eMS-NMS Architecture in Telecom Management Systems

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Abstract

This paper aims to discuss the functions of the Element Management Systems and Network Management Systems in Telecom Networks. It gives a brief about the evolution of telecom Network Management, different network systems deployed in the network and the network management issues faced by Telecom Service Providers. This document discusses in detail the different standards of ITU-T and Telecom Management Forum [TMF] for Telecom Network Management, their synergy and functional areas for Telecom network management. It discusses in detail about the eMS functions and NMS functions bringing a clarity into the boundaries between them. It also specifies the interface requirements for the eMS/NMS systems to inter-operate with the eMS, NMS, OSS-BSS and ERP systems.

Key words

Element Management System (eMS), Network management System (NMS), Enhanced Telecom Operations Map (eTOM), Element Management Layer (EML), Network management layer(NML), Service Management Layer(SML), Business management Layer (BML), Fault Management, Configuration Management, Accounting Management, Performance Management, Security Management, Business Process Framework

1.   Introduction
1.1   Genesis of Network Management in Telecom

Network management has taken a predominant role in telecom with the introduction of SDH based transport systems. Till the era of PDH based transmission systems, the management of the systems were mainly based on various visual indications on the equipment or by performing various test measurements. With the introduction of SDH based transport systems, a dedicated channel was available as a part of the Overhead bytes for carrying the network management information including the alarms and the performance related information.

Element Management Systems (eMS) were introduced into the network which acted as an interface to the network operators for getting the information about the system as well as configuration of the systems. Accordingly the element management systems were started performing the functions of Fault Management, Configuration Management, Accounting Management, Performance Management and Security Management which in-short is termed as FCAPS functions. It is briefed in Figure-1.
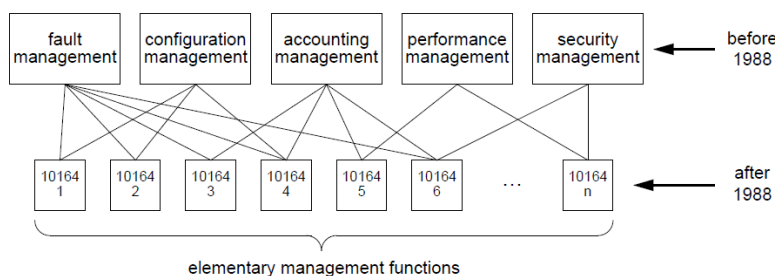
Figure 1: Element Management System Functions

In this architecture, the Network elements are termed as the agents and the eMS is termed as the Manager. The interaction between the Manager and the Agent is detailed in Figure-2.
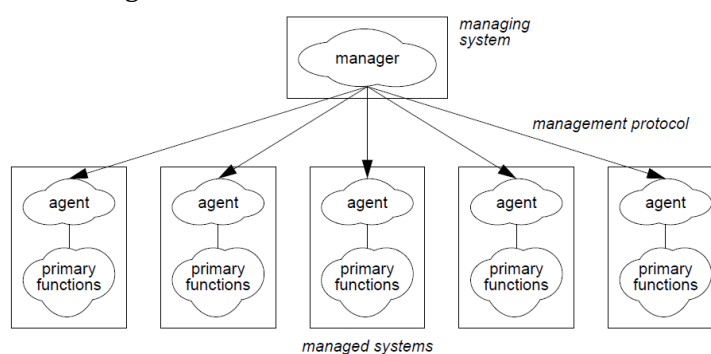

Figure 2: Interaction between the Manager and the Agents

The Network element performs the primary functions and an agent residing in the NE interacts with the Manager. A 7-layered OSI management model was proposed for the interaction between the Manager and the Agents which is given in Figure-3.
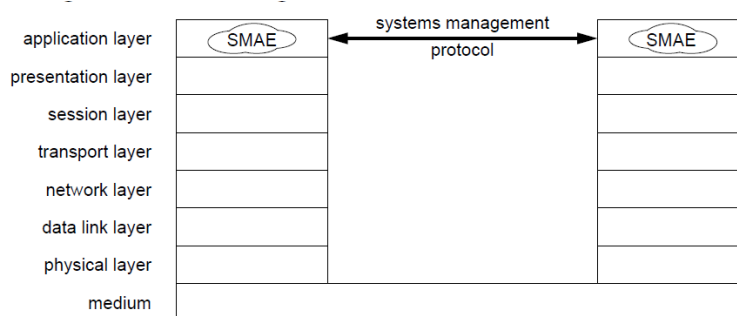

Figure 3: OSI Management Model for the Manager-Agent Interface

System Management Application Process [SMAP] is a process that runs in nodes that collect management information from processes running at each layer of the OSI protocol stack. A SMAP provides the interface through which MIBs share information. A SMAE (System Management Application Entity) supports SMAP communication, and SMAEs use Common Management Information Protocol [CMIP] to exchange data between nodes. The NE will be performing multiple primary functions and each function or the object is associated with a Managed Object. Thus the Managed Object is the abstract representation of a resource or function being managed. A management information base (MIB) is a

database used for managing the entities in a communications network complete collection of management information available on an entity. This is represented in Figure-4.
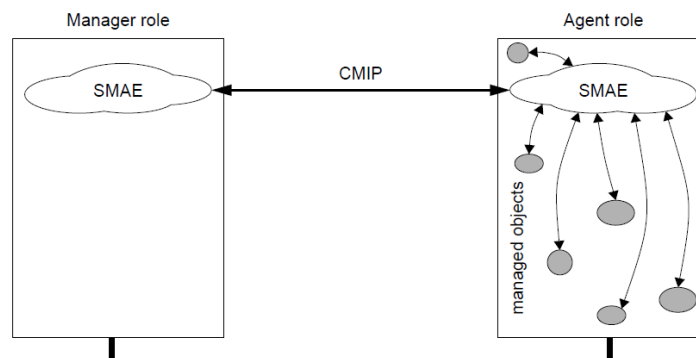

Figure 4: Managed Objects in an NE

Since the implementation of the complete 7-layered OSI stack was very complex, this protocol stack was not implemented across the networks. Instead many implementations were using Simple Protocol implementations like SNMP or proprietary protocol suits were used between Manager and the Agent as the Manager and the Agent were from the same OEM.

