization of Human resources. This leads to a need <del>for of</del> deployment of a NMS at a central location which is capable of Operation, Administration and Management (OAM) of <del>these</del> diverse network elements.	Information
1.2	<del>Element Management Systems (eMS) acts as an interface to the network elements of a particular vendor and technology for performing functions of Fault, Configuration, Accounting, Performance Management and Security Management termed as FCAPS functions specific to the Network Elements (Resources).Network management has taken a predominant role in telecom with the introduction of SDH based transport systems.</del>	Information

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1.3	<p>The Generic Requirements for Management of equipment's belonging to a single technology (e.g. Router) from an OEM will be part of the eMS of the Generic requirements of the respective product. <del>With the IP based systems being introduced in all layers of telecom networks including transport, access, application, the management of the network by way of configurations, fault management, performance monitoring etc., became very complex and NMS system became a necessity for managing the network.</del></p>	Information
1.4	<p>NMS systems perform all the FCAPS functions in a multi-vendor environment and having a complete view of the network comprising of equipment of different functional layers. <del>Element Management Systems (eMS) were introduced into the network which acted as an interface to the network elements of a particular vendor for getting the information about the system as well as configuration of the systems. Accordingly the element management systems were started performing certain functions of Fault, Configuration, Accounting, Performance Management and Security Management which in short is termed as FCAPS functions.</del></p>	Information
1.5	<p>This document is for an NMS system which is technology neutral i.e., NMS will interface with eMS systems of multiple vendors serving NEs of multiple technologies. <del>However an NMS system was required to manage and perform all</del></p>	Information

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	<del>the FCAPS functions in a multi-vendor environment and having a complete view of the network comprising of equipment of different functional layers.</del>	
1.6	<del>The Generic Requirements for Management of equipments belonging to a single technology (e.g. Router) from an OEM will be part of the respective product eMS.</del> The structure of the NMS described in this document is based on the ITU-T standards as well as the TMN forum eTOM model. The document describes various functions in a layered architecture, both horizontally as shown in Figure-2 and vertically as per clause 2.1.6. This document includes Network Management Layer and Service Management Layer functions. There are optional functions of Service Management Functions and Business Management Functions (Customer Oriented Functions) also which may be decided by the purchaser while procurement. Moreover the Security requirements of this document also include Security Information Event Management Functions requirement of which also may be decided by the purchaser while tendering.	Information

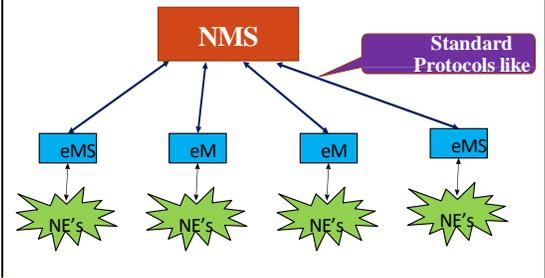
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1.7	<p>This document is for an NMS system which will interface with eMS systems of multiple vendors and multiple technologies. The NMS shall be technology neutral. The Management requirements for products of specific technologies or specific vendors shall form part of the eMS of Generic Requirements of the respective products. An architecture diagram of network management using eMS and NMS system is given in Figure-1 below</p>  <p>Figure-1: eMS and NMS architecture in a TSP network</p>	Information
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2.0	<p><b>General Description</b></p> <p>ITU-T and Telecom Management Forum develops standards for the Telecom Management Systems. The Telecom Management Forum has released the eTOM (Enhanced Telecom Operations Map) Standards (GB921). The ITU-T has standardized TMN Model vide M3010, TMN Functions vide M3400. There is a convergence between these two standards as ITU-T has standardized the eTOM to M3400 Mapping vide M3050.</p>	Information
2.1	<p><b>ITU TMN Model</b></p> <p>The architecture of TMN model is defined in ITU-T Rec M.3010. TMN Model has been layered horizontally into five layers.</p> <ol style="list-style-type: none"> <li>I. Business management layer (BML)</li> <li>II. Service management layer (SML)</li> <li>III. Network management layer (NML)</li> <li>IV. Element management layer (EML)</li> <li>V. Network Element layer (NEL)</li> </ol>	Information

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2.1.1	<p><b>Network Element Layer:</b></p> <p>It contains the actual <del>piece of</del> Hardware or Network devices that are responsible for providing the various services. This layer includes the Switches, Routers, Transmission Systems etc. This layer <del>shall</del> communicate with EML for different operations like provisioning, activation, testing, etc. Network Elements <del>shall</del> provide all information/ functions required by <b>NMS</b> Element Management Layer.</p>	Information
2.1.2	<p><b>Element management layer</b></p> <p>This layer is responsible for managing the set of homogeneous network elements <del>i.e. from a single OEM and having same technology</del>. EML function <del>shall be to</del> provides data, receive commands and fetch the responses to the NML. EML <del>shall</del> helps in providing the FCAPS management functionality to the network elements on the basis of orders received from NML. All proprietary implementations shall end at EML itself. EML shall provide all information/ functions required by NMS over open interfaces as per standards.</p>	Information
2.1.3	<p><b>Network Management Layer:</b></p> <p>All the network elements in the network are managed and controlled through Element Managers. The Network Management Layer shall provide the interface between the Service Management Layer and Element Management Layer. The Network Management layer shall be responsible for all the FCAPS <del>activities</del> functionalities.</p>	Information

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2.1.4	<p><b>Service Management Layer (SML):</b>  This layer manages the service offered to the customers e.g. meeting the customer service levels, service quality, cost and time-to-market objectives etc. SML <del>shall be the</del> <b>is the</b> customer interface of the networks of any telecommunication service provider. It keeps all the customer records and other related information like SLA, services available, etc. Order Management, Orchestration, Middleware, <b>Service</b> Provisioning Management, User account management, QoS management, Inventory management, monitoring of service performance etc., are functions of the SML.</p>	Information
2.1.5	<p><b>Business Management Layer (BML):</b>  BML is responsible for high level planning, budgeting, goal setting, business decisions, business level agreements (BLAs), partner management, etc. This layer manages the overall business i.e. achieving the return on investments, market share, employee satisfaction, community and government goals etc. Customer Management, Fault Reporting, <b>Customer Billing, Business Reporting Tools falls in this layer</b></p>	Information

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2.1.6	<p><b>FCAPS Function</b></p> <p>The Management Functions are vertically divided across Fault Management, Configuration Management, Accounting Management, Performance Management and Security Management, known by the acronym FCAPS. The functions coming under the various verticals is given in the table below:</p> <table border="1"> <tr> <td data-bbox="360 699 553 804">Fault Management</td> <td data-bbox="553 699 857 804">Quality Assurance, Alarm surveillance, Fault localization, Fault Correction, Testing, Trouble administration</td> </tr> <tr> <td data-bbox="360 804 553 936">Configuration Management</td> <td data-bbox="553 804 857 936">Network Planning and Engineering, Installation, Service Planning and Negotiation, Provisioning, Status and control</td> </tr> <tr> <td data-bbox="360 936 553 1041">Accounting</td> <td data-bbox="553 936 857 1041">Usage Measurement, Tariffing/pricing, Collections and Finance, Enterprise Control</td> </tr> <tr> <td data-bbox="360 1041 553 1119">Performance Management</td> <td data-bbox="553 1041 857 1119">Performance Monitoring, Performance Management Control, Performance Analysis</td> </tr> <tr> <td data-bbox="360 1119 553 1199">Security Management</td> <td data-bbox="553 1119 857 1199">Prevention, Detection, Containment and Recovery, Security Administration</td> </tr> </table>	Fault Management	Quality Assurance, Alarm surveillance, Fault localization, Fault Correction, Testing, Trouble administration	Configuration Management	Network Planning and Engineering, Installation, Service Planning and Negotiation, Provisioning, Status and control	Accounting	Usage Measurement, Tariffing/pricing, Collections and Finance, Enterprise Control	Performance Management	Performance Monitoring, Performance Management Control, Performance Analysis	Security Management	Prevention, Detection, Containment and Recovery, Security Administration	Information
Fault Management	Quality Assurance, Alarm surveillance, Fault localization, Fault Correction, Testing, Trouble administration											
Configuration Management	Network Planning and Engineering, Installation, Service Planning and Negotiation, Provisioning, Status and control											
Accounting	Usage Measurement, Tariffing/pricing, Collections and Finance, Enterprise Control											
Performance Management	Performance Monitoring, Performance Management Control, Performance Analysis											
Security Management	Prevention, Detection, Containment and Recovery, Security Administration											
2.2	<p><b>TMF forum eTOM Model</b></p> <p>The Business Process Framework (eTOM) standards released by Telecom Management Forum (TMF) defines a library of business processes in a hierarchical process decomposition. At the overall enterprise level (Level 0) it captures process descriptions, inputs and outputs. At each subsequent level (Level 1, 2 and sometimes even 3 or 4) other key elements of the process are also Documented. The processes</p>	Information										

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	described under the eTOM model are about the overall management system which may include many management systems like eMS, NMS, OSS/BSS systems etc. The processes required in the NMS perspective are further specified in section 2.5 of this document.	
2.2.1	<b>eTOM Level-0, Level-1</b>	Information
2.2.1.1	<p>Level 0 and Level 1 process areas from the Business Process Framework are shown in the Figure-3 of GR of NMS (TEC48100:2026). At the overall conceptual level, the Business Process Framework shall be viewed as having the following three major (Level 0) process areas given in Figure-3 of GR of NMS (TEC48100:2026).</p> <ul style="list-style-type: none"> <li>a) Strategy, Infrastructure &amp; Product covering planning and life-cycle management</li> <li>b) Operations covering the core of operational management</li> <li>c) Enterprise Management covering corporate or business support management</li> </ul>	Information

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2.2.1.2	The Business Process Framework contains seven end-to-end vertical Level 1 process groupings in the areas of Strategy, Infrastructure and Product and Operations. These vertical groupings of processes focus on end-to-end activities and each grouping <del>shall</del> includes processes involving customers, supporting services, resources and suppliers/partners. These vertical groupings can be thought of as a lifecycle <del>when seen from left to right in Fugure-4 of GR on NMS (TEC 18100:2026).</del>	Information
2.2.1.3	The Strategy, Infrastructure & Product process area contains the “back-office” processes. They enable, support and direct the work done in Operations	Information
2.2.1.4	The focal point of the Business Process Framework is in the area of Fulfilment, Assurance and Billing. These vertical groupings <del>contain the core processes related to customer operations.</del>	Information
2.2.1.5	<del>contain the core processes related to customer operations.</del> The fourth vertical grouping in the operations area is Operations Support & Readiness (OSR). Its processes focus on the support and automation of customer operations	Information

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2.2.1.65	The horizontal groupings represent major programs or functions that cut horizontally across an enterprise's internal business activities. For example, customer relationship management includes business processes in marketing, ordering, billing, after-service support and follow-on sales. Where a vertical process grouping and a horizontal process grouping intersect across the map, further process detail can be applied in either that horizontal or vertical context, according to the user's needs	Information
2.2.2	<b>eTOM Level-2 end to end process breakdown</b>	Information
2.2.2.1	Within the Business Process Framework, processes are decomposed to the lowest possible level. The operations vertical is the focus area coming under management Systems and its Level-2 breakup is shown in Figure-5 of GR on NMS (TEC 48100:2026)-	Information
2.2.2.2	Operations includes processes that support customers, network operations, and management. This also consists of sales management and supplier/partner relationships management	Information
2.2.2.3	Fulfillment is responsible for delivering products and services to the customer. This includes order handling, service configuration and activation, and resource provisioning	Information

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2.2.2.4	Assurance consists of proactive and reactive maintenance activities, service monitoring (SLA or QoS), resource status and performance monitoring, and troubleshooting. This includes continuous resource status and performance monitoring to proactively detect possible failures, and the collection of performance data and analysis to identify and resolve potential or real problems	Information
2.2.2.5	Billing collects usage data records (accounting), various rating functions, and billing operations. This includes production of timely and accurate bills, providing pre-bill use information and billing to customers, processing their payments, and performing payment collections. A detailed description of each layer can be found in the TMF's eTOM document (GB921).	Information
2.2.2.6	Resource Management & Operations (RM&O) is responsible for application, computing, and network resources. It includes Resource Trouble Management, which performs fault monitoring and management functions, such as processing device notifications, root cause analysis, and fault reporting. Resource Performance Management <b>monitors, analyzes, and reports performance data from the devices.</b> <del>is another function of RM&amp;O. It monitors, analyzes, and reports performance data from the devices.</del> A common RM&O function between assurance and billing is Resource Data Collection and Processing. It gathers and distributes management data <b>between devices and service instances.</b>	Information

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2.2.2.7	Service Management & Operations (SM&O) consists of Service Problem Management and Service Quality Management in the assurance section. These are responsible for monitoring, analyzing, and controlling operational services, as well as detecting, analyzing, and localizing service problems	Information
2.2.2.8	In the billing area, Service and Specific Instance Rating correlates service events and converts them into a specific format. <del>Reports on events can be generated for example, to identify fraud</del>	Information
2.3	<b>eTOM-M3400 Mapping</b> The synergy between the standards of ITU-T and the TMF has been brought by ITU-T through its recommendation M3050 where a mapping has been recommended between the ITU-T Functional Areas as per M3400 and the eTOM Level-2 processes	Information
2.4	<b>Generalised Model</b> <del>The Operations area in the eTOM model and the FCAPS functionality are as per the M.3400. Based on these standards, a generalised model for the various building Blocks of Telecom Management System is given in Figure-6 of GRN on NMS (TEC 48100:2026). The various functions in the M.3400 Model are performed by the eMS, NMS and OSS/BSS Systems in a Telecom Network. However, eTOM model goes into additional functionalities in Strategies,</del>	Information

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	Infrastructure & Product and Enterprise Management segments which are performed by Enterprise Resource Planning [ERP] systems. The role of ERP systems is not dealt with in this document	
2.4.1	Resource refers to a full or part of a network element (e.g. Router), application (e.g. Software) or compute (e.g. Server) or logical resources (e.g. bandwidth) having a specific role in the Telecom network.	Information
2.4.2	The functions of the EML namely Resource discovery, Resource provisioning / configuration, Resource performance data collection, Resource Fault data collection and Resource CDR data collection are performed by the eMS. Some of the Resource Administration and Resource Security features are also performed by the eMS. The EML functions of Network Probes and Route Analytics could be part of the eMS or NMS depending upon the purchaser's requirement.	Information
2.4.3	The overall system map is given in Figure-7 of GR on NMS (TEC 48100:2026). All the functions described in the figure covering The EML, NML, SML and BML Layers in a telecom network are performed by three systems namely the OSS/BSS System (Or Customer Relationship Management Systems), NMS System and eMS Systems. In certain deployments there is a separate provisioning system, as well which performs the provisioning	Information

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functions which is of part of the NMS and OSS/BSS system. However this document covers only the provisioning aspects related to NMS systems.

