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LIAISON STATEMENT

To:	**FGNGN, NGNMFG, ETSI TISPAN WG8, ATIS TMOC, TMF, 3GPP SA5, 3GPP2 TSG-S WG5, IETF (Management), ITU-T Q5/13, ITU-T Q14/15**
Approval:	**SG4 plenary**
For:	**Information/Comment**
Deadline:	**1 June 2005**

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ITU-T Draft Recommendation M.3060 (Principles for the Management of Next Generation Networks) is now nearing completion. In drafting this recommendation ITU-T SG4 have attempted to meet, not only, the known requirements of NGN Management as they have been contributed to us by our members, but also those submitted in liaisons from other bodies. It is our intention that this document will meet both the needs of ITU-T and also the wider needs of the telecom management standards community.

ITU-T SG4 plan to go for approval in July of this year.

We plan to make a final review of this document at our joint Q6/4 and Q8/4 experts meetings in April, June and July 2005 and would welcome any comments you may have. Specifically, does the document meet your requirements and if not what changes or additions would you like to see?

We look forward to receiving your comments.

Attachment: TD 28 (PLEN/4) - Draft Recommendation M.3060

INTERNATIONAL TELECOMMUNICATION UNION

TELECOMMUNICATION STANDARDIZATION SECTOR

STUDY PERIOD 2005-2008

STUDY GROUP 4

TD 28 (PLEN/4)

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TEMPORARY DOCUMENT

Source: Editor – M.3060/Y.NGN-Management (ex. M.NGN-Management)

Title: Draft New Recommendation M.3060/Y.NGN-Management, "Principles for the Management of Next Generation Networks", version 0.4

Title: Draft New Recommendation M.3060/Y.NGN-Management (ex. M.NGN-Management), "Principles for the Management of Next Generation Networks", version 0.4

Abstract

This document contains the draft text of new Recommendation "*Principles for the Management of Next Generation Networks* ". This version (0.4) is the output version from the SG4 February 2005 meeting.

Open issues remain to be resolved are listed in a temporary appendix at the end of the document.

Revision History

Version	Date	Note
0.4	February 24, 2005	Output version from the SG4 February 2005 meeting
0.3.3	February 21, 2005	Created based on the discussion on the Sunday (2/20) drafting session and the editing instructions received after the drafting session.
0.3.2	February 19, 2005	Created at the SG4 meeting for drafting purpose. Input from D32, D36, and Q8/4 discussion
0.3.1	January 21, 2005	Updated to complete the editing instruction from the October 2004 Electronic meeting and amended by the post meeting email correspondence
0.3	October 22 2004	Updated according to the Editing instruction from the October 18 - 22, 2004 Electronic meeting
0.2	August 20, 2004	Updated according to the Editing instruction from the July 26 – 29, 2004 Electronic meeting.
0.1	May 7, 2004	Initial draft version. It contains the execution of the agreed to editing instructions performed on delayed 182 agreed to at the 26 April - 7 May 2004 SG 4 meeting.

ITU-T RECOMMENDATION M.3060/Y.NGN-Management

PRINCIPLES FOR MANAGEMENT OF NEXT GENERATION NETWORKS

Summary

This Recommendation defines concepts for the management of Next Generation Networks architectures (functional architecture, information architecture, and physical architectures) and their fundamental elements.

This Recommendation also describes the relationship among the three architectures and provides a framework to derive the requirements for the specification of management physical architectures from the management functional and information architectures. A logical reference model for partitioning of management functionality, the Logical Layered Architecture (LLA), is provided.

Source

ITU-T Study Group 4 (2005 – 2008)

Keywords

Architecture, interfaces, management, reference points

CONTENTS

Recommandation M.3060/Y.3060

PRINCIPLES FOR MANAGING NEXT GENERATION NETWORKS

1 Scope

This Recommendation presents the general architectural principles for the management of NGN to support business processes to plan, provision, install, maintain, operate and administer NGN resources and services.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*

ITU-T Recommendations ~~Q~~G.85x-series, *Management of the transport network - Application of the RM-ODP framework~~Telecommunications management network~~*

ITU-T Recommendation G.8080/Y.1304 (2001), *Architecture for the automatic switched optical networks (ASON), and Amendment 2 (2005)*

ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*

ITU-T Recommendation M.3016.0 (2005), Security for the Management Plane: Overview

ITU-T Recommendation M.3016.1 (2005), Security for the Management Plane: Security Requirements

ITU-T Recommendation M.3016.2 (2005), Security for the Management Plane: Security Services