1.2 Management Systems deployed in Telecom Networks

Since the deployment of SDH systems, different management systems have been deployed in the Telecom Networks. Some of the Management systems deployed are listed below.

a) eMS/NMS for SDH Systems
b) eMS for Broadband Network elements like DSLAM, FTTH Systems, LAN/RPR/PBB-TE/MPLS-TP Switches, BRAS, BNG etc
c) eMS / NMS for MPLS Routers
d) eMS/NMS Systems for soft switches
e) eMS/NMS Systems for Mobile network elements like BTS, BSC, MSC, Gateways like SGSN/GGSN/P-GW/ASN-GW, IMS etc
f) eMS/NMS Systems for Content Delivery Networks
g) CPE Management Systems as per Broadband Forum TR-069
h) CRM Systems for Fixed Line Access, Mobile Access, Broadband Access
i) Provisioning Systems
j) ERP Systems
k) Fraud Management Systems

Where ever the management systems need to manage NE's of Single OEM and type like DSLAM etc., eMS systems are deployed. Wherever systems of different types or makes need to be managed, NMS systems were deployed. The NMS systems used to manage the NE's either through eMS or directly. Where ever OEM's were not having eMS's, NMS were deployed.

1.3 Network Management Issues

However Telecom Service Providers are facing many issues while deploying the eMS and NMS systems in the network. While the eMS and NMS

functionalities are getting evolved, there is overlap of functionalities between eMS and NMS Systems. Many equipment manufacturers do not have their own eMS solution and deploy NMS systems in place of eMS. Multi-vendor integration of the eMS systems and NE's to the NMS is also an issue. In the integration, software patches for integration are required to be developed called cartridges. Development of the cartridges and configuration and service provisioning in the NE's through the eMS is becoming a challenge. Clear definition of the functional boundaries between the eMS and NMS as well as defining the interface standards will resolve these issues to a greater extent. This paper is an attempt to define the functionalities and interface standards between the eMS and NMS.

1.4   Standardisation Bodies

Traditionally ITU-T and Telecom Management Forum were in the forefront of development of standards for the Telecom Management Systems. The OSI model based CMIP protocol was defined by ITU-T vide X.711. Further, some of the SDH systems started using TL-1 (Transaction Language-1) developed by Bellcore.

For all the IP based communication systems, IETF became the standardisation body and the systems used SNMP for alarms information while Network Configuration Protocol [NETCONF] as per RFC 4741 for configurations. The SNMP management structure is given in Figure-5. The SNMP messages included GET, GETNEXT, SET, RESPONSE and TRAP.
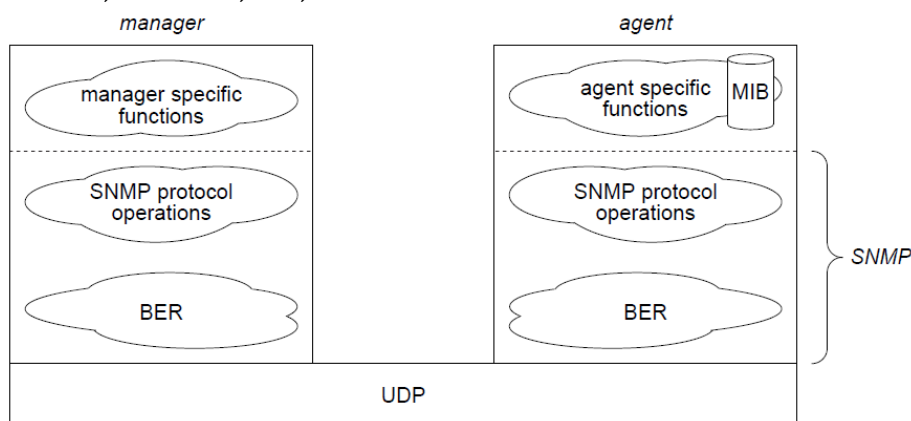

Figure 5: SNMP Management Model

The internet world through W3C has also standardised XML and SOAP which were also used as interface standard between the management entities. The object management group (OMG) has standardised IIOP [Internet Inter ORB Protocol] for communication between the management entities.

However the complete management model was standardised only by the ITU-T as well as the Telecom Management Forum. 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.