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2.5	<p><b>Functions to be performed by the NMS</b></p> <p><b>NMS function</b></p> <p>The NMS functions include the following functions. This is based on the horizontal and vertical layered architecture as in Figure 2 and clause 2.1.6 of GR on NMS (TEC 48160:2026)</p> <p>a) NML Functions</p> <ul style="list-style-type: none"> <li>i) Resource Administration</li> <li>ii) Resource Inventory</li> <li>iii) Resource Topology Discovery</li> <li>iv) Resource Function Management</li> <li>v) Resource Trouble Management</li> <li>vi) Resource Security</li> </ul> <p>b) SML Functions</p> <ul style="list-style-type: none"> <li>i) Service Quality / SLA Management</li> <li>ii) Service Problem Management</li> <li>iii) Service Configuration and Activation</li> </ul> <p>c) BML Functions</p> <ul style="list-style-type: none"> <li>i) Customer Experience Management</li> <li>ii) Web Portal</li> </ul> <p>d) EML Functions</p> <ul style="list-style-type: none"> <li>i) Route Analytics</li> <li>ii) Network &amp; Device Probes</li> </ul>	Information
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	<p>a—Resource Administration</p> <p>b—Resource Inventory</p> <p>e—Resource Topology Discovery</p> <p>d—Resource Performance Management</p> <p>e—Resource Trouble Management</p> <p>fa Resource Security</p>	
	<p>g—Service Quality Management</p> <p>h—Service Problem Management</p> <p>i—Service Configuration &amp; Activation</p> <p>j—SLA Management</p> <p>k—Customer Experience Management</p> <p>l—Route Analytics</p> <p>m—Network &amp; Device Probes</p> <p>ng Web Portal</p>	

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3.0	<p><b>FUNCTIONAL REQUIREMENTS :</b></p> <p>The Management Functions to be supported by the NMS described in this section consist of requirements as per ITU-T <del>REC</del>—M.3400. Functions of NMS <del>is</del> <b>are</b> based on FCAPS (Fault, Configuration, Accounting, and Performance &amp; Security) which are known as Function Groups. The NMS shall support the following Management Function groups. These Function Groups are further subdivided into Management Function sets which are included under individual function group. The implementation of management set can be done by a single device/<del>software</del> or with multiple <del>devices/software</del>.</p> <p><del>devices-</del></p>	Information
3.1	<p><b>Fault Management:</b></p> <p>Fault management is the set of functions that detect, isolate, and correct malfunctions in a telecommunications network, compensate for environmental changes, and include maintaining and examining error logs, accepting and acting on error detection notifications, tracing and identifying faults <b>including self-faults, correcting faults, reporting error conditions, and localizing and tracing faults by examining and correlating the underlying database information.</b></p>	Information

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	<del>correcting faults, reporting error conditions, and localizing and tracing faults by examining and correlating the underlying database information.</del>	
3.1.1	<b>Resource Trouble Management</b>	Information
3.1.1.1	It is expected that the eMS <del>shall carries</del> out the first level of alarm collection and filtration. <del>The eMS shall</del> and pass on the filtered alarms to the NMS.	Functional Verification
3.1.1.2	The NMS shall <del>enable the Service Provider in defining</del> define the Alarm Policy to the extent that which event shall raise an alarm of urgent nature or other different nature etc. <del>The NMS shall</del> also assist eMS to <del>in categorisation of</del> categorize an alarm into various categories. It shall assist the eMS in defining the filtering rules for the alarms and events for individual Network Element.	Functional Verification
3.1.1.3	The NMS shall carry out the analysis of the events in the networks and shall correlate the events to determine the root cause based on correlation and next level of filtering of alarms. The NMS shall assist in defining the policy for carrying out the root- cause analysis. The NMS shall have provision to add manual root cause analysis after the <del>operator</del> user has carried out the same to its Knowledge data base in an automatic manner.	Functional Verification

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3.1.1.4	The NMS shall <del>correlate various alarms and present</del> only the root cause <del>shall be presented</del> to <del>operator-user</del> as an alarm. It shall be configurable whether to present the all alarms along with the <del>root cause or some selected alarms only.</del>	Functional Verification
3.1.1.5	The NMS shall have provision for modification of alarm status from urgent to non-urgent or to be <b>acknowledged to acknowledged</b> etc	Functional Verification
3.1.1.6	<del>It NMS</del> shall <del>be possible to</del> define the destination of alarm reporting. It could be a centralised location for all the alarms or it could vary based on type of alarm. The NMS shall also support reporting of the alarms to a non NMS location in form of e-mail message, SMS, etc.	Declaration
3.1.1.7	The NMS shall detect the failure of a Network Element and report it to a configurable NMS or non NMS location <del>which is configurable through either as</del> an alarm or <del>m</del> Message (e-mail, SMS etc.).	Functional Verification
3.1.1.8	The NMS shall support presentation of alarms summary on demand or at configurable intervals to a NMS and/or non NMS location	Functional Verification
3.1.1.9	The NMS shall have provision for customizing the events trigger by alarm.	Declaration
3.1.1.10	The NMS shall support visual indication for alarms in form of an Alarm Panel or on NMS <del>operator-user</del> screen with option of audio indication.	Declaration

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3.1.1.114	<del>Audio/visual alarm indication shall be given when the processor load exceeds a certain configurable pre-set value.</del>	Declaration
3.1.1.112	All alarm related information (e.g. alarm receive-time start-time, clear-time, acknowledge-time etc.) shall be logged with time and date-stamped.	Functional Verification
3.1.1.123	The Alarm/event shall be logged to system file <del>which shall not be possible to modify except for the size of the file.</del>	Declaration
	<del>which shall not be possible to modify except for the size of the file.</del>	
3.1.1.134	NMS shall be able to display and print of detailed alarm logs with location, time and date of occurrence, duration of the faults, and event history information.	Functional Verification
3.1.1.145	NMS shall show operators <del>in the NOC</del> using the NMS terminals precisely which network users, customers or processes are affected by a fault.	Declaration
3.1.1.156	NMS shall be able to display alarm and events specified by the following criteria: <ul style="list-style-type: none"> <li>a Alarm types</li> <li>b Time interval</li> <li>c Vendor</li> <li>d Technology</li> <li>e Customer</li> <li>f Service</li> <li>g Location</li> </ul>	Declaration

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3.1.1.167	NMS shall allow escalation of alarms in case the same is not attended within a configurable time frame. Escalation shall increase the severity, list them in a separate group, <del>mail</del> raise it to next level of administrator, etc.	Functional Verification
3.1.1.178	The NMS shall have provision for determination of the fault in a network. It shall have the capability of fault localization upto a part of the network (e.g. up to a single or a group of NEs).	Functional Verification
3.1.1.189	The NMS shall have provision to invoke the diagnostic tools via eMS and eMS shall run it locally.	Declaration
3.1.1.1920	The NMS shall have provision for definition of the fault localization policy which shall be used to provide the assistance to the user involved in fault localisation or running the diagnostics on a part of the network or Network Element up to port level. It shall have an user upgradable database to add a new rule to the policy.	Declaration
3.1.1.2024	<del>NMS shall be possible to</del> automate the complete procedure of any particular type of testing using macros.	Declaration

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3.1.1.212	The NMS shall have control over the NEs over which the tests are being executed from the NMS through the eMS. Ideally no Local Craft Terminal shall be able to execute any operation once the test <del>is</del> being run on a NE under the control of NMS. However the <del>service-provider</del> user shall be able to configure the priority of local craft terminal / eMS over NMS and vice-versa for any given set of commands.	Declaration
3.1.1.223	The NMS shall correlate the test results and identify any fault on the basis of the correlation results.	Functional Verification
3.1.1.234	NMS shall be able to place a NE, which may be alarmed or non-alarmed, into maintenance mode for purposes of maintenance, troubleshooting and/or repair. Alarms received from the NE which are in maintenance mode shall be ignored.	Declaration
3.1.1.24	The NMS shall support priority messages to interrupt input or output message of lower priority	Declaration
3.1.1.25	<p>AI / ML Capabilities of NMS: Purchaser may specify the any or all of the following AI/ML capabilities required in the NMS while making procurement as mentioned under clause 10.3.</p> <p>i) NMS shall support Alarm correlation by leveraging AI/ML capabilities to quickly isolate network issues and identify root cause analysis</p>	Declaration

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with minimal human intervention or manual rule-based policy configurations to determine the underlying cause of a fault or an issue, propose/recommend corrective actions to resolve the fault/issue.

ii) NMS shall leverage machine learning algorithms to correlate performance management data and alarms to identify the root cause of network issues thereby reducing the time taken for root cause analysis.

iii) NMS shall use machine learning algorithms for anomaly detection, enabling the system to identify unusual patterns indicative of potential issues.

iv) NMS shall dynamically adjust to the changing network conditions to avoid false positives.

v) NMS shall provide predictive analytics to forecast potential incidents based on historical and real-time data.

vi) NMS shall incorporate feedback loops to continuously improve the accuracy of root cause analysis.

NMS shall leverage AI/ML capabilities for Performance Optimization and analyse network performance data, including traffic patterns, bandwidth utilization, and latency metrics, to optimize network configurations and resource allocation

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3.1.2	<p><b>Service Problem Management (Optional Requirement)</b></p> <p>Service Problem Management refers to functions that respond immediately to <b>group of</b></p>	Information
	<p>customer-affecting service problems or failures in order to minimize their effects on <b>group of</b> customers, and to invoke the restoration of the service, or provide an alternate service as soon as possible <b>automatically or through manual commands based on other conditions like network configurations, availability of resources, capability of underlying infrastructure etc.</b></p>	
3.1.2.1	<p>The NMS shall support the testing of the services through eMS. <del>is being provided from the network.</del> It shall be able to carry out the service testing for group of customers.</p>	Declaration
3.1.2.2	<p>NMS shall initiate and manage service alarm event records.</p>	Declaration
3.1.2.3	<p><del>The NMS</del> shall perform service alarm event notification localization analysis.</p>	Declaration
3.1.2.4	<p><del>The NMS</del> shall correlate and filter service alarm event</p>	Declaration

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	records.	
3.1.2.5	The NMS # shall report service alarm event record status changes to other processes.	Declaration
3.1.2.6	The NMS # shall manage service alarm event record trouble conditions. <del>jeopardy conditions.</del>	Declaration
3.1.2.7	Service alarm event notification analysis encompasses the identification of the service alarm event in terms of reporting entity and nature of the service alarm event.	Declaration
3.1.2.8	The NMS # shall analyze the service alarm events based on a number of criteria and then suppress redundant, transient or implied service alarm events by means of filtering and correlation.	Declaration
3.1.2.9	The NMS shall generate a trouble ticket on any configurable event of service fault/degradation.,- SLA breaches, etc.	Functional Verification
3.1.2.10	The NMS shall provide the management of trouble ticket status.,- whether it- The status changes like the trouble ticket has been	Functional Verification
	attended or is being attended etc., shall be available -the informed- in the status report.	
3.1.2.11	The NMS shall provide interrogation of trouble ticket information by the operators-users or the BML over standard North Bound interface.	Declaration

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3.1.2.12	The NMS shall create a new service problem report as a result of service alarm event notification analysis, and subsequent creation of new service alarm event records, undertaken by the survey & analyze service problem processes.	Declaration
3.1.2.13	If the service problem report is created as a result of a notification or request from processes other than the service problem processes, NMS shall create service problem report responsible for converting the received information into a form suitable for the service problem management processes.	Declaration
3.1.2.14	The NMS shall report/notify the opened trouble ticket to the pre designated location as per the policy configured.	Declaration
3.1.2.15	The NMS shall report service problem processes to monitor the status of service problem reports, provide notifications of any changes and provide management reports.	Functional Verification
3.1.2.16	The NMS shall also processes record, analyze and assess the service problem report status changes to provide management reports and any specialized summaries of the efficiency and effectiveness of the overall service problem management process.	Declaration
3.1.2.17	The NMS shall diagnose service problem processes	Declaration
	to identify the root cause of the specific service problem.	

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3.1.2.18	The NMS shall verify whether the service configuration matches the appropriate product features and perform diagnostics against the specific services;	Functional Verification
3.1.2.19	The NMS shall run tests against the specific services and start & stop audits against specific services	Functional Verification
3.1.2.20	The NMS shall also schedule routine testing of the specific services	Declaration
3.1.2.21	The NMS shall correct & resolve service problem processes to restore the service to a normal operational state as efficiently as possible. Based on the nature of the service failure leading to the associated service alarm event notification, automatic restoration procedures shall be triggered.	Declaration
3.1.2.22	The NMS shall give customizable alarms triggered to alert the appropriate personnel to either take action or raise service incidents or both allowing them to focus on the most critical issues immediately	Declaration
3.1.2.23	Depending on the nature of the specific service failure, <del>these processes</del> NMS shall re-assign services or re-configure service parameters as per need <b>automatically or through manual commands based on other conditions like network configurations, availability of resources, capability of underlying infrastructure etc.</b>	Declaration

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3.1.2.24	The NMS shall track & manage service problem processes to ensure that testing, repair and restoration activities are assigned, coordinated and tracked efficiently, and that escalation is invoked as required for any open service problem reports <del>in jeopardy.</del>	Declaration
3.1.2.25	The NMS shall <del>assist to</del> schedule, assign and coordinate repair and restore activities and generate the respective resource problem report. NMS shall also assist in necessary tracking of the execution progress and shall modify information in an existing service problem report based on assignments	Declaration
<del>3.1.2.26</del>	<del>NMS shall undertake necessary tracking of the execution progress and shall modify information in an existing service problem report based on assignments.</del>	<del>Declaration</del>
<del>3.1.3</del>	<del>SLA Management</del> The NMS system shall meet the following SLA Management Requirements.	<del>Information</del>
<del>3.1.3.1</del>	The NMS shall provide a web interface for the customers to login and verify their SLA related parameters	<del>Functional Verification</del>
<del>3.1.3.2</del>	The NMS shall provide visibility of the service quality delivered across the Network together with the ability to manage end customer SLAs.	<del>Functional Verification</del>

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3.1.3.3	The NMS shall support the following features: a) Dynamic service monitoring overview b) Service problem investigation c) Service quality impact analysis d) Real-time status views. e) Generates SLA violation alarms and notifications. f) Service quality trend reporting – historical reports on how key parameters have varied over user defined reporting periods. g) Produces periodic service level performance reports	Declaration
3.1.3.4	The NMS shall provide the capability to model services and report the overall Quality of Service and Service Level Agreement and SLA fulfilment.	Declaration
3.1.3.5	The NMS shall be capable of extending support to additional services required in the future	Declaration
3.1.3.6	The NMS shall provide service metrics to be defined using Key Quality Indicators (KQIs).	Functional Verification
3.1.3.7	The NMS shall provide resource metrics to be defined using Key Performance Indicators (KPIs).	Functional Verification
3.1.3.8	The NMS shall provide a GUI that allows KQIs and KPIs to be configured easily using point-and-click techniques.	Functional Verification
3.1.3.9	The NMS shall have the capability to use various mathematical and logical operations for calculating KQI and KPI metrics	Declaration

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3.1.3.10	The NMS shall allow the configuration of a variety of data sources including: a Performance data source for key network measures b Fault data sources for relevant alarms c Operational data sources like trouble tickets	Declaration
3.1.3.11	The NMS shall allow defining thresholds to detect SLA violations.	Functional Verification
3.1.3.12	The NMS shall generate service quality alerts when anomalies are detected based on a comparison to historical KQI trends.	Declaration
3.1.3.13	The NMS shall allow different thresholds to be configured for different times of day.	Declaration
3.1.3.14	The NMS shall have configurable interfaces to collect data from various data sources (eMS's, trouble-ticketing, fault management module, performance management module).	Declaration
3.1.3.15	The NMS shall allow privileged user to specify the list of resources from which to collect data, the list of measurements to collect, and the collection interval.	Declaration
3.1.3.16	The NMS shall use trouble ticket data to compute key KQIs like the MTTR.	Declaration
3.1.3.17	The NMS shall compute availability KQIs using the fault data source.	Declaration
3.1.3.18	The NMS shall calculate availability KQIs to monitor for SLA violations	Declaration

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3.1.3.19	The NMS shall generate SLA violation information in real time when a KQI/KPI threshold is violated so the Network Operation Centre can be alerted to this condition.	Functional Verification
3.1.3.20	The NMS shall forward service quality alarms to other systems via SNMP.	Declaration
3.1.3.21	The NMS shall aggregate Service Quality Records (KPI/KQI Reports) over time on a per customer/service basis.	Declaration
3.1.3.22	The NMS shall create historical trends based on quality parameters.	Declaration
3.1.3.23	In response to a threshold violation, the SLA Management system shall provide following automatic task: a) Generate an alert. b) Forward an email/SMS. c) Execute a customized script.	Functional Verification
3.1.3.24	The NMS shall provide viewing and editing displays of Service Definitions.	Declaration
3.1.3.25	The NMS shall provide a dashboard view on a browser front-end. The dashboard view can be configured so that it can be personalized for different users	Functional Verification
3.1.3.26	The NMS's dashboard shall provide instant visibility to potential alerts in the services.	Functional Verification
3.1.3.27	The NMS's dashboard view shall allow a user to view detailed service quality metrics on a per customer basis upon seeing an alert.	Functional Verification