ITU-T Recommendation M.3016.3 (2005), Security for the Management Plane: Security Mechanism

ITU-T Recommendation M.3016.4 (2005), Security for the Management Plane: Profile Proforma

ITU-T Recommendation M.3020 (2000), *TMN interface specification methodology*

ITU-T Recommendation M.3050.0 (2004), *Enhanced Telecom Operations Map (eTOM) – Introduction*

ITU-T Recommendation M.3050.1 (2004), *Enhanced Telecom Operations Map (eTOM) – The business process framework*

ITU-T Recommendation M.3050.2 (2004), *Enhanced Telecom Operations Map® (eTOM) – Process decompositions and descriptions*

ITU-T Recommendation M.3050.3 (2004), *Enhanced Telecom Operations Map® (eTOM) – Representative process flows*

ITU-T Recommendation M.3050.4 (2004), *Enhanced Telecom Operations Map (eTOM) – B2B integration: Using B2B inter-enterprise integration with the eTOM*

ITU-T Recommendations M.31xx-series, *Generic network information model*

ITU-T Recommendation M.3200 (1997), *TMN management services and telecommunications managed areas: Overview*

ITU-T Recommendation M.3400 (2000), *TMN management functions*

ITU-T Recommendation Q.811 (2004), *Lower layer protocol profiles for the Q and X interfaces*

ITU-T Recommendation Q.812 (2004), *Upper layer protocol profiles for the Q and X interfaces*

ITU-T Recommendation Q.82x-series, *Specifications of Signalling System No. 7 – Q3 interface maintenance*

ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open systems interconnection – Basic reference model: The basic model*

CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications*

ITU-T Recommendation X.703 (1997) | ISO/IEC 13244:1998, *Information technology –Open distributed management architecture*

ITU-T Recommendations X.73x-series, *Management functions and ODMA functions*

ITU-T Recommendation X.805 (2003), *Security Architecture for Systems Providing End-to-End Communications*

ITU-T Recommendation Y.110 (1998), Global information infrastructure principles and framework architecture

ITU-T Recommendation Y.2011 (2004) *General Principles and General Reference Model for Next Generation Networks*

ITU-T Recommendations Z.300-series, *Man-machine language – Basic syntax and dialogue procedures*

3 Definitions

This Recommendation uses the following terms from Recommendation G.805:

- Administrative Domain

This Recommendation uses the following terms from Recommendation G.8080/Y.1304:

- Transport Plane

This Recommendation uses the following terms from Recommendation M.3010:

- Business Management Layer
- Data Communication Network
- Element Management Layer
- F Interface
- F Reference Points
- Function Block
- Interface
- Logical Layered Architecture
- M Reference Points

- Managed Resource
- Management Domain
- Management Function [*Note*: *As opposed to the definition of "support function" in M.3010, in NGNM a support function is a special case of a management function, namely a management function that does not directly offer management functionality itself but assists other management functions in their management functionality. Since such a function is not perceived by the user of a Management Service or Business Process, this convention complies with the definition for management function.*]
- Management Function Set
- Management Layer
- Management Service
- Network Management Layer
- Network Element Function *[Note: SEF and TEF are specialization of NEF]*
- Operations System
- Physical Block
- Q Adaptor
- Q Interface
- q Reference point
- Reference Point
- Service Management Layer
- Transformation Function
- Workstation
- Workstation Function
- X Interface
- x Reference Points

This Recommendation uses the following terms from Recommendation Y.2011:

- Control Plane
- Management Plane

This Recommendation uses the following terms from Recommendation M.3050.1:

- Customer
- End-user

This Recommendation defines the following terms:

- **B2B/C2B interface**: synonymous to X interface
- **b2b/c2b reference point**: synonymous to x reference point
- **Business process**: a systematic, possibly triggered, sequence (or processing tree) of related or complementary functional activities that defines management functionality (and the

function blocks which will make it up), and possibly management services, to deliver specified business results.