2. ITU TMN Model

2.1 TMN Model

The TMN Generic Network Management Model is given in Figure-6. The different Network Elements of a Telecommunication Network like Exchanges, Transmission systems etc are managed by Operations Systems which connect to the Telecommunication Network over the Data Communication Channel (DCC).
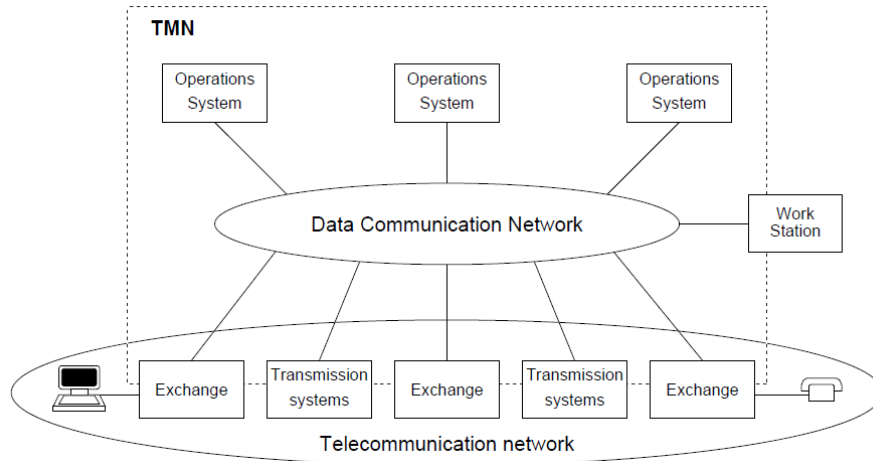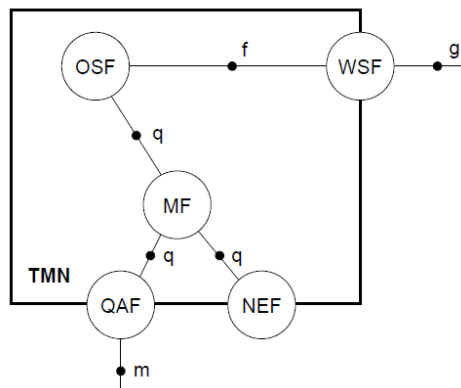

Figure 6: TMN Generic Network Management Model

The TMN functional blocks is given in Figure-7.

OSF: Operation Systems Functions
MF: Mediation Functions
WSF: Work Station Functions
NEF: Network Element Functions
QAF: Q Adapter Functions

Figure 7: TMN Function Blocks

The Network Element Functions are interfaced to the Operation Systems Functions through a Q interface. A flexibility in the architecture has been given through a mediation function for conversion to standardised Q interface. This is given in Figure-8. Non-TMN functional blocks are brought under the TMN umbrella over the QAF block. This is shown in Figure-10. The interfacing of QAF to OSF through MF using Q3 interface is given in Figure-9. Q3 has been standardised by ITU-T initially as the interface with the OSF. The OSF interfaces with the Work Stations over the WSF.
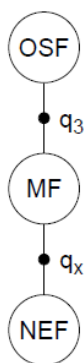
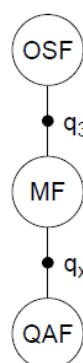Figure 8: TMN Function Blocks between NEF and OSF   Figure 9: TMN Functional Block between QAF and OSF
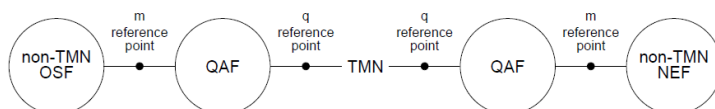

Figure 10: TMN Function Blocks-Interfaces

The TMN architecture has been layered horizontally as element Management, Network Management and Service Management layers. The Layered architecture is given in Figure-11. The Network elements interface with the element Management system over the Qx interface (Proprietory of the vendor) and the other interfaces of the eMS with other layers of Management functions is over the Q3 interface.
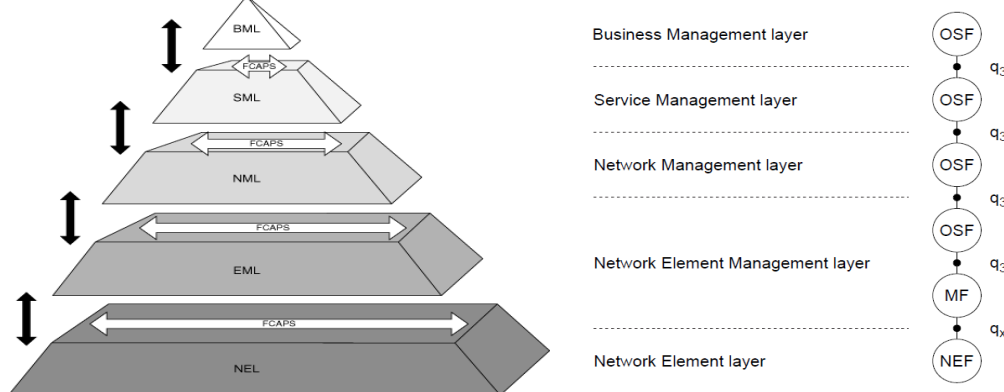

Figure 11: TMN Layered Architecture

The functions of the various Network Management layers is given below

a) Network Element Layer: This layer includes the Switches, Routers, Transmission Systems etc

b) Element Management Layer: This layer manages the elements comprising of networks and systems including the network configurations.

c) Network Management Layer: This layer manage the network and systems that deliver those services e.g. capacity, diversity, congestion etc. This layer manages from a multi-vendor perspective. It provides the Network View, Correlation of Network events, Single sign on to network elements and managers, Traffic Management, Monitoring network utilization & performance

d) Service Management Layer: 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. Order Management, Orchestration, Middleware, Provisioning Management, User account management, QoS management, Inventory management, monitoring of service performance

e) Business Management Layer: 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, Customer Billing, Business Reporting Tools falls in this layer.

2.2 FCAPS

The Management Functions are also 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:

Table 1: FCAPS Functions

Fault Management	RAS 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

It may be noted from Figure-11 that the FCAPS functions are available in every horizontal layer. But the definitions take care that same functionality is not repeated across the layers.

3. eTOM Model

The Business Process Framework (eTOM) defines a library of business processes in 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.