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3.1.3.28	The NMS shall provide user-configurable reports indicating SLA compliance on a per-customer basis.	Declaration
3.1.3.29	The NMS shall provide option for the scheduling of reports.	Declaration
3.1.3.30	The NMS shall provide reports to users via a web-based interface.	Declaration
3.1.3.31	The NMS shall generate management reports providing information on the following: a) Customer network configuration and changes b) Faults and achievement against the SLAs	Declaration
3.1.3.32	The NMS shall deliver network management reports via a secure Web site.	Declaration
3.1.3.33	The SLA Reports include latency, packet loss, jitter, error apart from the availability and the link utilization reports for IP networks.	Declaration
3.1.3.34	It shall generate detailed and summary reports for all the above parameters. The reports are customer friendly.	Declaration
3.1.3.35	The NMS shall provide customer his network topology as well as alarms on his network in a user friendly format.	Declaration
3.1.3.36	The NMS shall allow customer to view reports pertaining to different queues in case QoS for IP networks is implemented for the customer.	Declaration
3.1.3.37	The NMS shall store all collected service quality data with a timestamp including the date and time received.	Functional Verification

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3.1.3.38	The NMS shall support the computation and aggregation of KPI and KQI metrics indicative of the quality of service (QoS) for various services and applications delivered over the network infrastructure.	Declaration
3.1.3.39	The NMS shall support root cause analysis of QoS violations through 'drill down' analysis of KQI and KPI metric data. Root cause analysis includes the presentation of failure modes / cause codes and identification of failure distribution by location, service/device type, subscriber type or other dimensions as appropriate to the monitored services.	Declaration
3.1.3.40	The NMS shall monitor the service from both its internal perspective i.e. how the service is coping across the network as well as that of its customers and partners.	Declaration
3.1.3.41	The NMS shall provide a real-time availability based service management view.	Functional Verification
3.1.3.42	The NMS shall allow building service models, integrating business service status from data sources or event sources, and display customized business service views, scorecards, and dashboards in real time.	Declaration
3.1.3.43	The NMS shall provide service visualization capability, by integrating data from event sources or data sources to show the status of various services and the impact of outages.	Declaration

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3.1.3.44	The NMS shall allow creating custom business service views. The module provides a graphical user interface (GUI) that allows to logically linking services and business requirements within the service model.	Declaration
3.1.3.45	The NMS shall provide dynamic visualization of key performance indicators to show the health and performance of critical business services.	Declaration
3.1.3.46	The NMS shall display a dependency view which depicts the relationship models and the status of its building blocks as it relates to each model	Declaration
3.2	<b>Configuration Management :</b> Configuration Management provides functions to exercise control over NE's as well as , identify, collect data from and provide data to NEs. Configuration Management supports the following function set groups	Information
3.2.1	<b>Resource Inventory :</b>	Information
3.2.1.1	The NMS shall provide the complete view of the network elements and the interconnecting links	Functional Verification
3.2.1.2	The NMS shall be able to discover and keep the device information up to logical interface level.	Functional Verification
3.2.1.3	The NMS shall be able to store and/or display all the devices based on their make & model.	Functional Verification
3.2.1.4	The NMS shall be able to keep track on any change in the network inventory reported chronologically	Declaration

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3.2.1.5	The NMS shall provide the inventory information to the <del>SML</del> OSS/BSS so that the <del>SML</del> OSS/BSS is able to create and activate a service to the customer automatically. This shall also assist <del>SML</del> OSS/BSS in providing the network inventory to which the <del>SML</del> OSS/BSS shall add the customer identification and maintain this information in its database.	Declaration
3.2.1.6	The NMS shall be able to generate report based on the available device inventory up to logical interface level.	Functional Verification
3.2.1.7	The NMS shall be able to generate reports based on changes made in the Network Inventory.	Declaration
3.2.2	<b>Resource Topology discovery</b>	Information
3.2.2.1	The NMS shall be able to determine the layout of a particular network with network elements (Resources) in a Geographical map	Functional Verification
3.2.2.2	The <del>Network Manager</del> NMS shall <del>have the ability to</del> auto discover the network elements and the links to include them in the visual/graphical map of the domain. NEs need to support this feature (auto discovery) through their <del>e</del> EMS otherwise NEs shall introduce (register) themselves to the NMS.	Declaration
3.2.2.3	The Visual Maps shall display the elements and the links in different colour depending upon the	Functional Verification

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	status of the links. It is preferable that green colour for healthy and amber/yellow colour for degraded condition and red for unhealthy condition is used.	
3.2.2.4	<b>The NMS</b> shall indicate the absence or presence of any physical module in hardware elements. It shall also indicate the usage of module i.e. how many ports are in use, which interface is in use and which are free to be used etc.	Functional Verification
3.2.2.5	<del>The NMS</del> shall provide the ability to drill down to the individual element, then to subsystem, then to card and then to port level configuration template from the domain Map by clicking on the icon of the network element.	Functional Verification
3.2.3	<b>Service Configuration and Activation</b> Provisioning consists of procedures which are necessary to bring an equipment into service, excluding installation. Once the unit is ready for service, the supporting programs are initialized via the NMS. The state of the unit (e.g. in-service, out-of-service, standby, reserved) and selected parameters may also be controlled by provisioning functions. It is expected that all these operations are carried out on the NE's through their respective eMS's through standard open interface. Provisioning shall include the following functions	Information

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3.2.3.1	<del>NMS shall allow the design of network, based on customer location, requested service features, etc. It shall also determine the most efficient routing based on generic criteria for</del> The NMS shall support request for, and report the assignments of resources, as appropriate. These resources may be NEs, a group of NEs, or logical resources such as bandwidth or service logic programs	Declaration
3.2.3.2	<del>NMS shall support requests for a directory address e.g. telephone number, IP address, etc.</del> The NMS shall provide availability status of resources, selection and assignment of those resources, requests for the resources to change service state requests for network resources reservation (to eMS) and collect response regarding selected resources and the associated service features. It shall support requests for selection and assignment of resources and service features that meet any designated selection criteria.	Declaration
3.2.3.3	<del>NMS shall support requests that the specified service and/or feature(s) be activated, changed, or deactivated as a result of the negotiated customer solution.</del> The NMS shall support confirmation of execution of all requested actions. It shall support pending reports as appropriate.	Functional-VerificationDeclaration
3.2.3.4	<del>NMS shall provide access to a database for the logging and tracking of service requests to ensure that all requests for service are met in a timely manner.</del> The NMS shall provide access to information concerning NE resources that are assigned to services or that are currently available for assignment. It shall monitor utilization levels of resources and sends	Declaration

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	notifications when utilization exceeds configurable thresholds. It shall respond to requests for utilization information	
3.2.3.5	<del>NMS shall support request for, and report the assignments of resources, as appropriate. These resources may be NEs, a group of NEs, or logical resources such as bandwidth or service logic programs.</del> The NMS shall support loading of software to activate service-specific features in NE components such as the downloading of software features to line cards at the time of activation of service. Loading includes support of reporting the results of testing that the load is successful and of back-out of the software features if the load is not successfully completed	Declaration
3.2.3.6	<del>NMS shall provide availability status of resources, selection and assignment of those resources, requests for the resources to change service state requests for network resources reservation (to EMS) and collect response regarding selected resources and the associated service features. It shall support requests for selection and assignment of resources and service features that meet any designated selection criteria.</del> The NMS shall provide information about individual NE connections and the removal of NE connections if end-to-end connections cannot be completed. It shall support notification of changes that result from differences between assigned and installed NE configurations	Declaration
3.2.3.7	<del>NMS shall supports confirmation of execution of all requested actions. It shall support pending</del> The NMS shall support I/O logic command handling tool to perform various tasks such as configuration, functional change, administration,	Declaration

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	creation, deletion etc., of the Network Data which shall be residing at NMS and also in the network elements, in a centralized operation and maintenance environment	
	<del>reports as appropriate.</del>	
3.2.3.8	<del>NMS shall carry out the cross-connections to be established in NEs or groups of NEs in applicable technologies.</del> The NMS shall support configuration of the various network elements like creating, viewing, and editing. The NMS shall also store the configurations of the network elements from where it can be retrieved in case of failure	Declaration
3.2.3.9	<del>NMS shall provide access to information concerning NE resources that are assigned to services or that are currently available for assignment. It shall monitor utilization levels of resources and sends notifications when utilization exceeds configurable thresholds. It shall respond to requests for utilization information</del> The NMS shall back-out from an operation if not completed successfully i.e. the NMS shall delete all creation/modification from all involved network elements for all the commands which has been carried out as part of a task which was not completed successfully and involved many network Elements and commands. However clear alarm shall be generated in such cases where it may not be able to 100% back-out..	Declaration
3.2.3.10	<del>NMS shall allow for connection with different NEs or network interfaces through respective eMS's to establish an end-to-end circuit connection.</del> The NMS shall execute any command at any time by attaching a time tag to the command and it shall be executed when the Network real time matches the time tag. It shall be possible to define both time and date. If no	Declaration

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	date is mentioned, the command shall be executed daily at the time indicated.	
3.2.3.11	<del>The NMS shall provide access to status and shall receive requests to change status of network and its components.NMS shall support loading of software to activate service specific features in NE components such as the downloading of software features to line cards at the time of activation of service. Loading includes support of reporting the results of testing that the load is successful and of back-out of the software features if the load is not successfully completed.</del>	Declaration
3.2.3.12	<del>The NMS shall provide status of service resources and carry out requests for transitions after determining the legality and effect of requested state changes.NMS shall provide information about individual NE connections and the removal of NE connections if end-to-end connections cannot be completed. It shall support notification of changes that result from differences between assigned and installed NE configurations</del>	Declaration
3.2.3.13	<del>The NMS shall support I/O logic command handling tool to perform various tasks such as configuration, functional change, administration, creation, deletion etc., of the Network Data which shall be residing at NMS and also in the Elements, in a centralized operation and maintenance environment Automatic notification</del>	Declaration Functional Verification

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	of change of state may be initiated by the NE such as a change from "enabled" to "disabled" in the event of a failure.	
3.2.3.14	<del>The configuration of the various network elements like creating, viewing, and editing shall be possible from the NMS. The configurations of the network elements shall also be stored at suitable place in NMS from where it can be retrieved in case of failure. The NMS shall suggest through alarms/notifications for the exclusion of faulty equipment from operation. After exclusion, NMS may assist in rearranging equipments or re-routing of the traffic.</del>	Declaration
3.2.3.15	<del>The NMS shall back-out from the operation if not completed successfully i.e. the NMS shall delete all creation/modification from all involved network elements for all the commands which has been carried out as part of a task which was not completed successfully and involved many network Elements and commands. However it may not be 100% back-out, in such cases clear alarm shall be generated The NMS shall enable the entry of a proposed configuration in order to automatically analyze the feasibility of that design before implementing it.</del>	Declaration
3.2.3.16	<del>It shall be possible to execute any command at any time by attaching a time tag to the command and it shall be executed when the Network real-time matches the time tag. It shall be possible to define both time and date. If no date is mentioned, the command shall be executed daily at the time indicated. The NMS shall aid in determining the correctness of the parameters before they are committed to a command/operation. If the operator</del>	Declaration

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	gives/selects wrong parameters, the NMS shall prompt the user about the wrong value.	
3.2.3.17	The NMS shall support software download to the NE. Loading includes initialization and testing that the loading is successful and roll-back of the software if the loading is not successfully completed. <del>NMS shall provide access to status and receives requests to change status of network and its components.</del>	Declaration
3.2.3.18	The NMS shall provide a single GUI for configuration management across heterogeneous devices from multiple vendors. <del>NMS shall provide status of service resources and carry out requests for transitions after determining the legality and effect of requested state changes.</del>	<del>Declaration</del> Functional Verification
3.2.3.19	The NMS shall support discrete configuration file management. <del>Automatic notification of change of state may be initiated by the NE such as a change from "enabled" to "disabled" in the event of a failure.</del>	<del>Functional Verification</del> Declaration
3.2.3.20	The NMS shall maintain an active archive of configuration files for the managed network devices with modifications made in them. <del>NMS shall suggest the exclusion of faulty equipment from operation and as a result it may rearrange equipment or re-route traffic.</del>	Declaration
3.2.3.21	The NMS shall support recover back feature in case all the components involved in configuration are not able to be configured due to any reason. <del>NMS shall enable the entry of a</del>	Declaration

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	<del>proposed configuration in order to automatically analyze the feasibility of that design before implementing it.</del>	
3.2.3.22	<del>The NMS shall provide a comprehensive audit of network changes reported chronologically. The NMS shall aid the operator in determining the correctness of the parameters before they are committed to a command/operation. If the operator gives/selects wrong parameters, the NMS shall prompt the operator about the wrong value. The NMS shall assist the operator in verifying the connectivity from one end to other end before the operation is carried out on multiple Network Elements.</del>	Declaration
3.2.3.23	<del>The NMS shall maintain records of modifications in the areas of hardware and configurations. NMS shall support download of software to be stored in an NE. Loading includes initialization and testing that the load is successful and roll back of the software if the load is not successfully completed.</del>	Declaration
3.2.3.24	<del>The NMS shall buffer recent commands and be re-displayed, re-edited and re-issued on request. NMS shall provide a single GUI for configuration management across heterogeneous devices from multiple vendors.</del>	Functional Declaration
3.2.3.25	<del>NMS shall support discrete configuration file management</del> The NMS shall support macro command/subroutine facility to carry out the	Declaration

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	same kind of operation on a group of interfaces by a single command. It shall be possible to generate a macro program which integrates the various operations in an intelligent sequence to carry out complex tasks of creation, modification and deletion of entities like Trunks, Software control of Elements etc. It shall also support import of Macro programs/routines from a program written as a text file from an external storage media.	
3.2.3.26	It shall be possible through a single Man-Machine Command to obtain a list and the total number of equipment of a particular domain in a state (e.g. In-service, blocked etc.). <del>NMS shall maintain an active archive of configuration files for the managed network devices with modifications made in them.</del>	Declaration
3.2.3.27	Where several man-machine terminals are in use on a single network element a mechanism shall be available to avoid clashes of command. <del>The configuration module shall support recover back feature in case all the components involved in configuration are not able to be configured due to any reason.</del>	Declaration
3.2.3.28	The execution of any command shall not result in malfunctioning or/and over loading of the network. <del>This set provides guidelines for determining which services have priority for restoration in the event of a catastrophic failure, e.g. hospitals, police and emergency services</del>	Declaration
3.2.3.29	Command errors detected by the network shall be indicated by the output of error messages. <del>NMS shall provide a</del>	Declaration

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	<del>comprehensive audit of network changes reported chronologically.</del>	
	Note: Following NMS requirements are applicable to specific technologies which may be considered depending upon the actual network requirement.	
3.2.3.30	The NMS shall assist the user in verifying the connectivity from one end to other end in applicable technologies before the operation is carried out on multiple Network Elements. <del>NMS shall maintain records of modifications in the areas of hardware and configurations</del>	Declaration
3.2.3.31	The NMS shall support to assign priority services for restoration in the event of a catastrophic failure, e.g. hospitals, police and emergency services etc., in applicable technologies. <del>It shall be able to buffer recent commands and be re-displayed, re-edited and re-issued on request.</del>	Declaration
3.2.3.32	The NMS shall carry out the cross-connections to be established in NEs or groups of NEs in applicable technologies. <del>It shall support macro-command/subroutine facility to carry out the same kind of operation on a group of interfaces by a single command. It shall be possible to generate a macro program which integrates the various operations in an intelligent sequence to carry out complex tasks of creation, modification and deletion of entities like Trunks, Software control of Elements etc. It shall also support import of</del>	Declaration