- **Distributed multi-element structure**: An architectural concept that represents a grouping of network elements that must be managed as a single entity for operational efficiency sake. Examples include Optical Bidirectional Line Switched Ring (BLSR) or an entire MPLS network when viewed from the perspective of an edge router.
- **Element management function (EMF)**: A function block that processes information related to the telecommunications management for the purpose of monitoring/coordinating and/or controlling network elements on an individual or collective basis.
- **Function block**: The smallest (deployable) unit of management functionality that is subject to standardization.
- **HMI Interface**: synonymous to G interface
- **hmi reference point**: synonymous to g reference point
- **Management functionality**: One or more management function sets or management functionalities. This allows a recursive grouping of related and complementary management function sets to an appropriate level.
- **Network management function (NMF)**: A function block that processes information related to the management of the network, including coordination of activity in a network view.
- **Next generation networks (NGN) management (NGNM)**: planning, provisioning, installation, maintenance, operation and administration, of next generation telecommunications equipment for transmission or control of resources and services within NGN transport and service strata.
- **NGN Network Element (NNE)**: An architectural concept that represents telecommunication equipment (or groups/parts of telecommunication equipment) and supports equipment or any item or groups of items considered belonging to the telecommunications environment that performs at least one of transport element functions (TEFs) or service element function (SEFs).

  Note: In this document, the term NGN Network Element (NNE) is used interchangeably with Net work Element (NE).
- **Operations System (OS)**: an architectural concept representing the physical realization of one or more OSFs through the grouping of OS components (i.e. being able to perform some management functionality).
- **Service Element Function (SEF)**: A function block that is a specialization of NEF representing the telecommunication service functions.
- **Service management function (SMF)**: A function block that processes information related to service instance management, including the contractual aspects, service order handling, complaint handling and invoicing, of services that are being provided to customers or available to potential new customers.
- **Service Resource**: Resources in the NGN service stratum.
- **Service resource management function (SRMF)**: A function block that processes information related to the management of service resources, including inventory and availability.

- **Transport Element Function (TEF)**: A function block that is a specialization of NEF representing the telecommunication transport functions
- **Transport Resource**: Resources in the ~~user plane of the~~ NGN transport stratum.
- **Transport resource management function (TRMF)**: A function block that processes information related to the management of network transport resources, including inventory and availability.

Editor's note: for all OSF specializations, indicate that they are within the definition

Abbreviations

This Recommendation uses the following abbreviations:

A Agent
A/M Agent/manager
AE Application entity
ASN.1 Abstract Syntax Notation number One
ATM Asynchronous Transfer Mode
B2B Business to Business
BML Business management layer
B-OSF Business Management Layer – Operations Systems Function
C2B Customer to Business
DCF Data communication function
DCN Data communication network
EMF Element Management Function
EML Element management layer
E-OSF Element Management Layer – Operations Systems Function
GDMO Guidelines for the Definition of Managed Objects
HMI Human Machine Interface
IN Intelligent Network
ISO International Organization for Standardization
ITU International Telecommunication Union
LLA Logical Layered Architecture
M Manager
M Mandatory
MAF Management application function
MAN Metropolitan Area Network
MIB Management information base

MIS Management information service

MO Managed objects

NE Network element

NEF Network element function

NEF-MAF Network element function – Management application function

NGN Next Generation Networks

NGNM NGN Management

NMF Network management function

NML Network management layer

N-OSF Network management layer – Operations Systems Function

O Optional

OA&M Operations, Administration and Maintenance

OID Object Identifier

OS Operations system

OSF Operations systems function

OSF-MAF Operations systems function – Management application function

OSI Open systems interconnection

QA Q adapter

QoS Quality of Service

R Resource

SDH Synchronous Digital Hierarchy

SEF Service element function

SMF Service management function

SMK Shared management knowledge

SML Service management layer

S-OSF Service management layer – Operations Systems Function

TEF Transport element function

TF Transformation Function

TF-MAF Transformation Function – Management application function

WSF Workstation function

WSSF Workstation Support function

5 Introduction

This Recommendation presents the management requirements, general principles and architectural requirements for managing Next Generation Networks.

This Recommendation presents the general architectural principles for the management of NGN to support business processes to plan, provision, install, maintain, operate and administer NGN resources and services. Customer operations processes may also include customer activity.

Within the context of NGN, management refers to a set of capabilities to allow for the exchange and processing of management information to assist network operators and service providers in conducting their business efficiently.

NGN management (NGNM) provides management functions for NGN resources and services and offers communications between the management plane and the NGN resources, services and other management planes.

The aim of NGNM is to facilitate the effective interconnection between various types of Operations Systems (OSs) and/or NGN resources for the exchange of management information using an agreed architecture with standardized interfaces including protocols and messages. In defining the concept, it is recognized that many network operators and service providers have a large infrastructure of OSs, networks and equipment already in place, and which must be accommodated within the architecture.

Next Generation Networks are essentially about delivering new services that are available any place, any time, and on any device, through any customer chosen access mechanism.