3.1 eTOM Level-0, Level-1

Level 0 and Level 1 process areas from the Business Process Framework are shown in the figure below. At the overall conceptual level, the Business Process Framework can be viewed as having the following three major (Level 0) process areas given in Figure-12:

a) Strategy, Infrastructure & Product covering planning and life-cycle management
b) Operations covering the core of operational management
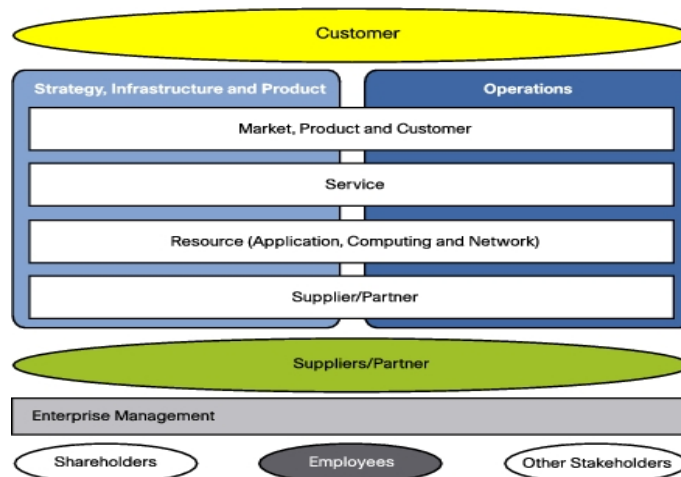c) Enterprise Management covering corporate or business support management

Figure 12: eTOM Level-0 Process

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 includes processes involving customers, supporting services, resources and suppliers/partners. These vertical groupings can be thought of as a lifecycle when from left to right in the Figure-13.
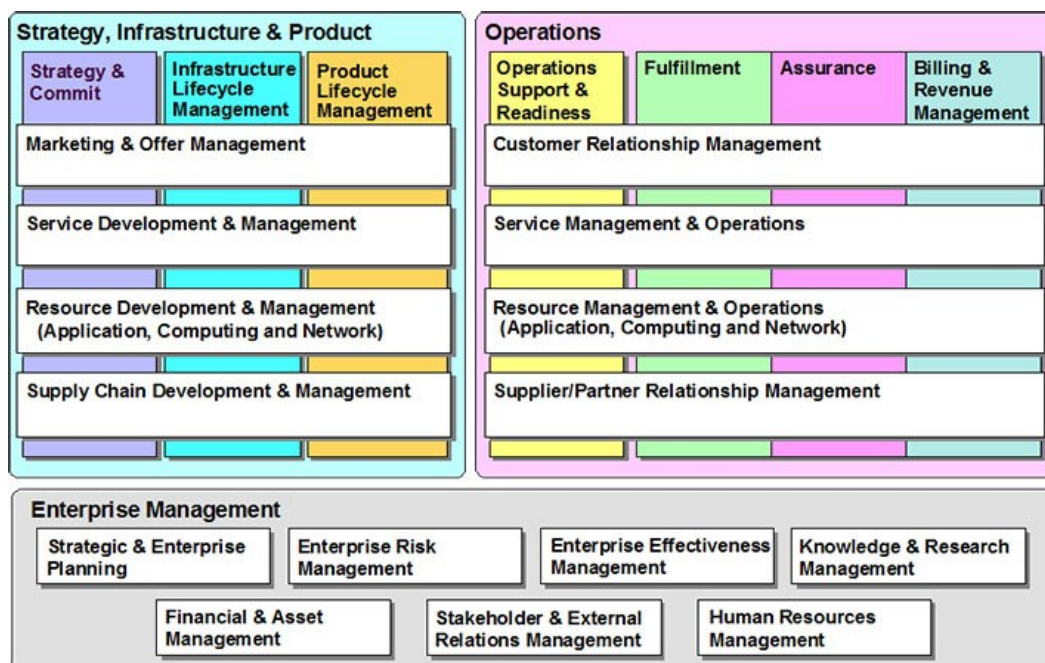
Figure 13: eTOM Level-1 Business Process Framework

The Strategy, Infrastructure & Product process area in blue in Figure-13 contains the "back-office" processes. They enable, support and direct the work done in Operations.

The focal point of the Business Process Framework is in the area of Fulfillment, Assurance and Billing. These vertical groupings contain the core processes related to customer operations. The fourth vertical grouping in the

operations area is called Operations Support & Readiness (OSR). Its processes focus on the support and automation of customer operations.

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.

3.2 eTOM Level-2 end to end process breakdown

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-14.
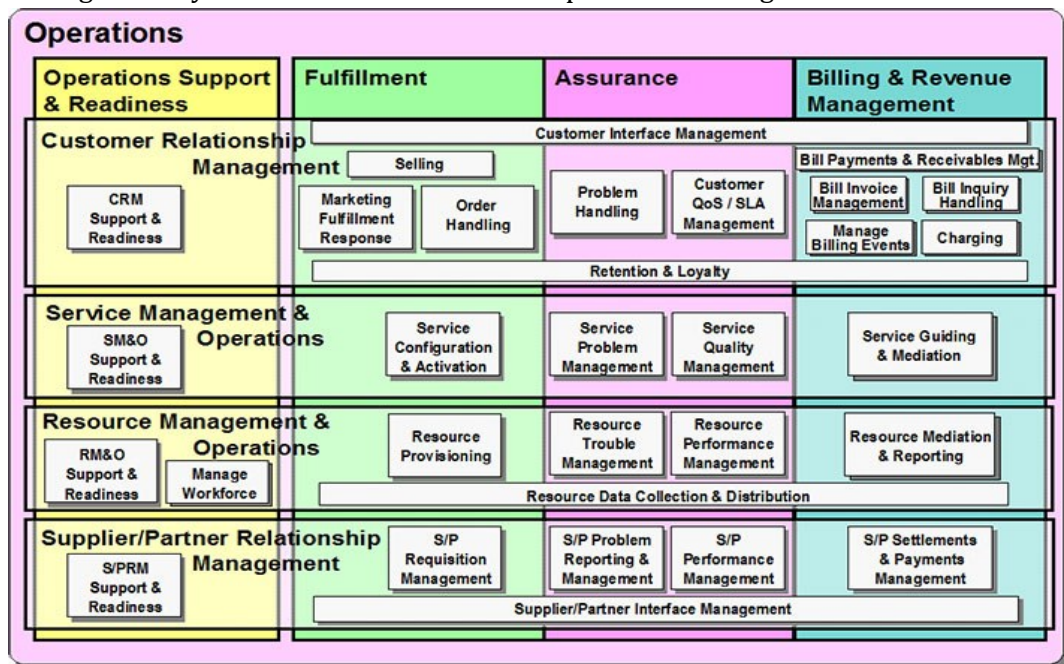