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	<del>Macro programs/routines from a program written as a text file from a floppy/CD.</del>	
3.2.3.33	The NMS shall allow for connection with different NEs or network interfaces through respective eMS's to establish an end-to-end circuit connection in applicable technologies.	Declaration
	Note: Following NMS requirements are customer oriented which may be considered for NMS for managing services to end customers.	
3.2.3.34	The NMS shall allow the design of network, based on customer location, requested service features, etc. It shall also determine the most efficient routing based on generic criteria for routing, such as traversing the least number of nodes, and customer specific criteria, such as alternate path routing in case of applicable technologies.	Declaration
3.2.3.35	The NMS shall support requests for a directory address e.g. telephone number, IP address, etc., as applicable.	Declaration
3.2.3.36	The NMS shall support requests that the specified service and/or feature(s) be activated, changed, or deactivated as a result of the negotiated customer solution.	Functional Verification
3.2.3.37	The NMS shall provide access to a database for the logging and tracking of service requests to ensure that all requests for service are met in a timely manner.	Declaration

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3.2.4	<b>Provisioning Management</b> These functions may be performed by the NMS itself or through an integrated Provisioning Management system/module.	Information
3.2.4.1	The NMS shall support single GUI based provisioning system which provisions network and end user services from a single screen.	Functional Verification
3.2.4.2	The NMS shall support consistent and simplified service activation methodology across services.	Declaration
3.2.4.3	The NMS shall allow one touch network / service provisioning for all the services as mentioned in the earlier sections.	Declaration
3.2.4.4	The NMS shall maintain a detailed association of the resources for each of the services deployed. NMS shall maintain a complete inventory of end customers being served along with contact information and automatically associate services against customers in this list.	Declaration
3.2.4.5	The NMS shall maintain a real-time database of the existing customer / services / resources i.e. NE's/Slot/Port –the object chain involved in providing services. For each of these services deployed, NMS shall maintain a detailed association of the resources	Declaration Functional Verification
3.2.4.6	The NMS shall maintain a real-time database of the existing customer / services / resources i.e. NE's/Slot/Port –the object chain involved in providing services. The NMS shall handle end-to-end service provisioning from one single point of provisioning platform regardless of whether the system manages a single family or different family products.	Functional Verification Declaration

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3.2.4.7	The NMS shall provide GUI-based features for all applications such as system configuration, service provisioning etc. <del>The NMS shall automatically capture all the configurations from the existing network and make an inventory of end subscribers out of it.</del>	<del>Declaration</del> Functional Verification
3.2.4.8	The NMS shall be configurable from the GUI for all services. <del>The NMS shall handle end-to-end service provisioning from one single point of provisioning platform regardless of whether the system manages a single family or different family products.</del>	<del>Declaration</del> Functional Verification
	Note : Following NMS requirements are applicable to specific technologies which may be seen depending upon the actual network requirement.	
3.2.4.9	<del>The NMS shall provide GUI-based features for</del> NMS shall maintain a complete inventory of end customers being served and automatically associate services against customers in this list for applicable technologies.	Functional Declaration
	<del>all applications such as system configuration, service provisioning etc.</del>	Verification
3.2.4.10	<del>The NMS shall be configurable from the GUI for all services.</del> The NMS shall automatically capture all the configurations from the existing network and make an inventory of end customers out of it for applicable technologies.	Functional Verification Declaration

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3.3	<p><b>Performance Management</b></p> <p>Performance Management provides functions to evaluate and report upon the behaviour of telecommunication equipment and the effectiveness of the network or network element. <del>#</del>The NMS shall gather and analyze statistical data for the purpose of monitoring and correcting the behaviour and effectiveness of the network, NEs or other equipment through the respective eMS's. The NMS <del>#</del> shall aid in planning, provisioning, maintenance and the measurement of quality.</p> <p><del>The end customer's perception of the quality, availability, and reliability when using the services is in most cases the deciding factor in ensuring customer loyalty.</del></p>	Information
3.3.1	<b>Resource Performance Management</b>	Information
3.3.1.1	<p>The NMS shall be able to establish Performance Monitoring (PM) policy such as the values of threshold settings and schedules for data collection for specific kinds of circuits. These settings are to be applied during activation of such circuits. Different policies are likely to be created for special service circuits of various kinds, for message circuits, and for facilities.</p>	Declaration
3.3.1.2	<p>The NMS shall report the root--cause of PM threshold crossing alerts and other PM events.</p>	Declaration

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3.3.1.3	NMS shall provide aggregated and correlated end-to-end current and history of PM information to detect and aid in the localization of network faults and impairments. It shall also provide access to trending information, which supports the extrapolation of historical data to predict future performance and to identify persistent or worsening impairments.	Declaration
3.3.1.4	<del>Graphical display of percentage of Link utilization and the network element resource shall be provided. The traffic observation shall indicate, for each type of service and for each type of call processing / call handling unit the number of units installed, number of units in service, call attempts, calls processed, calls answered etc.</del> The NMS shall report of trends that are detected by processing the historical data of an NE or group of NEs. The NMS shall be able to store historical data of at least past three months.	Functional Verification Declaration
3.3.1.5	The NMS shall support the reporting of results of the continuous detection, collection, and reporting of performance primitives, i.e. data or measurements, associated with a transmission, traffic, or service entity. <del>NMS shall provide current traffic status information of a sub-network and its major components</del>	Functional Verification
3.3.1.6	The NMS shall be able to store all the performance and traffic statistics for at least 3 month. It shall also be possible to generate	Declaration

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	<p>daily, weekly, monthly reports for the individual element as well as complete domain. The report generation shall be supported for text and graphic reports. <del>NMS shall report current performance measurements of the traffic being offered and carried by one or more NEs. These measurements relate to the assessment of the current performance of the network and the traffic being offered and carried.</del></p>	
3.3.1.7	<p>The NMS shall carry out the systematic Health Monitoring of the elements of the Network. It shall be possible to check on the health of the card of any network element. <del>NMS shall report of trends that are detected by processing the historical data of an NE or group of NEs. The NMS shall be able to store historical data of atleast past three months.</del></p>	Declaration
3.3.1.8	<p><del>The NMS shall provide for, at least the following types of supervision:</del></p>	Declaration

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	<p><del>a) Automatic detection of congestion on the incoming routes, the final backbone routes, the signaling devices and control units.</del></p> <p><del>b) Continuous supervision of Power Supply Units (PSU).</del></p> <p><del>c) Continuous supervision of tones for levels, etc.</del></p> <p><del>d) Automatic detection of any abnormalities in processing.</del></p> <p><del>e) Detection of trunks that are incapacitated for accepting traffic.</del></p> <p><del>f) Supervision of automatically blocked devices to ensure that conditions leading to traffic overload are not created.</del></p> <p>The NMS shall provide recommendations for performance improvement including corrective actions.</p>	
3.3.1.9	<p><del>NMS shall support the reporting of results of the continuous detection, collection, and reporting of performance primitives, i.e. data or measurements, associated with a transmission, traffic, or service entity.</del></p> <p>The NMS shall provide traffic forecasting based on history.</p>	Functional Verification Declaration
3.3.1.10	<p><del>It shall be possible to store all the performance and traffic statistics for at least 3 month. It shall also be possible to generate daily, weekly, monthly reports for the individual element as well as complete domain. The report generation shall be supported for text and graphic reports.</del></p> <p>The NMS shall provide reports to characterize end-to-end performance of dedicated digital networks, which includes Network Interface-to- Network Interface, and</p>	Declaration

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	Network Interface-to-Inter-Network Interface (point of termination), in relation to long-term (i.e. 30 or more days) accuracy and availability objectives.	
3.3.1.11	The NMS shall monitor NE quality and availability performance parameters in order to support service assurance and/or service offerings. <del>The NMS shall carry out the systematic Health Monitoring of the elements of the Network. Check on the health of the card of any element of the Network shall be possible through command</del>	<del>Declaration</del> Functional Verification
3.3.1.12	The NMS shall monitor network performance quality and availability in order to support service assurance and service offerings. <del>NMS shall have plans for anticipated conditions of congestion (for example, burst traffic that are typical to a region and focused demands that result from promotions and surveys).</del>	<del>Declaration</del> Functional Verification
3.3.1.13	The NMS shall monitor if the performance data, such as a count, has been compromised or invalidated by re-initialization (for example, the resetting of a clock), or internal equipment failure. <del>NMS shall allow creating and modifying routing patterns to relieve network congestion due to unusually high offered load, an unusual distribution of offered load, or one or more unprotected faults.</del>	Declaration

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3.3.1.14	<p>The NMS shall support scheduling of the Performance measurement, collection, storage and transfer of the performance statistics. It shall also support presentation of the performance statistics in graphical and text mode as and when requested and at repeated interval automatically.<del>NMS shall be able to create and manage the schedule for traffic measurement and other data that support traffic measurements and traffic control</del></p>	Declaration Functional Verification
3.3.1.15	<p>The NMS shall also provide real-time data/statistics on all the network elements under maintenance-mode or in fault state in a single command and in a single console.<del>NMS shall provide recommendations for performance improvement including corrective actions</del></p>	Declaration Functional Verification
3.3.1.16	<p>It shall be possible to get display and print-out of the measurement results on demand at any time during the measurement period.<del>NMS shall provide traffic forecasting based on history and an evaluation of business factors. The prediction may be required to maintain quality targets.</del></p>	Declaration
	<p>Note: Following requirements are specific to management of traffic oriented networks.</p>	

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3.3.1.17	<p>The NMS shall provide graphical display of percentage of Link utilization and the network element resource in applicable technologies.</p> <p>The traffic observation shall indicate, for each type of service and for each type of call processing / call handling unit the number of units installed, number of units in service, call attempts, calls processed, calls answered etc., in applicable technologies.</p> <p><del>NMS shall provide traffic exception analysis in order to detect and report on exceptional conditions due to unusual demand or reduced capacity. It provides sufficient supporting information to reveal the extent of congestion and to support a determination of remedial action.</del></p>	Declaration Functional Verification
3.3.1.18	<p>The NMS shall have plans for anticipated conditions of congestion (for example, burst traffic that are typical to a region and focused demands that result from promotions and surveys) as applicable.</p> <p><del>NMS shall provide traffic capacity analysis to estimate the level of offered traffic that can be carried by the current resources at the desired level of QOS.</del></p>	Declaration
3.3.1.19	<p><del>NMS shall provide reports to characterize end-to-end performance of dedicated digital networks, which includes Network Interface-to-Network Interface, and Network Interface-to-Inter-Network Interface (point of termination), in relation to long-term (i.e. 30 or more days) accuracy and availability objectives. The NMS shall provide current traffic status information of</del></p>	Declaration Functional Verification

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	a sub network and its major components in applicable technologies.	
3.3.1.20	<p>The NMS shall report current performance measurements of the traffic being offered and carried by one or more NEs. These measurements relate to the assessment of the current performance of the network and the traffic being offered and carried. NMS <del>shall provide following analysis for individual NE:</del></p> <p><del>NE(s) performance characterization</del></p> <p><del>NE(s) traffic exception analysis</del></p> <p><del>NE(s) traffic capacity analysis</del></p>	Declaration
3.3.1.21	<p><del>NMS shall monitor NE quality and availability performance parameters in order to support service assurance and/or service offerings. The NMS shall provide for, at least the following types of supervision in applicable technologies:</del></p> <p>a) Automatic detection of congestion on the incoming routes, the final backbone routes, the signaling devices and control units.</p> <p>b) Continuous supervision of Power Supply Units (PSU).</p> <p>c) Continuous supervision of tones for levels, etc.</p> <p>d) Automatic detection of any abnormalities in processing.</p> <p>e) Detection of trunks that are incapacitated for accepting traffic.</p> <p>f) Supervision of automatically blocked devices to ensure that conditions leading to traffic overload are not created.</p>	Functional- Verification Declaration
3.3.1.22	<p><del>NMS shall monitor network performance quality and availability in order to support service assurance and service offerings. The NMS shall allow creating and modifying routing</del></p>	Functional- Verification Declaration

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	patterns if applicable to relieve network congestion due to unusually high offered load, an unusual distribution of offered load, or one or more unprotected faults.	
3.3.1.23	<del>NMS shall monitor if the performance data, such as a count, has been compromised or invalidated by re-initialization (for example, the resetting of a clock), or internal equipment failure</del>	Declaration
3.3.1.24	<del>The NMS shall be able to create and manage the schedule for traffic measurement and other data that support traffic measurements and traffic control. The NMS shall support scheduling of the Performance measurement, collection, storage and transfer of the performance statistics. It shall also support presentation of the performance statistics in graphical and text mode as and when requested and at repeated interval automatically.</del>	<del>Functional-Verification Declaration</del>
3.3.1.25	<del>The NMS shall provide traffic exception analysis in order to detect and report on exceptional conditions due to unusual demand or reduced capacity. It shall provide sufficient supporting information to reveal the extent of congestion and to support a determination of remedial action. NMS shall also provide real-time data/statistics on all the network elements under maintenance mode or in fault state in a single command and in a single console</del>	<del>Functional-Verification Declaration</del>

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	The NMS shall provide following analysis for individual NE in applicable technologies: a) NE(s) performance characterization b) NE(s) traffic exception analysis c) NE(s) traffic capacity analysis	<b>Declaration</b>
<b>3.3.1.27</b>	The NMS shall be capable of measuring the slips on interfaces, designated through Man-Machine Commands in applicable technologies.	<b>Declaration</b>
3.3.2	<b>Service Quality/Service Level Agreement[SLA] Management (Optional Requirement)</b> The NMS shall perform the following Service Quality / SLA Management Requirements. These functions may be performed by the NMS or through an integrated SLA Management system.	Information
3.3.2.1	NMS shall have features to enable service quality management	Declaration
3.3.2.2	NMS shall provide customer service performance summary by evaluating the performance of a particular transport service or group of services.	Functional Verification
<del>3.3.2.3</del>	<del>NMS shall provide customer traffic performance like usage and measures of congestion on a leased circuit, a group of leased circuits, a hunt group, a leased physical or virtual network, etc.</del>	<del>Functional Verification</del>

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3.3.2.34	The NMS shall be able to retrieve, generate and print reports and graphs on Service Performance Management data based on real time, time intervals, daily, weekly, monthly, annually or specific period, for all NEs and its resources by using the built-in report capabilities of the System	Functional Verification
3.3.2.45	The NMS shall enable correlation of Service Performance Measurement is linked and featured in the fault management module with the following: <ul style="list-style-type: none"> <li>a Customer profile</li> <li>b Customer services</li> <li>c Logical network infrastructure</li> <li>d Physical network infrastructure</li> </ul>	Declaration
	e Class of Service / Type of Service	
3.3.2.56	The NMS shall provide the monitoring and tracking tool for services with Service Level Agreement (SLA) for Service Assurance Management	Declaration
3.3.2.67	The NMS shall also provide automated calculation of service achievement, management and operational report for SLA and Non-SLA services.	Declaration
3.3.2.78	The NMS shall have a built-in report authoring tool to customize Service performance reports.	Declaration
3.3.2.89	The NMS shall provide full visibility in real time on service quality and experience through consolidated services views.	Declaration

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3.3.2.910	The NMS shall maintain service quality by collecting key performance indicators (KPIs) from different sources such as network performance and fault management, network surveillance or passive probes, active probes, customer experience applications, traffic management, as well as trouble ticketing systems.	Declaration
3.3.2.104	The NMS shall use different KPIs are further used to compute service key quality indicators (KQIs) according to resource and service dependencies.	Declaration
3.3.2.112	KQIs shall be made available in a dashboard to allow operations to immediately detect issues damaging the user experience.	Declaration
3.3.2.123	NMS shall provide consolidated, synthetic views, which provide an “at-a-glance view” of	Declaration
	the services and the associated user experience across different services, in terms of service availability, accessibility, retainability, security, and support QoE indicators.	
3.3.2.134	NMS shall allow to see the service quality, in terms of availability, accessibility, retainability, supportability, and security as well as the associated specific KQIs	Declaration
3.3.2.14	The NMS shall provide a web interface for the customers to login and verify their SLA related parameters.	Functional Verification