Figure 14: Lavel-2 Breakdown of Operations Business Process

Operations includes processes that support customers, network operations, and management. This also consists of sales management and supplier/partner relationships management.

Fulfillment is responsible for delivering products and services to the customer. This includes order handling, service configuration and activation, and resource provisioning.

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.

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). The following is a brief summary of the two areas that are most relevant for accounting and performance management. Within these two, the emphasis is on assurance and billing, because neither fulfillment nor OSR is related to accounting and performance:

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 is another function of RM&O. It monitors, analyzes, and reports performance data from the devices. A common RM&O function between assurance and billing is Resource Data Collection and Processing. It gathers and distributes management data between devices and service instances.

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.

In the billing area, Service and Specific Instance Rating correlates service events and converts them into a specific format. Reports on events can be generated—for example, to identify fraud.

3.3   eTOM-M3400 Mapping

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. The top level process and functional area mapping is in Figure-15. Figure-16, Figure-17, Figure-18 and Figure-19 gives the Configuration Management, Fault Management, Performance Management and Accounting Management functional Area mapping as per ITU-T M.3050.
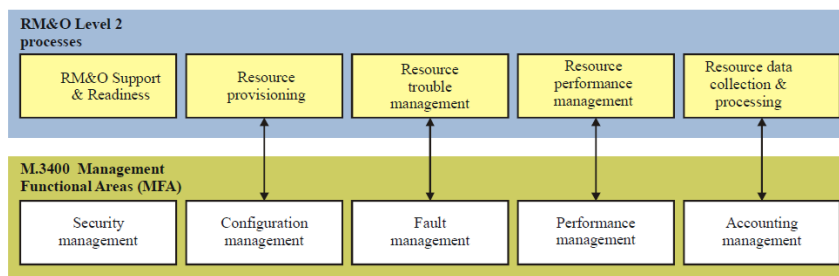

Figure 15: RM&O Level-2 Process and M3400 Management Functional Area Mapping
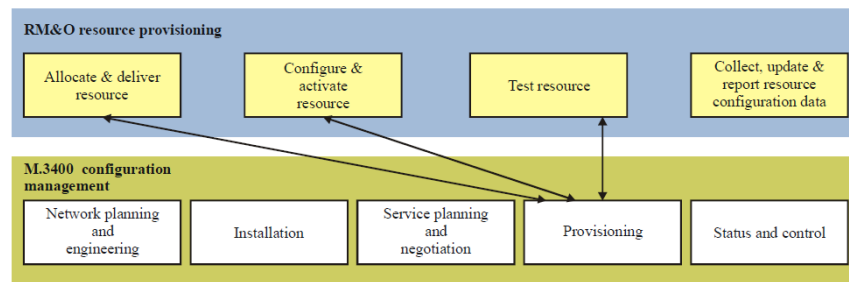
Figure 16: RM&O Resource Provisioning and M3400 Configuration Management Mapping
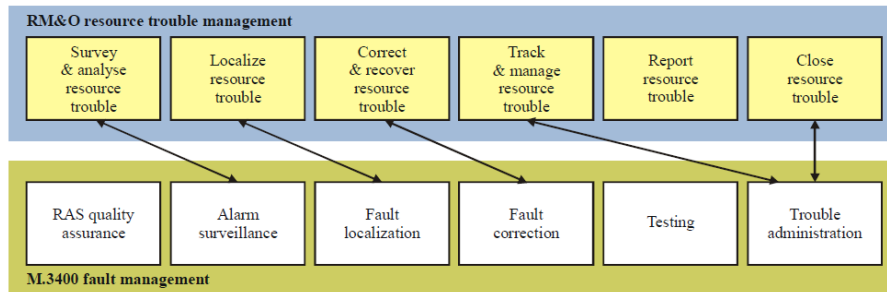

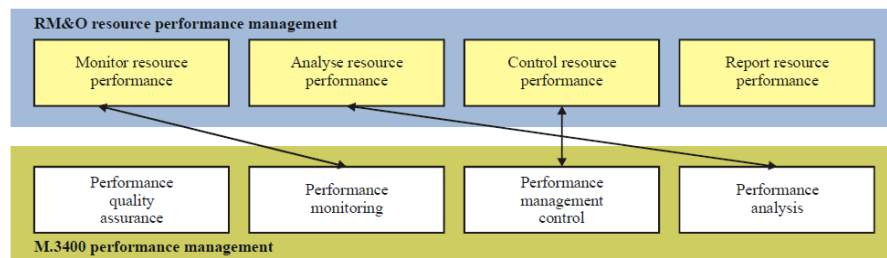Figure 17: RM&O Resource Trouble Management and M3400 Fault Management mapping