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<b>3.3.2.15</b>	The NMS shall provide visibility of the service quality delivered across the Network together with the ability to manage end customer SLAs.	<b>Functional Verification</b>
<b>3.3.2.16</b>	The NMS shall support the following features: a) Dynamic service monitoring overview b) Service problem investigation c) Service quality impact analysis d) Real-time status views. e) Generates SLA violation alarms and notifications. f) Service quality trend reporting - historical reports on how key parameters have varied over user defined reporting periods. g) Produces periodic service level conformance reports	<b>Declaration</b>
<b>3.3.2.17</b>	The NMS shall have the capability to model services and report the overall Quality of Service and Service Level Agreement and SLA fulfilment.	<b>Declaration</b>
<b>3.3.2.18</b>	The NMS shall have the capability to extend support to additional services required in the future.	<b>Declaration</b>
<b>3.3.2.19</b>	The NMS shall provide service metrics to be defined using Key Quality Indicators (KQIs).	<b>Functional Verification</b>
<b>3.3.2.20</b>	The NMS shall provide resource metrics to be defined using Key Performance Indicators (KPIs).	<b>Functional Verification</b>

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3.3.2.21	The NMS shall provide a GUI that allows KQIs and KPIs to be configured easily using point-and-click techniques.	<b>Functional Verification</b>
3.3.2.22	The NMS shall have the capability to use various mathematical and logical operations for calculating KQI and KPI metrics	<b>Declaration</b>
3.3.2.23	The NMS shall allow the configuration of a variety of data sources including: a) Performance data source for key network measures b) Fault data sources for relevant alarms c) Operational data sources like trouble tickets	<b>Declaration</b>
3.3.2.24	The NMS shall allow defining thresholds to detect SLA violations.	<b>Functional Verification</b>
3.3.2.25	The NMS shall generate service quality alerts when anomalies are detected based on a comparison to historical KQI trends.	<b>Declaration</b>
3.3.2.26	The NMS shall allow different thresholds to be configured for different times of day.	<b>Declaration</b>
3.3.2.27	The NMS shall have configurable interfaces to collect data from various data sources like eMS's.	<b>Declaration</b>
3.3.2.28	The NMS shall allow privileged user to specify the list of resources from which to collect data, the list of measurements to collect, and the collection interval if required.	<b>Declaration</b>

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3.3.2.29	The NMS shall use trouble ticket data to compute key KQIs like the MTTR.	<b>Declaration</b>
3.3.2.30	The NMS shall compute availability KQIs using the fault data source.	<b>Declaration</b>
3.3.2.31	The NMS shall calculate availability KQIs to monitor for SLA violations.	<b>Declaration</b>
3.3.2.32	The NMS shall generate SLA violation information in real time when a KQI/KPI threshold is violated.	<b>Functional Verification</b>
3.3.2.33	The NMS shall aggregate Service Quality Records (KPI/KQI Reports) over time on a per customer/service basis.	<b>Declaration</b>
3.3.2.34	The NMS shall create historical trends based on quality parameters.	<b>Declaration</b>
3.3.2.35	In response to a threshold violation, the NMS shall provide following automatic task: a) Generate an alert. b) Forward an email/SMS. c) Execute a customized script.	<b>Functional Verification</b>
3.3.2.36	The NMS shall provide viewing and editing of Service Definitions.	<b>Declaration</b>
3.3.2.37	The NMS shall provide a dashboard view on a browser front-end. The dashboard view can be configured so that it can be personalized for different users	<b>Functional Verification</b>
3.3.2.38	The NMS's dashboard shall provide instant visibility to potential alerts in the services.	<b>Functional Verification</b>

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3.3.2.39	The NMS's dashboard view shall <i>allow a user to view detailed service quality metrics on a per customer basis upon seeing an alert.</i>	<b>Functional Verification</b>
3.3.2.40	The NMS shall provide user-configurable reports indicating SLA compliance on a per-customer basis.	<b>Declaration</b>
3.3.2.41	The NMS shall provide option for the scheduling of reports.	<b>Declaration</b>
3.3.2.42	The NMS shall provide reports to users via a web-based interface.	<b>Declaration</b>
3.3.2.43	The NMS shall generate management reports providing information on the following: a) Customer network configuration and changes b) Faults and achievement against the SLAs	<b>Declaration</b>
3.3.2.44	The NMS shall deliver network management reports through the web portal.	<b>Declaration</b>
3.3.2.45	The NMS shall generate detailed and summary reports for all the above parameters.	<b>Declaration</b>
3.3.2.46	The NMS shall provide customer his network topology as well as alarms on his network in a user friendly format.	<b>Declaration</b>
3.3.2.47	The NMS shall store all collected service quality data with a timestamp including the date and time received.	<b>Functional Verification</b>

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<b>3.3.2.48</b>	The NMS shall support the computation and aggregation of KPI and KQI metrics indicative of the quality of service (QoS) for various services and applications delivered over the network infrastructure.	<b>Declaration</b>
<b>3.3.2.49</b>	The NMS shall support root cause analysis of QoS violations through 'drill down' analysis of KQI and KPI metric data. Root cause analysis includes the presentation of failure modes / cause codes and identification of failure distribution by location, service/device type, subscriber type or other dimensions as appropriate to the monitored services.	<b>Declaration</b>
<b>3.3.2.50</b>	The NMS shall monitor the service from both its internal perspective i.e. how the service is coping across the network as well as that of its customers and partners.	<b>Declaration</b>
<b>3.3.2.51</b>	The NMS shall provide a real-time availability based service management view.	<b>Declaration</b>
<b>3.3.2.52</b>	The NMS shall allow building service models, integrating business service status from data sources or event sources, and display customized business service views, scorecards, and dashboards in real time.	<b>Declaration</b>
<b>3.3.2.53</b>	The NMS shall provide service visualization capability, by integrating data from event sources or data sources to show the status of various services and the impact of outages.	<b>Declaration</b>

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3.3.2.54	The NMS shall allow creating custom business service views. The module provides a graphical user interface (GUI) that allows to logically linking services and business requirements within the service model.	Declaration
3.3.2.55	The NMS shall provide dynamic visualization of key performance indicators to show the health and performance of critical business services.	Declaration
	Note: Following NMS requirements are applicable to specific technologies which may be considered depending upon the actual network requirement.	
3.3.2.56	The NMS shall provide customer traffic performance on a leased circuit, a group of leased circuits, a hunt group, a leased physical or virtual network, etc., as applicable.	Functional Verification
3.3.2.57	The SLA Reports include latency, packet loss, jitter, error apart from the availability and the link utilization reports for applicable technologies.	Declaration
3.3.2.58	The NMS shall allow customer to view reports pertaining to traffic in QoS paths for applicable technologies.	Declaration
3.3.3	<b>Customer Experience Management [Optional Requirement]</b> Customer Experience Management (CEM) refers to assuring optimal quality of experience to customers while using the services	Information

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	The NMS shall have the following CEM functionalities.	
3.3.3.1	<p><del>Assuring optimal quality of experience to customers while using the services is referred to as Customer Experience Management (CEM). It</del> The CEM shall carry out the following performance measurements as per ITU-T M.20 for monitoring and recording of parameters.</p> <ul style="list-style-type: none"> <li>a Connection establishment (e.g. call set-up delays, successful and failed call requests).</li> <li>b Connection retention.</li> <li>c Connection quality.</li> <li>d Cooperation with fault (or maintenance) management to establish possible failure of a resource and with configuration management to change routing and load control parameters/limits for links, etc.</li> <li>e Initiation of test calls to monitor SLA parameters</li> </ul>	Declaration
3.3.3.2	CEM shall provide reporting on service quality and user experience and compare with defined service-level objectives.	Functional Verification

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3.3.3.3	The CEM shall define service levels to have the overall view of service availability and accessibility percentages over time, and showing the frequency at which service quality or user experience is degraded	Functional Verification
3.3.3.4	The CEM shall define the levels of service by capturing service-specific achievements such as worst number of dropped calls in peak hours for voice, percentage of text messages with transfer delay above 60 seconds for Short Message Service (SMS), ratio of unsuccessful session setup for video streaming, and others	Declaration
3.3.3.5	The CEM shall support integration with application- level probes provides rich with insight into customer activity, drilling down to application- level interactions.	Declaration
3.3.3.6	The CEM shall capture QoE parameters captured by application-level probes for each application-level interaction for every single subscriber.	Declaration
3.3.3.7	The CEM shall display charts of most relevant QoE network indicators onto the dashboard to efficiently monitor customers' experience.	Functional Verification
3.3.3.8	The CEM shall make available network-level key performance indicators (KPIs) and service level key quality indicators (KQIs) and associated reports.	Functional Verification
3.3.3.9	The CEM shall provide accurate and timely image	Functional

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	of services, which can be drilled down by subscriber, device type, node, service path, location, and more.	Verification
3.3.3.10	The CEM shall monitor Performance Management information of a customer, such as grades of service options, performance monitoring thresholds, or the possible conditions under which rebates are awarded when service quality goals are not met.	Declaration
3.3.3.11	The CEM shall provide streaming reproduction indicators for media streaming service. <del>CEM shall provide RANAP indicators, TCP-level indicators, PDP context indicators, ICMP analysis, DNS indicators, Latency, IP throughput for Data bearer level QoE indicators etc., based on the service being managed.</del>	Declaration
3.3.3.12	The CEM shall provide node-level key performance indicators (KPIs) and service-level key quality indicators (KQIs) and statistics. These can be segmented by service, network, subnet, network element, and also by the path taken by the user's service throughout the operator's network. <del>CEM shall provide service specific indicators, end-to-end indicators, HTTP service indicators, IP-level indicators, Data-transfer indicators Web browsing (HTTP).</del>	Declaration

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	Note: Following NMS requirements are applicable to specific technologies which may be considered depending upon the actual network requirement.	
3.3.3.13	<del>CEM shall provide streaming reproduction indicators for media streaming service.</del> The CEM shall provide RANAP indicators, TCP-level indicators, PDP context indicators, ICMP analysis, DNS indicators, Latency, IP throughput for Data bearer-level QoE indicators etc., based on the service being managed as applicable.	Declaration
3.3.3.14	The CEM shall provide service specific indicators, end-to-end indicators, HTTP service indicators, IP-level indicators, Data transfer indicators Web browsing (HTTP) as applicable. <del>CEM shall provide end-to-end indicators, file sharing service indicators, IP-level indicators, data transfer indicators for file sharing service, email service indicators, data transfer indicators for email service.</del>	Declaration
3.3.3.15	The CEM shall provide end-to-end indicators, file sharing service indicators, IP-level indicators, data transfer indicators for file sharing service, email service indicators, data transfer indicators for email service. <del>CEM shall provide node level key performance indicators (KPIs) and service level key quality indicators (KQIs) and statistics. These can be segmented by service, network, subnet, network element,</del>	Declaration

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	<del>and also by the path taken by the user's service throughout the operator's network.</del>	
3.4	<p><b>Security Management</b></p> <p>Security Management provides for the management of security. In addition, security of management is required for all Management Functional Areas and for all TMN transactions. Security of management appears as part of the Security Function in ITU-T M.3010. Security of Management functionality includes Security services for communications and Security event detection and reporting</p>	Information
3.4.1	<b>Resource Security</b>	Information
3.4.1.1	All access to NMS shall be through login and password and all operations shall be logged.	Functional Verification
3.4.1.2	It shall include operator authentication, command, and menu restriction and operator privileges.	Functional Verification
3.4.1.3	NMS shall allow the System administrator to define the level of access to the network capabilities or features for each assigned password. The NMS shall block the access to the operator in case of unauthorized commands being tried for five consecutive times. The NMS shall also not allow the entry into the NMS in case wrong password is provided more than three consecutive times during the login.	Functional Verification

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3.4.1.4	The supervisor shall be able to monitor and log all operator activities in the NMS and Local Management Terminal.	Functional Verification
3.4.1.5	The dynamic password facility shall be provided in which the <del>operator-user</del> may change his password at any time.	Declaration
3.4.1.6	The NMS shall have the feature of idle time disconnection which shall be configurable.	Functional Verification
3.4.1.7	The <del>man-machine communication programs-</del> NMS shall have the facility of restricting the use of certain commands or procedures to certain passwords and terminals.	Functional Verification
3.4.1.8	<del>The NMS</del> shall provide a time-stamped audit log of all transactions, indicating operator login ID, etc.	Functional Verification
3.4.1.9	<del>The NMS</del> shall be able to define the access levels the users have to the resources. The basic access levels are: a) Read. b) Write. c) Delete. d) Modify	Declaration
3.4.1.10	<del>The NMS</del> shall be capable of generating reports based on the security alerts.	Functional Verification

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3.4.1.11	The <del>NMS</del> system shall support automatic password aging. The system shall provide an automated procedure for aging passwords and allowing the user to assign their new password. The <del>system-NMS</del> shall allow the system administrator to configure the maximum age of the password based on user or user profile. For example, system administrator's passwords shall expire every 30 days, and all other users' password shall expire every 90 days.	Declaration
3.4.1.12	The <del>system-NMS</del> shall date and time stamp all database entries. The system shall put a date and time stamp on all entries made into the database. The system shall also add an identifier indicating the program or user that made the database entry.	Functional Verification
3.4.1.13	<del>#</del> The NMS shall provide secure maintenance windows accessible by only authorized users to makes changes to system data (e.g., Lookup table modifications, etc.).	Functional Verification
3.4.1.14	The NMS shall have the Aability for configurable debugging logs and trace activities on the system/solution.	Declaration
3.4.1.15	The <del>system-NMS</del> shall support ability to set group and user permissions	Declaration

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3.4.1.16	All Commands which are executed over the NMS program or data shall be logged in a file (read only) and it shall be possible to retrieve the same on demand whenever required, using Man-Machine Commands. The file usage of up to 50%, 75% and 90% (configurable) shall generate alarms of suitable category prompting the <del>operator</del> user to initiate the backup operation.	Declaration
3.4.1.17	<del>The NMS shall support segregation of</del> <del>it shall be possible to segregate</del> the commands/operations into at least five classes; the authorisation to these command classes shall be based on combination of terminal Id, login, password, time of day and type of day.	Functional Verification
3.4.2	<b>Security Information Event Management [SIEM]</b> <b>Securityfeatures [Optional Requirement]</b>	Information
3.4.2.1	<del>The SIEM shall support A</del> analysis of significant shifts in revenue that might indicate fraud or theft of service.	Declaration
3.4.2.2	<del>The SIEM shall support d</del> etermination of need, monitoring and analysis of alarm systems that support structures that house network equipment. These alarms may include power, HVAC (Heating, Ventilation, and Air Conditioning), fire, flood, and open-door-or-cabinet systems.	Declaration

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3.4.2.3	The SIEM shall support for the reading of usage data and customer profiles from other functions for recording of service irregularities or anomalies such as billing and usage abnormalities. It provides access to such records.	Declaration
3.4.2.4	The SIEM shall support for investigation of customer and internal users including usage patterns indicate possible fraud or theft of service. It shall include requests for credit checking, and employment record checking, etc.	Declaration
3.4.2.5	The SIEM shall support for the collection of audit trail information and the recording of anomalies or abnormalities that may indicate a breach of security or theft of customer services through employee action. It provides access to such data.	Declaration
3.4.2.6	The SIEM shall have provision for security alarm information that indicates network security violations.	Declaration
3.4.2.7	The SIEM shall support for signs of software intrusion (e.g. the presence of a known virus) in the NMS. It can be regularly scheduled and/or they may be triggered by security events.	Declaration
3.4.2.8	The SIEM shall support report information about security alarms so	Declaration

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	that containment and recovery activities <del>may</del> <del>can</del> be initiated. It shall include the reporting of environment alarms (e.g. fire or moisture) and intrusion detection alarms.	
3.4.2.9	<del>The SIEM shall support p</del> Protection of storage of business data (e.g. backup).	Functional Verification
3.4.2.10	<del>The SIEM shall support P</del> provision for exception reports such as security alarms.	Declaration
3.4.2.11	<del>The SIEM shall S</del> support for actions to limit the security breach such as isolation of equipment or data so that corruption is not propagated and support for restoration of any corrupted data or equipment.	Declaration
3.4.2.12	<del>The SIEM shall s</del> Support for actions to limit the security breach (e.g. remove user's access privileges, etc.) and support for restoration of any corrupted data or equipment.	Functional Verification
3.4.2.13	<del>The SIEM#</del> shall support the identification of an intruder (for example, by analyzing security logs, monitoring targets of intrusion or feeding misinformation to a suspected intruder).	Functional Verification
3.4.2.14	<del>The SIEM shall s</del> Support restoration from backup files in order to restore service after detection of a security violation. This also includes the customer data including billing, service profile etc	Declaration

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3.4.2.15	The SIEM <del>#</del> shall generate a list of all customer/ network/ network elements public keys and access control certificates for the current time period that are known or suspected of being invalid due to security violation (e.g. stolen secret keys) or administrative procedures (e.g. a customer has moved elsewhere).	Declaration
3.4.2.16	The SIEM <del>#</del> shall allow the severance of connections with a customer/ internal user in an attempt to contain data and system corruption as the result of a detected security violation.	Declaration
3.4.2.17	<del>#</del> The SIEM shall store the network configuration data that can be used in support of intrusion recovery. It shall allow for backup of such data, and for restoration of such backed up data upon request.	Declaration
3.4.2.18	The SIEM shall support <del>M</del> methods and procedures to be used in restoring the network in the event of a security breach and the resulting corruption of data or due to a natural calamity damaging the whole NMS site.	Declaration
3.4.2.19	The SIEM shall support <del>M</del> methods and procedures for audit trail information to be collected and evaluated to identify possible and/or potential security violations by individuals or groups of users	Declaration

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3.4.2.20	The SIEM shall support Policy for the monitoring, evaluating, and correlating security alarms.	Declaration
3.4.2.21	The SIEM shall support for the collection of security alarm information that indicates network security violations.	Declaration
3.4.2.22	The SIEM shall protect the network and the network management system <del>shall be protected</del> against intentional or accidental abuse, unauthorized access and loss of communication.	Declaration
3.4.2.23	The SIEM shall support log transaction between Client/Agent & Engine shall support SSL/encryption.	Declaration
3.4.2.24	The <del>NMS-SIEM</del> shall have capability to gather information on real-time threats and zero day attacks through signatures issued by anti-virus or IDS vendors or audit logs and add this information as intelligence feed in to the solution via patches.	Declaration
3.4.2.25	The SIEM shall support Archival information and summary information <del>shall to</del> be provided separately.	Declaration
3.4.2.26	The <del>NMS-SIEM</del> shall maintains audit trail for the management activities of individual users accessing and using the application.	Declaration
3.4.2.27	The <del>NMS-SIEM</del> shall support capability to create and assign role-based views.	Functional Verification

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3.4.2.28	The <b>NMSSIEM</b> shall support mechanism for protection of unauthorized access on the Log Database.	Declaration
3.4.2.29	<del>The SIEM shall support</del> Incident status and escalation <del>shall be supported</del> and a record of action taken shall be maintained.	Declaration
3.4.2.30	The <b>NMS-SIEM</b> shall support Robust & scalable architecture to handle high volume of data with high Events per second.	Declaration
3.4.3	<b>SIEM LOG Capturing/Analysis [Optional Requirement]</b>	Information
3.4.3.1	The <b>NMS-SIEM</b> shall support collection of logs via either of the following methods: a) Syslog over UDP/TCP. b) SyslogNG c) Check Point LEA. d) SNMP e) ODBC (to pull events from a remote database).	Declaration
	f) FTP (to pull a flat file of events from a remote device that can't directly write to the network). g) Windows Event Logging Protocol. h) XML	
3.4.3.2	The <b>NMS-SIEM</b> shall support collection of log data during database backup, defragmentation and other management scenarios, without any disruption to service.	Declaration

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3.4.3.3	RAW logs <del>that are send to the SIEM [Security Information and Event Management] solution if any</del> shall be Authenticated (time-stamped), encrypted and compressed before being written to log storage. Encryption can be achieved through OS capability.	Declaration
3.4.3.4	The <del>NMS-SIEM</del> shall support log compression capability for storage optimization (compression level at least 50%). It can be achieved through OS capability.	Declaration
3.4.3.5	The <del>solution-SIEM</del> Database shall use Write Once Read Many (WORM). Once the logs are written to the disk/database no one including database/system administrator can alter the stored RAW logs.	Declaration
3.4.3.6	The SIEM shall use <del>P</del> purpose built object oriented database <del>shall be used</del> for storing IP related information and not relational databases. The storage system has flat file system to store log data.	Declaration
3.4.3.7	Parting of logs or filtering of logs shall not be done at any stage of log collection or log storage.	Declaration
3.4.3.8	The <del>NMS-SIEM</del> shall support Single Global View of all the data across sites/geographies.	Functional Verification
3.4.3.9	The <del>NMS-SIEM</del> shall collect raw data in real-time to a Central Database from any IP device including home grown, customized and proprietary applications.	Functional Verification

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3.4.3.10	Historical records and database query done shall be within the <del>solution</del> SIEM. No third party tool shall be required to access the database.	Declaration
3.4.3.11	The <del>NMSSIEM</del> shall support compliance to Regulations with data archival.	Declaration
3.4.3.12	<del>The SIEM shall use</del> Log parsing <del>shall use</del> only <del>using</del> XML and shall not use any other proprietary parsing mechanisms.	Declaration
3.4.3.13	The <del>NMSSIEM</del> shall support two factor authentications or multi factor authentication (MFA) to login to the system.	Declaration
3.4.3.14	The <del>NMS-SIEM</del> shall support watch list feature to monitor desired data like specific IP addresses, usernames and other data.	Functional Verification
3.4.4	<b>SIEM Altering and Viewing Requirements [Optional Requirement]</b>	Information
3.4.4.1	The <del>NMS-SIEM</del> shall support full playback of events that have occurred to ensure comprehensive trend and historical analysis and reporting.	Functional Verification
3.4.4.2	The <del>NMS-SIEM</del> shall support email alerts and integration capabilities to third party ticketing engines and forward alerts via Syslog or SNMP.	Declaration
3.4.4.3	The <del>NMS-SIEM</del> shall categorize all event collected by device into event taxonomies for easier classification and management.	Declaration

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3.4.4.4	The <del>NMS-SIEM</del> shall support Distributed viewing and delegation of user rights across devices and access to individual components of the application.	Functional Verification
3.4.4.5	The <del>NMS-SIEM</del> shall support Alert suppression for specific events.	Declaration
3.4.4.6	The <del>NMS-SIEM</del> shall allow creating baselines of network activity and shall provide a mechanism to raise alerts when baselines are crossed.	Declaration
3.4.4.7	The <del>NMS-SIEM</del> shall support Email of scheduled reports to recipients.	Functional Verification
3.4.4.8	Email notifications shall contain the content of the report capable of being saved as HTML and/or PDF.	Functional Verification
3.4.4.9	The <del>NMS-SIEM</del> shall support configurable automated actions in response to security problem, sending E-mail Notifications, SMTP notification, SYSLOG notification, SNMP Notification to operators.	Declaration
3.4.4.10	The <del>NMSSIEM</del> shall support facility to view Summary of all Dashboard views for the entire enterprise.	Declaration
3.4.4.11	The <del>NMS-SIEM</del> shall support provision of view filter when displaying the logs related to specific IP address, specific service or specific time duration.	Functional Verification

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3.4.4.12	The <b>NMS-SIEM</b> shall support event display Window for all alerts.	Declaration
3.4.4.13	The <b>NMS-SIEM</b> shall support web based (both http and https) user interface for device performance monitoring and analysis with SSL connectivity to backend appliances.	Declaration
3.4.5	<b>SIEM Correlation Requirements [Optional Requirement]</b>	Information
3.4.5.1	The <b>NMS-SIEM</b> shall support correlation of logs from all the devices within an enterprise and all security scenarios like spoofing, authentication failure, etc. Multi-device, multi-event and multi-site correlation across the enterprise.	Functional Verification
3.4.5.2	The <b>NMSSIEM</b> shall support correlation using suitable correlation engine	Declaration
3.4.5.3	The <b>NMSSIEM</b> shall display of summarization of events.	Declaration
3.4.5.4	The rules shall allow import/export in XML format. <b>SIEM shall provide</b> a GUI based application for creating new correlation rules/modifying existing rules.	Declaration
3.4.5.5	The <b>NMS-SIEM</b> shall support capability to correlate all the fields in a log without normalizing the logs at collection points.	Declaration

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3.4.5.6	The <b>NMS-SIEM</b> shall support wizard based interface for rule creation. The rules shall support logical operators for specifying various conditions in rules.	Declaration
3.4.5.7	The <b>NMS-SIEM</b> shall support system leverage information about enterprise assets and known vulnerability to identify false-positive IDS messages and to browse assets and vulnerabilities.	Declaration
3.4.6	<b>SIEM Forensic Capabilities [Optional Requirement]</b>	Information
3.4.6.1	The <b>NMS-SIEM</b> shall support flexible dashboard interface customized to user preferences allowing the examination of a specific event or a holistic view of the systems within the enterprise.	Declaration
3.4.6.2	The <b>NMS-SIEM</b> shall support Quick and easy access to real-time as well as historical operational data.	Functional Verification
3.4.6.3	The <b>NMS-SIEM</b> shall provide tool for comprehensive trend and historical analysis of logs and their reporting.	Functional Verification

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3.4.6.4	<p>The SIEM shall support the following categories of predefined graphs and queries- <del>shall be supported:</del></p> <ul style="list-style-type: none"> <li>a Firewall, including Top Firewall Interface, File Access through Firewall, and Login Failure Summary.</li> <li>b Database, such as Login Activity, Authorization Level and Authorization Level by User.</li> <li>c Intrusion detection, including Top Attack Signatures, Attack Type by Severity Level, and IDS Signature Summary.</li> <li>d Operations, such as Device Activity Analysis, Activity by Event Category, and Network over Time.</li> <li>e User, including Privilege Users Monitoring, Configuration Change Details and Activity by Specific Username.</li> </ul>	Declaration
3.5	<b>Resource / System Administration</b>	Information
3.5.1	System administration functions shall include backup, recovery, installation, automatic fail-over, account maintenance and logging for all components of NMS	Declaration

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3.5.2	<p>The NMS shall provide the single point capability for backup and recover the application and databases. The NMS shall have suitable Backup mechanism for taking backup of NMS data of at least one month. The backup device shall be a read/write CD/DVD/ MOD (magneto-optical disk) drive / <b>Cloud storage / network-attached storage (NAS)</b> or some other state of the art backup device. It shall be possible to take back up at any interval either automatically and under operator control. Incremental backup over a configurable period in steps of 12 hour shall be possible. It shall be possible to test the full backup with stand by arm of NMS. The system shall support:</p> <ul style="list-style-type: none"> <li>a Electronic Document Workflow Feed</li> <li>b Backup strategy</li> <li>c Nightly archive</li> <li><b>d Weekly backup w/monthly offsite backup</b></li> <li><b>d The purchasing authority may specify the actual backup device required as mentioned under clause number 10.3</b></li> </ul>	Declaration
3.5.3	<p>The <del>system</del><b>NMS</b> shall provide the system administrator with the capability to monitor the processes running on the system.</p>	Functional Verification

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3.5.4	The <del>system-NMS</del> shall provide capability for remote system administration. The system shall provide the ability for system administrators to logon and administer the system from location other than the system console. It shall be possible to disable this feature.	Functional Verification
3.5.5	The <del>system-NMS</del> shall track users. The system shall be able to identify upon request all users that are currently active on the application.	Functional Verification
<del>3.5.6</del>	<del>Platform shall be implemented on a client server platform</del>	<del>Declaration</del>
<del>3.5.7</del>	<del>All Application Functions shall be able to use high availability features of the Operating System.</del>	<del>Declaration</del>
<del>3.5.68</del>	The <del>system-NMS</del> shall have the ability to upload existing network resource <del>information</del> (logical and addressable physical resources) into the data store.	Declaration
<del>3.5.9</del>	<del>The system/solution shall support mechanisms to detect resource shortages such as CPU, processes, disk, etc.</del>	<del>Declaration</del>
<del>3.5.10</del>	<del>The NMS system shall provide password protection and level of access / privileges along with access restriction to a single command / set of commands.</del>	<del>Functional Verification</del>
3.6	<b>Other Requirements</b>	Information

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3.6.1	<b>Route Analytics [Optional Requirement]</b> Route Analytics is an EML layer module provided in the NMS for analysis of the information from IP transport networks like Interface diagnostics, Route to node, IP route, Spanning tree info, Router info, and Switch info	Information
3.6.1.1	<b>The</b> NMS shall support the selection of an appropriate path for circuits/route that cross node boundaries based on routing design, facility design and demand forecast.	Functional Verification
3.6.1.2	<del>The</del> NMS shall analyse the Trap and provide the information like trap rate etc.	Functional Verification
3.6.1.3	<del>The</del> NMS shall help to improve time to repair by capturing problem information before the network changes in a way that removes the data, for faster problem analytics, quickly find where hosts with problems are connected to the network, enabling faster problem resolution, and tune the management environment for efficient operation	Declaration
3.6.2	<b>Network &amp; Device Probes [Optional Requirement]</b>	Information
3.6.2.1	The system should have wide range of network probes and collectors from a variety of data sources like network devices, customer end devices etc. to know the network and customer end device performance.	Declaration
3.6.2.2	It shall provide the data for the measurement of the Quality of Service and Root cause analysis	Functional Verification

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3.6.3	<b>Web Portal</b> The Web Portal will Organize, consolidate, and automate all service management functions. The access of the web portal may be through internet with suitable firewall etc., or through VPN or through a dedicated overlay network of remote and local terminals	Information
3.6.3.1	The Web Portal shall get a real-time window into how services perform by using its ability to draw information and metrics directly into the dashboards from underlying systems and devices	Functional Verification
3.6.3.2	When there is an issue with network or service performance, its problem resolution capabilities shall act, in addition to its end-to-end service monitoring features	Declaration
3.6.3.3	The web portal shall have the feature to drill down to the individual element, then to subsystem, then to card and then to port level configuration template from the domain Map by clicking on the icon of the network element.	Declaration
3.6.3.4	Drill-down capabilities shall enable to descend through the layers of information to the underlying systems, which will launch integrated views into the unified dashboard	Declaration
3.6.3.4	<del>The man-machine language shall be in English. Commands shall be English based and responses shall be in English.</del>	<del>Functional Verification</del>

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3.6.3.5	The Portal shall be <b>Web</b> GUI based, easy to learn and use, easy to input the commands and to interpret the outputs.	Functional Verification
3.6.3.6	The web portal shall be in English. The man machine commands and response shall also be in English.	<b>Information</b>
3.6.3.76	The Portal shall have an open-ended structure such that any new function or requirement added shall have no influence on the existing ones. The language structure shall be such that subsets can be created. Product API shall be provided for future expansion and/ or integration of new features.	Declaration
3.6.3.87	The Portal shall provide facilities for editing, cancelling and stopping, the completion of commands.	Functional Verification
3.6.3.98	The Portal shall have facility for restricting the use of certain commands or procedures to certain staff/terminals based on the set privileges.	Functional Verification
3.6.3.9	<del>Where several man-machine terminals are in use on a single network element a mechanism shall be available to avoid clashes of command.</del>	<b>Declaration</b>
3.6.3.10	<del>The execution of any command shall not result in malfunctioning or/and over loading of the network.</del>	<b>Declaration</b>
3.6.3.104	The Portal shall be implemented in such a way	Declaration
	that errors in commands or control actions shall not cause the network to stop or unduly alter the network configuration.	