Figure 18: RM&O Resource Performance Management and M3400 Performance Management Mapping
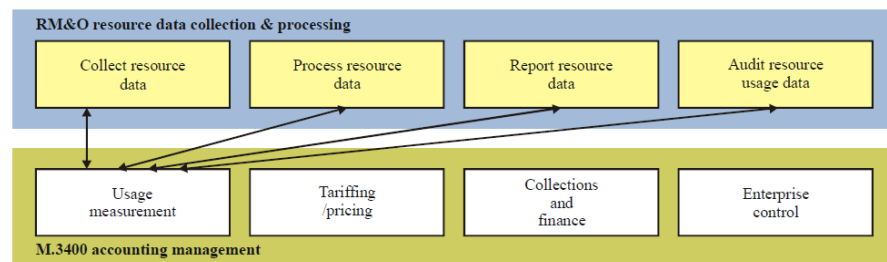
Figure 19: RM&O Resource Data Collection & Processing and M3400 Accounting Management Mapping

4. Generalised Model Building Blocks

The discussion in this paper is limited to the Operations area in the eTOM model in Figure-15 and the FCAPS functionality as per the M.3400. Based on these standards, a generalised model for the various building Blocks of Telecom Management System is introduced and is given in Figure-20. The various functions in the M.3400 Model is performed by the eMS, NMS and OSS/BSS Systems in a Telecom Network. However, eTOM model goes into additional functionalities in Strategies, Infrastructure & Product and Enterprise Management segments which are performed by Enterprise Resource Planning [ERP] systems. The role of ERP systems is not dealt within this paper. However these systems needs to provide necessary interfaces required towards the ERP systems.

Figure 20: TMN / eTOM Building Blocks for TMN

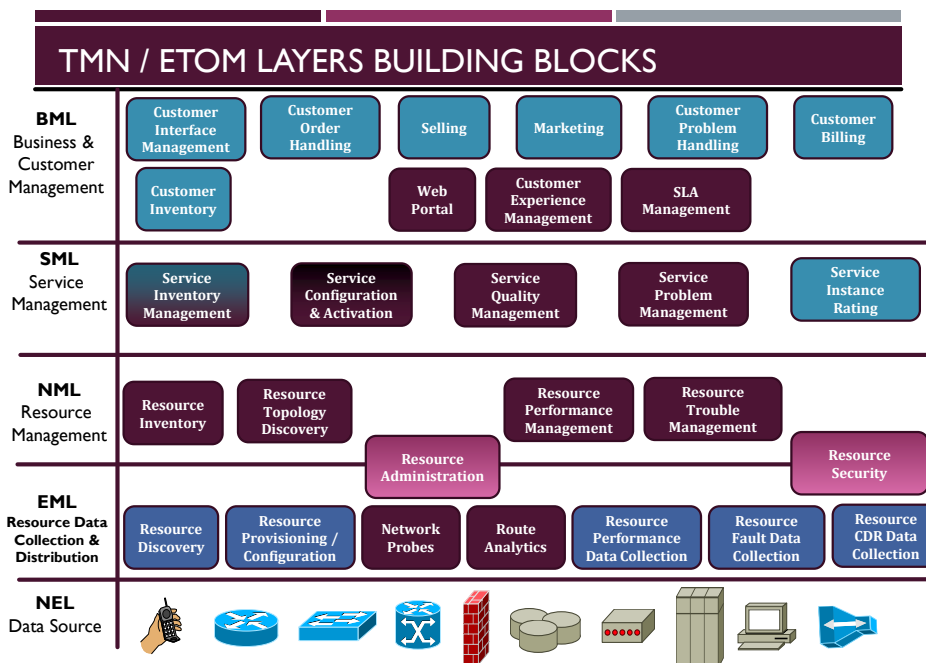The overall system map is given in Figure-21. All the functions described in Figure-20 covering the EML, NML, SML and BML Layers in a telecom network are performed by three systems namely the OSS/BSS System (Or Customer Relationship Management Systems), NMS System and eMS Systems.
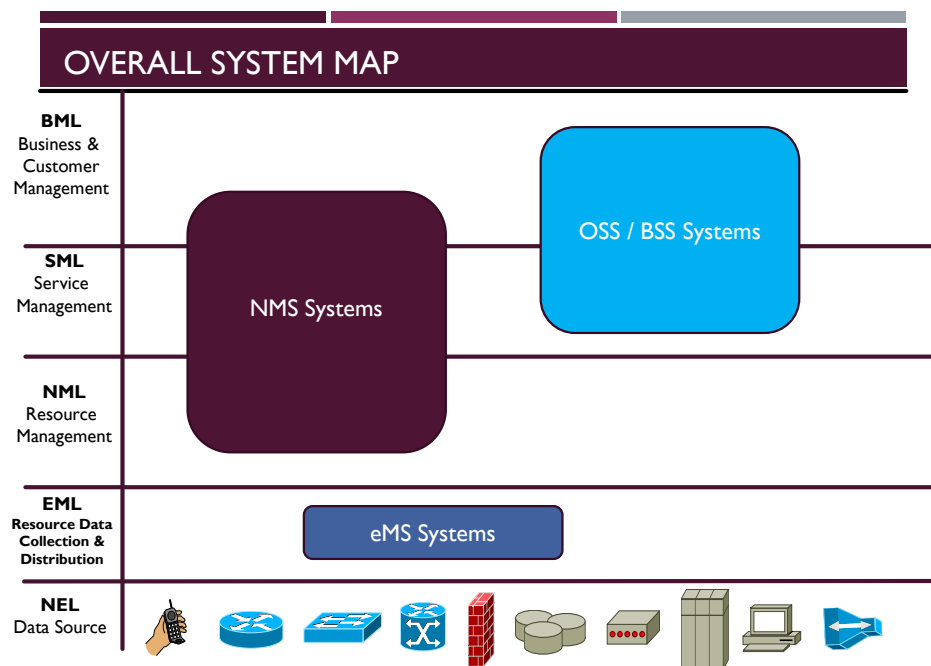

Figure 21: Overall System Map

The eMS functions include the following:

a) Resource Administration

b) Resource discovery
c) Resource provisioning and Configurations
d) Resource Performance data collection
e) Resource Fault Data collection
f) Resource CDR Data collection
g) Resource Security

The NMS functions include the following:
a) Resource Administration
b) Resource Inventory
c) Resource Topology Discovery
d) Resource Performance Management
e) Resource Trouble Management
f) Resource Security
g) Service Quality Management
h) Service Problem Management
i) Service Configuration & Activation (It can be part of a separate Provisioning Management System as well)
j) SLA Management
k) Customer Experience Management
l) Route Analytics
m) Network & Device Probes
n) Web Portal

The OSS/BSS functions include the following. However these functions are not discussed in detail in this paper.
a) Customer Interface Management having Call Center and Self Service Portal
b) Customer Order Handling
c) Customer Inventory
d) Selling
e) Marketing
f) Customer Billing having Billing and Collection
g) Service Inventory carrying out mediation, Rating and analysis of usage records
h) Service Instance Rating

5. eMS Functions

The function sets under various function categories for the eMS are described in this chapter. Most of the functions are coming in the EML layer of the Architecture as per Figure-20. The Route Analytics and the Network probes functions are described under the NMS as they are generally modules under the NMS system.

5.1 Resource Administration

The resource Administration function include the following function sets.
a) NE(s) status and control function set
b) Access to state information in NEs function set
c) Software administration function set

d) NE(s) administration function set

5.2 Resource Discovery

The resource discovery function as per M.3400 include the following function sets.
a) NE(s) database management function set
b) NE(s) inventory notification function set
c) NE(s) inventory query function set
d) Self-inventory function set

5.3 Resource Configuration & Provisioning

The resource Configuration & provisioning function as per M.3400 include the following function sets.
a) NE installation administration function set
b) Loading software into NEs function set
c) Network connection management function set
d) NE(s) configuration function set
e) NE(s) resource selection and assignment function set
f) NE(s) path design function set
g) Loading program for service feature(s) function set
h) Manage pending changes in NE(s) function set
i) Access to parameters and cross-connects in NEs function set
j) Access to service features in NEs function set

5.4 Resource Trouble Management

The resource Trouble or Fault Management function as per M.3400 include the following function sets.
a) NE(s) outage reporting function set
b) Alarm correlation and filtering function set
c) Failure event detection and reporting function set
d) NE(s) fault localization function set
e) NE(s) fault correction function set
f) Automatic restoration function set
g) Test point policy function set
h) NE(s) test control function set
i) Test access function set
j) Notification of state changes by NEs function set

5.5 Resource Performance Management

The resource CDR performance management function as per M.3400 include the following function sets.
a) NE(s) performance assessment function set
b) NE(s) threshold crossing alert processing function set
c) NE(s) trend analysis function set
d) NE(s) performance characterization function set
e) NE(s) traffic exception analysis function set
f) NE(s) traffic capacity analysis function set

5.6   Resource CDR Data collection

The resource CDR data collection function as per M.3400 include the following function sets.

a) Usage accumulation function set
b) Usage validation function set
c) Administration of usage data collection function set
d) Usage generation function set

5.7   Resource Security

The resource security function as per M.3400 include the following function sets.

a) Software intrusion audit function set
b) Support element security alarm reporting function set
c) NE(s) intrusion recovery function set
d) Administration of NE(s) revocation list function set
e) Protected storage of NE(s) configuration data function set
f) NE(s) audit trail management function set
g) NE(s) security alarm management function set
h) Administration of keys for NEs function set
i) Administration of keys by an NE function set

6.   NMS Functions

The function sets under various function categories for the NMS are described in this chapter. Most of the functions are coming in the NML, SML and BML layers of the Architecture as per Figure-20. Basic Resource Administration & Resource Security functions are duplicated in NMS as well.

6.1   Resource Inventory

The resource Inventory function as per M.3400 include the following function sets.

a) Circuit-specific data collection function set
b) Circuit inventory notification function set
c) Circuit inventory query function set
d) Assignable inventory management function set

6.2   Resource Topology Discovery

The resource topology discovery function will have a network topology view of the Network Elements (Resources) in a Geographical map or so. The Topology discovery function set will utilise the Resource discovery functions and the Resource Inventory functions.

6.3   Resource Performance Management

The resource Performance Management function as per M.3400 include the following function sets.

a) Network performance goal setting function set
b) Network performance assessment function set
c) Data integrity check function set

d) Performance monitoring policy function set
e) Network performance monitoring event correlation and filtering function set
f) Data aggregation and trending function set
g) Traffic status function set
h) Traffic performance monitoring function set
i) Performance monitoring data accumulation function set
j) Detection, counting, storage and reporting function set
k) Network traffic management policy function set
l) Traffic control function set
m) Traffic administration function set
n) Performance administration function set
o) Execution of traffic control function set
p) Traffic exception analysis function set
q) Traffic capacity analysis function set
r) Network performance characterization function set
s) Message handling systems network status function set
t) Leased circuit network status function set
u) Transport network status function set

6.4 Resource Trouble Management

The resource Trouble Management function as per M.3400 include the following function sets.
a) Recommendations for performance improvement function set
b) Exception threshold policy function set
c) Traffic forecasting function set
d) Network RAS goal setting function set
e) RAS assessment function set
f) Network outage reporting function set
g) Alarm policy function set
h) Network fault event analysis, including correlation and filtering function set
i) Alarm status modification function set
j) Alarm reporting function set
k) Alarm summary function set
l) Alarm event criteria function set
m) Alarm indication management function set
n) Log control function set
o) Fault localization policy function set
p) Verification of parameters and connectivity function set
q) Network fault localization function set
r) Running of diagnostic function set
s) Circuit selection, test correlation and fault location function set
t) Selection of test suite function set
u) Test access network control and recovery function set
v) Test access configuration function set
w) Test circuit configuration function set
x) Results and status reporting function set

y) Test access path management function set

6.5 Resource Security

The resource security function applicable at the NMS layer as per M.3400 include the following function sets.