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3.6.3.12	<del>Command errors detected by the network shall be indicated by the output of error messages.</del>	Declaration
3.6.3.13	<del>The NMS shall support priority messages to interrupt input or output message of lower priority.</del>	Declaration
3.6.3.14	Sufficient checks and safeguards shall be built in to the implementation of the <b>commands from the portalMMG</b> so as to ensure reliable operation of the network.	Declaration
3.6.4	<b>NMS Reporting</b>	Information
3.6.4.1	<del>Reports shall be available for compliance and supported devices.</del>	Functional Verification
3.6.4.12	The <del>system</del> -NMS shall allow modification of existing reports and creation of new reports (through wizard).	Functional Verification
3.6.4.23	Reports shall be available in the following exported formats: a PDF b CSV c HTML d XLSX e JSON Further the the purchasing authority may specify the actual report formats required as mentioned under clause number 10.3	Functional Verification
3.6.4.34	The NMS shall support capability to schedule reports. All raw log format fields shall be available for query. <del>using the solution.</del>	Declaration

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3.6.4.45	The NMS shall provide process for creating adhoc queries. This process shall use standard syntax such as wildcards and regular expressions.	Declaration
3.6.4.56	The <del>process</del> -NMS shall allow applying filters and	Functional
	sorting to query results.	Verification
3.6.4.6	The NMS shall have capability to provide real-time reporting of user defined critical metrics and alarms, with options to refresh data automatically.	Declaration
3.7	<b>Hardware Requirements</b>	Information
3.7.1	The MPLS Core/Edge <del>router is existing or the being deployed</del> —MPLS Network of the TSP is shown in Figure 8 of GR on NMS (TEC 48100:2026).  <del>Service Provider.</del>	Information
3.7.2	For the Firewall requirements, the latest TEC standard on Firewall available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ) may be referred. The type of firewall required shall be specified by the purchaser. <del>The Firewall shall be as per TEC GR GR/FWS-01. The type of firewall required shall be specified by the purchaser.</del>	Declaration
3.7.3	For the Load Balancer requirements, the latest TEC standard on Load Balancer available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ) may be referred. The Category of Load Balancer required shall be specified by the purchaser. <del>The Load Balancer shall be as</del>	Declaration

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	<del>per TEC GR GR/SA/LSW-02. The Category of Load Balancer required shall be specified by the purchaser.</del>	
3.7.4	For the Ethernet Switch requirements, the latest TEC standard on Ethernet Switch available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ) may be referred. The Category of Switch required shall be specified by the purchaser. <del>The Ethernet Switch shall be as per TEC GR TEC/GR/IT/LSW-01. The Category of Switch required shall be specified by the purchaser.</del>	Declaration
3.7.5	The NMS Server hardware configurations can be referred from the latest TEC standard on NMS Server available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ). <del>The NMS Server hardware dimensioning and configurations can be referred from TEC GR TEC/GR/IT/SRV-01.</del> The Category of Server required shall be specified by the purchaser.	Declaration
<del>3.7.6</del>	<del>The Type of server required shall be specified by the purchaser.</del>	<del>Declaration</del>
3.7.67	For the Storage hardware requirements, the latest TEC standard on Storage hardware available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ) may be referred. <del>The Storage hardware shall be as per TEC GR GR/ESI-001.</del> The type of Storage hardware required shall be specified by the purchaser.	Declaration

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3.7.78	The NMS solution runs in high availability mode with redundancy i.e. <b>N+1 (Active or Passive) configuration</b>	Declaration
3.7.89	All SW applications shall run in a redundant active – standby pair of hosts with automatic switchover in case active server or its applications have any failure.	Declaration
3.7.940	Hardware Sizing Guidelines: Hardware sizing is based on the following CPU utilization metric (CPU Utilization = 100 – CPU Idle)%. Peak CPU Utilization shall not exceed 75% at any time, on 24x7 basis. Average CPU Utilization over any hour, measured at 5 minute intervals, shall not exceed 60%. The hardware sizing indicated is minimum and indicative	Declaration
3.7.11	<del>The NMS shall include essential technologically advanced support tools that efficiently manage the network infrastructure. The servers shall be able to provide a response to the interrogation command for node status within 4 seconds when all the operators are accessing the NMS concurrently either from local or remote terminal.</del>	Declaration
3.7.12	<del>The NMS shall be multi-user system. The authorizations and the privileges of the operators (Remote and Local) shall depend upon the Login and password.</del>	Functional-Verification

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3.7.13	<del>The NMS is considered to be mission critical system and the whole system shall be able to operate 24x7 basis with over 99.99% availability. High availability and fail-over capability shall be one of the main design focuses.</del>	Declaration
3.7.10	The servers shall be able to provide a response to the interrogation command for node status within 4 seconds when all the operators are accessing the NMS concurrently either from local or remote terminal.	Declaration
3.7.114	The implementation of the hardware and software configuration shall allow for future expansion and be able to handle maintenance with minimum disruption to the <del>production</del> Main NMS environment.	Declaration
3.7.125	The design of the NMS system shall not be dependent on single machine setup, which shall have an impact on the Main NMS <del>production environment</del> during upgrading. Scalability of the NMS system shall not be limited to increasing the processing power of single hardware. The NMS system shall fully utilize the performance of multiple hardware, and at the same time reducing the cost and downtime of the system while upgrading.	Declaration

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3.7.136	The NMS system shall have the capacity for fail-over with duplication of processes. Any failure in the individual module shall have a minimum impact on the entire NMS system.	Declaration
3.7.147	NMS System shall support flexibility for optimal load distribution on servers.	Declaration
3.7.158	NMS System shall be linearly scalable and it shall be possible to add additional servers/databases with the growth in number of subscribers.	Declaration
3.7.169	The NMS Solution-system shall be able to scale hardware expansions.	Declaration
3.7.1720	NMS application-system shall be scalable horizontally and vertically.	Declaration
3.7.1824	NMS System performance shall not degrade as all the users use the system simultaneously.	Declaration
3.7.1922	Users running reports shall not affect system performance.	Declaration
3.7.203	NMS shall support a large <del>numberspecified</del> of transactions per day/per hour/per minute as applicable as below (to be indicated by tendering authority):	Declaration
	a X activations	
	b Y faults per day	
	c Z network elements or circuits	

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3.7.214	The <del>Solution</del> -NMS system shall properly maintain the data. Data consistency checks and cleansing shall be performed on a regular basis to prevent corruption.	Declaration
3.7.225	The <del>Solution</del> -NMS system shall be able to recover point-in-time due to hardware or software failure(s).	Declaration
3.7.236	The System shall allow the disconnection of a redundant system with no adverse impact on the Network or to the <del>Solution</del> -NMS itself.	Declaration
3.7.247	The NMS system shall support unattended automatic shutdown and restart of core processes in case of component failure	Declaration
3.7.258	The NMS system shall support ability for auto restart after application failure or power-up	Declaration
3.7.269	The NMS system shall maintain data integrity in case of failure of a single component.	Declaration
3.7.2730	<del>NMS s</del> System design shall support automatic rerouting and reconnection. For example, if a server supporting a client application fails, the client shall be able to reconnect and reroute through an alternative path.	Declaration
3.7.2834	The NMS system shall notify the system operators of critical errors that impact the normal operation of the system. The system shall notify the operators via defined alerts/messages sent to the data center console.	Declaration

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3.7.2932	The NMS system shall generate error message data for every error condition that can occur within the application.	Declaration
3.7.303	It shall be possible to connect NMS, EMS and components of SML to the IP network. The NMS and eEMS and components of SML shall may be part of the common VPN providing the inherent security required for the Management information in addition to the login and Password based authorization for the operators of the Network Manager. The connectivity between eEMS and the Network Elements NMS shall be TCP/IP based with the Data Link layer being the Ethernet. However in case the connectivity between eEMS and Network Element NMS is not supported over TCP/IP interface then suitable converters shall be provided for transporting the Management information over the IP network	Declaration
3.7.34	<del>It shall be ensured that in case of any link failure, the NMS connectivity to network is not disrupted and there is no loss of NMS data from the network. In absence of the NMS or EMS the Network shall continue to provide the services without any deterioration</del>	Declaration
3.8	<b>Software Requirements</b>	Information

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3.8.1	<p>The NMS shall support <del>to carry out</del> support the following tasks under the software management function</p> <ul style="list-style-type: none"> <li>a Loading of new system software.</li> <li>b Manage different versions of software.</li> <li>c Shall have the capability of managing multiple versions of software for individual elements.</li> </ul>	Functional Verification
	<ul style="list-style-type: none"> <li>d Installation of software patches.</li> <li>e Examine contents of all system memory and disk memory.</li> <li><del>f At the time of downloading the software, the message shall be displayed that the software has been downloaded successfully or failed and at what stage.</del></li> </ul>	
3.8.2	<p><del>At the time of downloading the software, the message shall be displayed that the software has been downloaded successfully or failed and at what stage.</del></p>	Functional Verification
3.8.32	<p>The NMS shall support FTP for downloading of Software, configuration, patches etc., to the network Element.</p>	Declaration
3.8.43	<p>The <del>system</del>NMS shall support version control process/software</p>	Functional Verification
3.8.54	<p>The <del>system</del>NMS shall support ability to uninstall a release</p>	Functional Verification

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3.8.65	The NMS shall enable operations like changing the system configuration, reconfiguration of input and output devices, loading a new software package, etc. Both automatic and manual reconfiguration capabilities shall be available.	Declaration
3.8.76	<del>It shall be possible through a single Man-Machine Command to obtain a list and the total number of equipment of a particular domain in a state (e.g. In service, blocked etc.).</del> All Application Functions shall be able to use high availability features of the Operating System.	Declaration
3.8.87	The NMS shall support mechanisms to detect resource shortages such as CPU, processes, disk, etc. <del>It shall be possible to execute any command at any time by attaching a time tag to the command and it shall be executed when the NMS real time matches the time tag. It shall be possible to define both time and date. If no date is mentioned, the command shall be executed</del>	Declaration
	<del>daily at the time indicated.</del>	
3.8.8	<del>The system shall be capable of measuring the slips on interfaces, designated through Man-Machine Commands. It shall be possible to get display and print out of the measurement results on demand at any time during the measurement period.</del>	Declaration

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3.8.9	The <del>system-NMS</del> shall allow a workstation/PC based monitoring tool for high volume processes which can do the following: <ul style="list-style-type: none"> <li>a Halting of tasks</li> <li>b Altering of periodic schedule</li> <li>c Requesting status information</li> <li>d Changing the status of jobs in bulk</li> <li>e Starting volume processing applications on demand</li> </ul>	Declaration
3.8.10	The diagnostic program shall also be locally available and shall be able to run even in case any module or link with NMS goes down.	Declaration
3.8.11	On a faulty condition, <del>the software shall provide for isolating the faulty network element, its sub-system and then automatically activating the diagnostic programs for diagnostic purposes.</del> The NMS shall support the diagnostics on the NMS elements also.	Declaration
3.8.12	The NMS shall monitor its own hardware and software and shall present the performance-related information.	Functional Verification
3.8.13	<del>Audio/visual alarm indication shall be given when the processor load exceeds a certain configurable pre-set value. The NMS shall provide the graphical display of percentage of Link utilisation and other network element resource utilization. The traffic observation shall be for each type of service.</del>	<del>Functional Verification Declaration</del>

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3.8.14	<del>The NMS shall provide the ability to drill down to the individual element, then to subsystem, then to card and then to port level configuration template from the domain Map by clicking on the icon of the network element.</del>	Functional-Verification
3.8.15	<del>The NMS shall have the capability of supporting the management of Network through local and remote Operators. The authorizations and the privileges of the operators (Remote and Local) shall depend upon the Login and password.</del>	Functional-Verification
3.8.16	<del>It shall support macro command/subroutine/scripts facility to carry out the same kind of operation on a group of interfaces by a single command. It shall be possible to generate a macro program which integrates the various operations in an intelligent sequence to carry out complex tasks of creation, modification and deletion of entities like Trunks, Software control of Elements etc. It shall also support import of Macro programs/routines/scripts from a program written as a text file from a floppy/CD.</del>	Declaration
3.8.147	In case a fault is detected requiring reloading of the program/software, this shall be carried out automatically. In case of manual re-loading, it shall be possible to stop and start at any particular point in the program. It shall be possible to load a designated file or group of files of the entire software.	Declaration

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3.8.158	The NMS shall have RDBMS for a common data repository. Persistent data shall be maintained in a commercially available relational database management system (RDBMS). Access to all RDBMS stored procedures shall be available through ODBC, JDBC, BDE, C and Active X.	Declaration
3.8.169	<del>#</del> The NMS shall provide a hot standby mechanism among the production (or primary) and backup database servers across LAN and WAN.	Declaration
3.8.1720	RDBMS shall also be capable of operating in a standby or clustered environment with multiple standby (backup) system.	Declaration
3.8.1824	The NMS shall support <del>B</del> built-in feature for graceful switchover and switchback between the primary and the standby databases (without any direct intervention from the database administrators).	Declaration
3.8.1922	The NMS shall support <del>A</del> a means to transport and apply the logical copy of the changes in the primary database to the standby database.	Declaration
3.8.2023	<del>System/solution</del> The NMS shall support automatic synchronization between the network and the database.	Declaration

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3.8.214	A file-based interface shall be available with the following <ul style="list-style-type: none"> <li>a An import file format.</li> <li>b A protocol for importing files into the managed environment.</li> <li>c A mechanism for importing files.</li> <li>d An export file format.</li> <li>e Protocols for exporting files out of the managed environment.</li> </ul>	Declaration
3.8.225	The main NMS shall update disaster recovery (DR) NMS at regular interval & this interval shall be configurable in steps of at least 30 minutes.	Declaration
3.8.26	<del>DR site shall have processing capacity of 100 % of the production capacity, so that in case of any natural or manmade DR instance, all functionalities related to all the applications shall continue to work.</del>	Declaration
3.8.237	Actions to initiate Switchover to DR site and Switchback from DR to <del>production-main</del> site shall initiated manually. <del>by the DR Manager.</del> Switchover or Switchback shall be completed in 4 hours.	Declaration
3.8.248	The NMS shall provide feasible solution for DR like log transfer, application level DR/replication manager and other best practices. <del>in the proposed solution shall be provided.</del>	Declaration

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3.8.259	When the <del>Primary-NOC of</del> Main NMS fails, the <del>Secondary-DR NOC-NMS</del> shall take over the functions of the <del>Primary-Main</del> without minimum loss of data or functionality <del>related to the update interval / transfer period. It shall be possible to update the secondary by the Primary on-line or at configurable intervals in steps of at least 15 minutes.</del> The replication solution shall be designed to have negligible impact on the server & storage resources of the <del>Main NMS</del> production environment.	Declaration
3.8.2630	During regular updates, only incremental data pertaining to the previous interval shall be transferred. However, it shall also be possible to mirror the whole database during slack hours	Declaration
	any number of times during the day at prescribed hours through manual commands of network manager.	