a) Network security alarm function set
b) Network intrusion recovery function set
c) Administration of network revocation list function set
d) Protected storage of network configuration data function set
e) Severing internal connections function set
f) Network audit trail management function set
g) Network security alarm management function set

6.6 Service Problem Management

The Service Problem Management function as per M.3400 include the following function sets.

a) Create Service Problem report
b) Diagnose Service Problem
c) Correct & Resolve Service Problem
d) Track & Manage Service Problem
e) Report Service Problem
f) Survey & Analyse Service Problem

6.7 Service Quality Management

The Service Quality Management function as per M.3400 include the following function sets.

a) Enable Service Quality Management
b) Monitor Service Quality
c) Analyse Service Quality
d) Improve Service Quality
e) Report Service Quality
f) Create Service Performance Degradation Report
g) Track & Manage Service Quality Performance Resolution

6.8 Service Configuration & Activation

The Service Configuration & Activation function include the following function sets.

a) Enable Service Configuration & Activation
b) Develop overall Design & Service Implementation Plan
c) Allocate parameters to Services
d) Track and Manage Service Provisioning
e) Implement, Configure and Activate Service
f) Test End-To-End Service
g) Issue Service Orders including Order Orchestration for Configuration of Multiple Network Elements in a pre-defined Sequence of operation
h) Report Service Provisioning

6.9 **SLA Management**

The Service Configuration & Activation function include the following function sets.

a) Assess Customer QoS/SLA Performance
b) Manage QoS/SLA Violations
c) Report Customer QoS/SLA Performance
d) Customer QoS/SLA Performance Degradation report
e) Track & Manage Customer QoS/SLA Performance

6.10 **Customer Experience Management**

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. Assuring optimal quality of experience to customers while using the services is referred to as Customer Experience Management (CEM). CEM allows the TSP to gain understanding of individual customers' experiences in real time and ideally, provide a single solution for Customer Care, Marketing, Service and Network Operations, as well as Network Engineering and Planning. As such, it should provide continuous visibility of the actual end-user experience across multiple dimensions including type of user devices, geographical localization, health and performance of the service and network infrastructure, service plans, usage behaviour, traffic, capacity etc. It helps TSPs to:

a) Improve the business processes and functions associated with customer experience responsibilities across the Network Engineering, Operations, Customer Care, Marketing and Quality departments.
b) Overcome the complexity of managing networks, services, and subscribers across their technical and user experience dimensions.
c) Provide decision making visibility into network traffic, service usage, and user experience to each of the different stakeholders so that abnormal situations can be addressed without delays.
d) Create value from a variety and heterogeneous data sources, including those not being exploited today, as alternative or in addition to probes, such as logs and xDRs.
e) Gain a single-pane-of-glass visibility into individual user's experience, services and network out of huge data volumes, with easy-to-use drill downs into necessary details where mandated
f) Manage the network capacity in accordance with traffic growth and policies and detect network
g) Scale up to accommodate traffic and services usage growth across multiple network technologies

6.11 **Route Analytics**

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. It can analyse the Trap and provide the information like trap rate etc. It helps 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

6.12   Network & Device Probes

In most of the solutions, the Network and device probes are part of the Customer Experience Management solution. 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. It can provide the data for the measurement of the Quality of Service and Root cause analysis.

6.13   Web Portal

The Web Portal will Organize, consolidate, and automate all service management functions. It will 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. When there is an issue with network or service performance, its problem resolution capabilities act, in addition to its end-to-end service monitoring features. Drill-down capabilities will enable to descend through the layers of information to the underlying systems, which will launch integrated views into the unified dashboard.

7.   Interfaces

In addition to feature sets, another important aspect of interworking are the availability of standardised open interfaces.

7.1   eMS Interfaces

The eMS systems are managing the NE's or Resources of the same OEM and hence, they can use any type of interfaces towards the NE's. The protocol being followed between the eMS and NMS can be standard protocols or any proprietary protocol set. It is expected that for all the configuration or any other requirements of the NE's, the NMS systems will interact through the eMS.

7.2   NMS Interfaces

The NMS systems will have the North Bound Interfaces towards other NMS systems, OSS/BSS Systems and ERP Systems. These interfaces shall be one of the standard interfaces like J2EE, CORBA, .Net or XML

The NMS systems will have the South Bound Interfaces towards the eMS systems. The standard protocol being followed in these interfaces are SNMP, XML, TEXT or CORBA

7.3   Cartridge Development

Cartridge is an interface software required between different systems i.e. eMS and NMS or NMS and OSS/BSS etc. The interface requirements need to specify the information required by the NMS from the eMS. This will also specify the details of all the commands going to the eMS from the NMS including the configuration etc.

As can be seen from the previous para, the functionalities of the NMS systems have increased many fold while the interface standards have become very simple as compared to the Q3 interface standards in the beginning. This has both

advantage as well as disadvantage. The major disadvantage being the development of the cartridge become more and more complex.

8. Conclusion

This study paper is an in depth analysis of the evolution of the Telecom Network Management along with the different Network Management Stands by ITU-T and the TMF. This paper examines the various issues involved in the implementation of a unified eMS-NMS architecture for the Telecom Service Providers. This paper attempts to define the functional requirements for the eMS and NMS systems by defining their boundaries and role in order to avoid the overlapping of the functionalities between eMS and NMS Systems. This paper also examines interface standards between the eMS and NMS so that the deployment of the systems become simple and cost effective.

9. References

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