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3.8.2734	The connectivity of operator terminals at main site and terminals at remote sites shall be provided in such a way that during failure of main site connectivity of the terminals is automatically transferred to the Disaster recovery (DR) site & vice versa. However, during complete unavailability of the main site, the onsite terminals of the Disaster recovery site shall take over the control. The engineering of the main & DR system shall be done in such a way that the connectivity of remote terminals to system remains available under all circumstances and no functionality is lost.	Declaration
3.8.2832	It shall be possible to define and redefine the Disaster recovery policy at any time as per the <del>needs of service provider requirement.</del>	Declaration
3.8.2933	It shall be possible to monitor the health of disaster recovery system from main system and vice – versa continuously or under operator command at the choice of the network manager.	Declaration
3.8.3034	In case of main NMS becoming un-operational, <del>it shall be possible to transfer the control</del> <del>the control shall pass automatically as well as</del> manually to the disaster recovery NMS. The control shall not come back automatically to main NMS & it shall take over the control under the operator command.	Declaration
3.8.3135	It shall be possible to test the Disaster recovery	Functional

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	NMS live at any time without minimum loss of data or Service (Synchronization time difference data).	Verification
3.8.36	<del>It shall be possible to check the health of disaster recovery NMS by operator command.</del>	<del>Functional Verification</del>
3.8.327	The NMS shall have the capability to synchronise with an NTP network synchronization source.	Functional Verification
3.8.33	NMS shall meet the IPv6 requirements.	Declaration
4.0	<b>INTERFACE REQUIREMENTS</b>	Information
4.1	<p>The NMS systems shall have the South Bound Interfaces towards the eMS systems. The standard protocol <del>being followed in these interfaces are namely</del> SNMP <del>(All versions)</del>, XML, TEXT, CORBA <del>and</del> TL-1, REST API, T-API, NetConf,</p> <p>YANG shall be available to interface with different eMS systems having one of these <del>different</del> open standard interfaces.</p> <p>Further the purchasing authority may specify the actual type of protocols required to be supported on these interfaces</p> <p>as mentioned under clause number 10.3—</p> <p><del>(All interfaces shall be supported).</del></p>	<p><del>Information</del></p> <p>Declaration</p>

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4.2	The NMS systems will have the North Bound Interfaces towards other NMS systems, OSS/BSS Systems and ERP Systems. These interfaces shall be as per standard interfaces SNMP (All versions), XML, TEXT, ODBC, JDBC,CORBA, REST API, Websocket, T-API, NetConf, YANG etc., based on the requirement of the OSS/BSS/ERP Systems. Further the purchasing authority may specify the actual type of interfaces required to be supported as mentioned under clause number 10.3.	Information Declaration
5.0	<b>QUALITY REQUIREMENTS (QR):</b> No requirements specified <del>The supplier / manufacturer shall manufacture with international quality standards ISO 9002 for which the manufacturer shall be duly accredited. The quality plan describing the quality assurance system followed by the manufacturer shall be submitted.</del>	Information
6.0	<b>EMI/EMC REQUIREMENTS</b>	Information. <del>No</del>
	No Requirements Specified. <del>However the servers shall meet the safety requirements as per the Server GR No. TEC/GR/IT/SRV-04</del>	<del>certificate is required.</del> Information.
7.0	<b>SAFETY REQUIREMENTS</b> No Requirements Specified	Information
8.0	<b>SECURITY REQUIREMENTS</b> No Requirements Specified	Information
9.0	<b>VARIOUS REQUIREMENTS OF THE CATEGORY/CONFIGURATION OF THE PRODUCT</b> <del>No Requirements Specified</del>	Information

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9.1	Minimum equipments required for Type Approval. The following minimum requirements shall be offered for Type Approval	Information
9.1.1	The NMS software in a suitable server hardware. <del>It is optional to offer the optional items of the NMS of this document.</del> Any of the requirements shown as optional in the GR, if offered for testing shall be indicated by the applicant. These shall be mentioned in the Type Approval certificate.	Information
9.1.2	<del>A</del> Three router or any Network Element along with <del>their its</del> eMS	Information
<b>CHAPTER -2</b>		
<b>10.0</b>	<b>INFORMATION FOR THE PROCURER OF PRODUCT</b>	<del>Information</del>
<b>10.04</b>	<b>Documentation:</b>	Information
10.04.1	Technical literature hard copy in English with complete layout, detailed block schematic shall be provided. A soft copy or QR code as well as the above shall also be provided both in Hindi and English. All aspects of installation, operation, maintenance, troubleshooting and repair shall be covered in this manual. The manual shall comprise of System description documents, Operation documents and Training documents <del>All literature and instructions required shall be made available in English language.</del>	<del>Information</del> Declaration
10.1.2	<del>The documents shall comprise of System description documents, Operation documents and Training documents</del>	<del>Information</del>
10.04.23	<b>System description documents:</b> The following system description documents shall be supplied along with the system. i. Over-all system specification and	<del>Information</del> Declaration

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	<p>description of the software</p> <p>ii. Detailed description of software describing the principles, functions, and interactions with hardware, structure of the program and data.</p> <p>iii. Detailed description of each individual software package indicating its functions and its linkage with the other packages, hardware, and data</p> <p>iv. Graphical description of the system. In addition to the narrative description a functional description of the system using the functional Specification</p>	
<del>10.1.3.1</del>	<del>Over-all system specification and description of the software</del>	<del>Information</del>
<del>10.1.3.2</del>	<del>Detailed description of software describing the principles, functions, and interactions with hardware, structure of the program and data.</del>	<del>Information</del>
<del>10.1.3.3</del>	<del>Detailed description of each individual software package indicating its functions and its linkage with the other packages, hardware, and data</del>	<del>Information</del>
<del>10.1.3.4</del>	<del>Graphical description of the system. In addition to the narrative description a functional description of the system using the functional Specification</del>	<del>Information</del>
10.0.34.4	<p><b>System operation documents:</b></p> <p>The following system operation documents shall be available.</p> <p>i. Installation manuals and testing procedures</p> <p>ii. Precautions for installation, operations</p>	<p><del>Information</del></p> <p><del>Declaration</del></p>

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	and maintenance iii. Operating and Maintenance manual of the system iv. Man-machine language manual	
<del>10.1.4.1</del>	<del>Installation manuals and testing procedures</del>	<del>Information</del>
<del>10.1.4.2</del>	<del>Precautions for installation, operations and maintenance</del>	<del>Information</del>
<del>10.1.4.3</del>	<del>Operating and Maintenance manual of the system</del>	<del>Information</del>
<del>10.1.4.4</del>	<del>Man-machine language manual</del>	<del>Information</del>
10.0.41.5	<b>Training Documents</b> i. <b>Training manuals and documents necessary for organizing training in installation, operation and maintenance and repair of the system shall be made available.</b> ii. <b>Any provisional document, if supplied, shall be clearly indicated. The updates of all provisional documents shall be provided immediately following the issue of such updates.</b> iii. <b>The structure and scope of each document shall be clearly described.</b> iv. <b>The documents shall be well structured with detailed cross-referencing and indexing enabling easy identification of necessary information.</b> v. <b>All diagrams, illustrations and tables shall be consistent with the relevant text.</b>	<del>Information</del> Declaration
<del>10.1.5.1</del>	<del>Training manuals and documents necessary for organizing training in installation, operation and maintenance and repair of the system shall be made available.</del>	<del>Information</del>

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40.1.5.2	<del>Any provisional document, if supplied, shall be clearly indicated. The updates of all provisional documents shall be provided immediately following the issue of such updates.</del>	Information
40.1.5.3	<del>The structure and scope of each document shall be clearly described.</del>	Information
40.1.5.4	<del>The documents shall be well structured with detailed cross-referencing and indexing</del>	Information
	<del>enabling easy identification of necessary information.</del>	
40.1.5.5	<del>All diagrams, illustrations and tables shall be consistent with the relevant text.</del>	Information
<b>CHAPTER - 2</b>		
11.0	<b>INFORMATION FOR THE PROCURER OF PRODUCT</b> This section describes the information for the procurer of the product which relates to the deployment guidelines, checklist to be taken care of at the time of tender etc.	
11.140.2	<b>NMS Deployment Guidelines</b>	Information
<del>40.2.411.1.1</del>	<del>If a DR is planned, it shall normally be geographically separated. The Main as well as the DR NMS is to be connected on normal and standby link with IP network. The NMS shall have a geographically separated DR site</del>	Information
<del>40.2.211.1.2</del>	<del>It is recommended that the DR NMS site have processing capacity of 100 % of the production capacity, so that in case of any natural or manmade DR instance, all functionalities related to all the applications shall continue to work. NMS shall have Disaster recovery NMS which shall be connected on normal &amp; standby</del>	Information

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	<del>link with IP network, dark fiber or on single lambda of DWDM system. It shall be located in a geographically separate location.</del>	
40.2.311.1.3	NMS for different networks (e.g. IP network, circuit switched network, transmission network, etc.) can be put under single OSS of the service provider. This is ideal deployment to start with. The function of NMS is described in this document. <del>However many of these functions are related to the capability of the eMS/NE and eEMS/ NE shall be capable to support those functions.</del>	Information
40.2.411.1.4	<del>eEMS of individual networks without full EMS eMS capabilities can be integrated into one or more big umbrella NMS (with the EMS capabilities and shall be able to talk communicate with the NEs directly) for providing full EMS-NMS functions. Such umbrella NMS(s) and also other NMSs can be put under single OSS of service provider. Such deployment is useful when existing NEs with less number of functionalities capable eEMS needed to be integrated with NMS. In this case, it is essential to develop and deploy the proxy/ mediation device which could enable the communication between NMS and</del>	Information

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	NE over proprietary interface. Normally the proxy/ mediation function is performed by eEMS. This deployment is suitable for small networks and has limitation in scalability to support the expansion of network.	
40.2.511.1.5	In case the NMS of a network does not have some features (like performance management, etc.), such NMSs (actually the upgraded EMSs) can be put under one umbrella OSS of the service provider for providing full NMS-OSS functions. This deployment is envisaged for the scenario where the individual networks have grown up with EMS only without integration to a full NMS. In this case, OSS shall also perform NMS functions. However since the some NMS functions can be specific to a particular type of network and since the OSS is network independent, this deployment becomes very complex in cases where OSS is required to manage multiple networks and also to provide NMS functions to all/ some of them.	Information
40.2.611.1.6	The NMS shall store both raw service quality data for a period of 3 months and normalized data in a historical log for a period of one year. However the exact period of storage shall be specified by the service provider.	<del>Information</del> <del>Declaration</del>

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11.1.7	The NMS is considered to be mission critical system and the whole system should be able to operate 24x7 basis with over 99.99% availability. High availability and fail-over capability shall be one of the main design focuses.	Declaration
11.1.8	It shall be ensured that in case of any link failure, the NMS connectivity to network is not disrupted and there is minimal loss of NMS data from the network. In absence of the NMS or eMS the Network shall continue to provide the services without any deterioration.	Declaration
11.1.9	The automatic switchover from Main NMS to DR NMS may require additional networking requirements which may be taken care while network design.	Declaration
11.1.10	Wherever e-mail / SMS alert is mentioned in this document requires PLMN / Internet connectivity which shall be ensured by the Service Provider.	Declaration
<del>10.3</del> 11.2	<b>Items to be Specified while Tendering:</b> The following information shall be specified by the purchaser while tendering the items	Information
11.2.1	The purchaser may make the requirements more explanatory wherever required based on the type of network / networks proposed to be managed	Information

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40.3.411.2. 2	The exact requirement for number of concurrent users and maximum users of the system with the future scalability.	Information
40.3.211.2. 3	The requirement of redundancy of the NMS network elements shall be decided by the purchaser. Purchaser can procure the NMS servers alone also with or without the SAN Switch and Storage components.	Information
40.3.311.2. 4	The tendering authority shall indicate the redundancy requirement for Firewall, Load Balancer, Ethernet switch, SAN Switch etc.	Information
40.3.411.2. 5	The tendering authority shall indicate whether separate Storage is required as shown in the Figure--8 of GR on NMS (TEC 48100:2026) or the Storage in the NMS Server is adequate or as separate server is required.	Information
40.3.511.2. 6	<del>The</del> For category of the Server and other items to be specified, the latest TEC standard on Server available on TEC website ( <a href="https://tec.gov.in/standards-specifications">https://tec.gov.in/standards-specifications</a> ) may be referred. <del>as per the Server GR No. TEC/GR/IT/SRV-01</del>	Information
11.2.7	The number of transactions per day/per hour/per minute to be supported as per clause 3.7.20	Information
40.3.611.2. 8	Category of the various hardware components as per clause 3.79	Information
11.2.940.3. 7	Number of licenses required in terms of the CPU Core or named licenses or data size for the Database and the number of local/remote NMS terminals.	Information

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<del>40.3.811.2.</del> 10	<del>The tendering authority shall indicate the</del> details of technologies / vendors equipment's for which auto discovery of the NE's is required as per clause 3.2.2.2	Information
11.2.11	In case the remote terminal locations from where the NMS is accessed do not have IP VPN connectivity with the NMS, requirement of DCN shall be indicated at the time of tendering by the Purchaser.	Information
<del>40.3.911.2.</del> 12	<del>The tendering authority shall indicate the</del> requirement of the following Optional Modules based on need with further customization where required	Information
11.2.12.1	Service Problem Management as per clause 3.1.2	Information
11.2.12.2	Service Quality/SLA Management requirements as per clause 3.3.2	Information
<del>40.3.9.411.</del> 2.12.3	Customer Experience Management as per clause 3.3.34	Information
<del>11.2.12.440</del> <del>3.9.2</del>	SIEM Security Features as per clause 3.45.2	Information
<del>11.2.12.540</del> <del>3.9.3</del>	SIEM LOG Capturing / Analysis as per clause 3.45.3	Information
<del>11.2.12.640</del> <del>3.9.4</del>	SIEM Altering and Viewing Requirements as per clause 3.45.4	Information
<del>11.2.12.740</del> <del>3.9.5</del>	SIEM Correlation Requirements as per clause 3.45.56	Information
<del>11.2.12.840</del> <del>3.9.6</del>	SIEM Forensic Capabilities as per clause 3.4.65.7	Information
<del>11.2.12.940</del> <del>3.9.7</del>	Route Analytics as per clause 3.6.17.4	Information

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11.2.12.104 0.3.9.8	Network & Device probes as per clause 3.67.2. In case this module is required details of the network elements required to be probed and their interface supported shall be specified.	Information
11.2.1340.3 9.9	NMS North Bound interfaces to be supported as per clause 4.2	Information
11.2.14	<p>Wherever applicable technology is mentioned, these clauses need to be modified / amended based on the type of networks to be managed.</p> <p>This document provides the details of generic requirements for the NMS and purchaser can modify and customize any requirement based on the networks and services to be managed.</p>	Information
11.2.15	The purchaser may provide additional performance monitoring parameters in clause 3.3 as required based on the NEE purcha monitored.	Information
11.2.16	The purchaser may specify the AI/ML capabilities for the NMS required as mentioned in clause 3.1.1.25.	Information
11.2.17	The purchaser may specify the actual backup device required as mentioned under clause number 3.5.2	Information
11.2.18	The purchaser may specify the actual report formats required as mentioned under clause number 3.6.4.2	Information
11.2.19	The purchaser may specify the actual type of protocols required to be supported on south bound interfaces as	Information

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	mentioned under clause number 4.1	
11.30	<b>SPECIFIC ITEMS TO BE MENTIONED IN THE CERTIFICATE</b> The following items shall be specified in the Certificate:	Information
11.34.1	Name/Model of the NMS	Information
11.34.2	Version of the NMS Software	Information
11.34.3	Operating Systems supported	Information
11.34.4	Category of Server used while testing the NMS	Information
11.3.545	Optional requirements/features offered for type approval validation	Information
11.3.6	NEs used for testing NMS requirements	Information

\* Physical Check/Declaration/Documentation/ Report from Accredited test lab/ Functional verification/Information/Test No.

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## J. TEST SETUP & PROCEDURES:

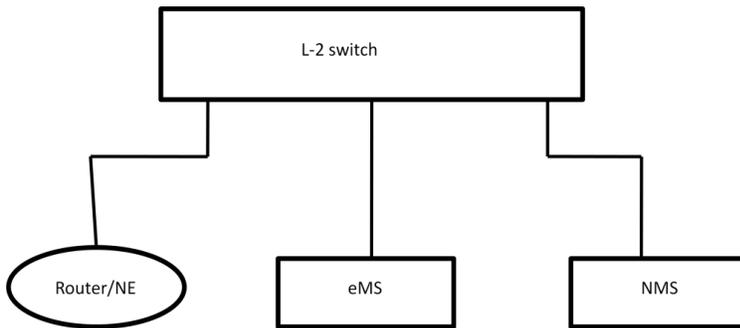


Fig1 : Test set up for NMS

### Test Procedure:

1. Connect the test setup as shown in the above figure.
2. Verify the various functionality using NMS GUI.
3. Wherever the data for an NMS function is not possible to be generated using the above step, availability of the feature may be verified and recorded.

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**K. SUMMARY OF TEST RESULTS**

GR/IR No.: ~~TEC/GR/IT/NMS-001/01/OCT-2015~~ 48100:2026

TSTP No. : TSTP/~~GR/IT/NMS-001/01/OCT-2015~~ 48101:2026

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Equipment name & Model No. \_\_\_\_\_

<b>ClauseNo.</b>	<b>Compliance</b> <i>(Complied/Not Complied/ Submitted/Not Submitted/Not Applicable)</i>	<b>Remarks /</b> <b>Test Report Annexure No.</b>

**Date:**

**Place:**

**Signature & Name of TEC testing Officer /**

**\* Signature of Applicant / Authorized Signatory**

*\* Section J as given above is also to be submitted by the Applicant/Authorised signatory as part of in-house test results alongwith Form-A. The Authorised signatory shall be the same as the one for Form 'A'.*

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