A Management Framework is required that increases customer satisfaction and at the same time underpins a significant reduction in operating costs through new technologies, new business models, and new operational methods.

The use of the term “Services” in this context is the traditional telecommunication use of the word encompassing applications such as: voice, multimedia, messaging, etc. which in most industries are referred to as Products.

Much of the NGN challenge arises from new business models and the effective operational delivery of those services, which in turn is high dependant on flexible and efficient management systems and processes.

6 Basic objectives for managing a next generation network

The objective for this Recommendation is to provide a set of principles and a framework for managing next generation networks. This requires agreement amongst suppliers and operators on the organization of processes amongst them that may be operated by people, Operation Systems (OS) or other Information Technology (IT) systems. The management architecture needs to address:

- Administrative boundaries amongst operator domains
- Processes amongst operators across these domain boundaries
- Processes between Operators and their suppliers’ equipments
- Reference points and interfaces between the logical functions and implantations used to realize those processes
- Information models used to support logical functions

For example by the use of the concepts of generic network models for management, it is possible to perform general management of diverse equipment, networks and services using generic information models and standard interfaces.

Management of telecommunications networks is intended to support a wide variety of management areas, which cover the planning, installation, operations, administration, maintenance and provisioning of telecommunications networks and services.

The ITU-T has categorized management into five broad management functional areas (Recommendation M.3400 [11]). The five FCAPS management functional areas identified to date are as follows:

- Fault management;
- Configuration management;
- Accounting management;
- Performance management;
- Security management.

This classification of the information exchange within the management framework is independent of the use that will be made of the information.

The management of the telecommunications network needs to be aware of networks and services as collections of cooperating systems. The business processes in M.3050 and the FCAPS Management Functional Areas in M.3400 should be considered for abstracting constructs required for NGN networks and services. The architecture is concerned with orchestrating the management of individual systems so as to have a coordinated effect upon the network. Management objectives for Next Generation Networks include:

- minimize mediation work between different network technologies through management convergence and intelligent reporting
- minimize management reaction times to network events;
- minimize load caused by management traffic
- allow for geographic dispersion of control over aspects of the network operation;
- provide isolation mechanisms to minimize security risks;
- provide isolation mechanisms to locate and contain network faults;
- improve service assistance and interaction with customers.

The following areas are for further stdy:

- The implications of needing to manage end to end services needs further study
- The layering of services to enable a provider to provide the building blocks for services and others to bundle the services and its implications on the management architecture is for further study
- The business processes in defined in M.3050 and how they would be used in NGN is an area for further study

7 General next generation network management requirements

NGN management supports the monitoring and control of the NGN services and service and transport components via the communication of management information across interfaces between NGN components and management systems, between NGN-supportive management systems, and between NGN components and personnel of service providers and network operators.

NGN management supports the aims of the NGN by:

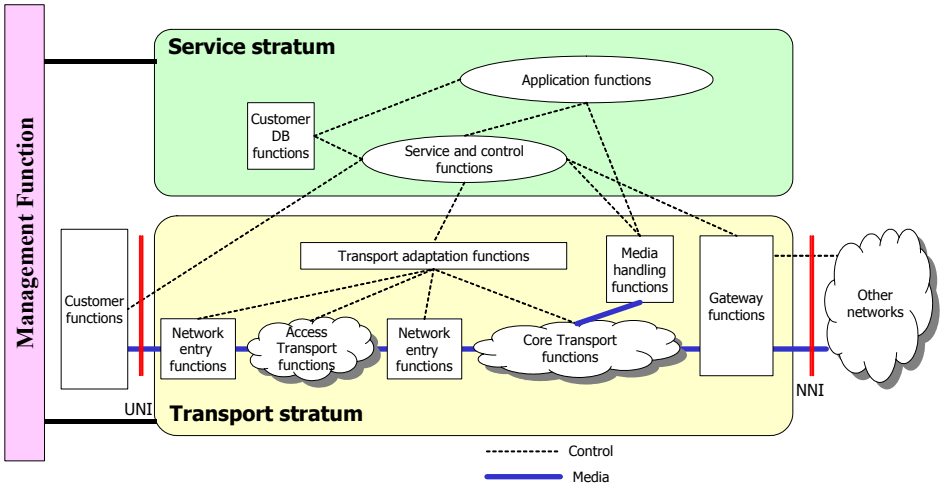
- Providing the ability to manage, throughout their complete life cycle, NGN system components, both physical and logical. This includes resources in the core network (including IMS), access networks, interconnect components, and customer networks and their terminals.
- Providing the ability to manage NGN service Stratum components independently from the underlying NGN Transport Stratum components and enabling organizations offering NGN end user services (potentially from different service providers) to build distinctive service offerings to customers.
- Providing the management capabilities that will enable organizations offering NGN end user services to offer customers the ability to personalize end user services and to create new services from service capabilities (potentially from different service providers).
- Providing the management capabilities that will enable organizations offering NGN service to provide end user service improvements including customer self-service (e.g. provision of service, reporting faults, online billing reports).
- Developing a management architecture and management services which will enable service providers to reduce the time frame for the design, creation and delivery of new services.
- Ensuring secure access to management information by authorized management information users, including customer and end user information..
- Supporting the availability of management services any place any time to any authorized organization or individual (e.g. access to billing records shall be available 24/7).
- Supporting eBusiness Value Networks based upon concepts of business roles (Customer, Service Provider, Complementor, Intermediary, Supplier (e.g. Equipment Vendor)) [Y.110, M.3050/eTOM].
- Allowing an enterprise and/or an individual to adopt multiple roles in different value networks and also multiple roles within a specific value network (e.g. one role as a retail Service Provider and another role as a wholesale Service Provider) [M.3050/eTOM].
- Supporting B2B processes between organizations providing NGN services and capabilities.
- Allowing the management of hybrid networks comprising NGN and non-NGN (e.g. PSTN, cable network) resources.
- Integrating an abstracted view on Resources (network, computing and application), which is hiding complexity and multiplicity of technologies and domains in the resource layer.
- Supporting the collection of charging data for the network operator regarding the utilization of resources in the network either for later use by billing processes (offline charging) or for near-real time interactions with rating applications (online charging).
- The ability to provide survivable networks in the event of impairment.
- The ability to have proactive trend monitoring.
- The ability to manage customer networks.
- The ability to have integrated end-to-end services provisioning.

- The ability to have automatic and dynamic allocation of network resources.
- The ability to have service quality-based network operations.
- The ability to have management that is independent of company organizations, which are subject to change, while maintaining the concept of organizational boundaries.
- The ability to exchange management information across the boundary between network environments; the three types of boundaries to be considered are: the boundary between the transport and service stratums, the boundary between control and management planes and the boundary between administrative domains.
- Have consistent cross-technology management interfaces on network elements allowing an integrated view of resources and include available management technology implementations, as appropriate.
- A management architecture and set of management services which will enable service providers to reduce the time frame for the design, creation, delivery, and operation of new services.
- The ability to manipulate, analyze and react to management information in a consistent and appropriate manner.
- The ability to deliver management information to the management information user and to present it in a consistent and appropriate manner.

~~8~~8 NGN Architecture

~~8.1~~8.1.1 Functional Architecture for NGN

The goal of NGN is to provide the capabilities to make the creation, deployment, and management of all kinds of services possible. In order to achieve this goal, it is necessary to decouple the service creation/deployment infrastructure from and independent of the transport infrastructure. Such decoupling is reflected in the NGN architecture as the separation of the Transport and Service strata and shown as two independent stratums. Figure 1 below, derived from Figure 1 of Y.FRA, shows the scope of this management architecture in the context of NGN.



Note: Charging and billing functions and Management functions are applied to both Service and Transport strata

Figure 1 – The NGN Architecture Overview

~~8.1.1~~8.1.1 Service Stratum

The NGN Service Stratum provides the functions that control and manage network services to enable the end-users services and applications. End-user services may be implemented by a recursion of multiple service strata within the network. Services may be related to voice, data or video applications, arranged separately or in some combination in the case of multi-media applications.

~~8.1.2~~8.1.2 Transport Stratum

The NGN Transport Stratum is concerned with transfer of information between peer entities. For the purposes of such transfers dynamic or static associations may be established to control the information transfer between such entities. Associations may be of durations that are extremely short, medium term (minutes), or long term (hours, day, or longer).

~~8.2~~8.2 NGN Management Plane

The high-level requirements of the NGN management plane are specified in Section 7 of this document. The detail architecture of the NGN management plane is specified in Section 8, including its interactions to the other NGN planes and also the intra NGN Management plane interaction. The architecture and requirements of the NGN Control plane and its interactions to the other planes, in particular to the Service plane, are specified in the NGN control document(s).

~~8~~9 NGN Management Architecture Overview

Editing Instruction 9.1 XXXXXXXX (Merge this with 9.1, 9.2, 9.3, 9.4)

The NGN Management architecture will be divided into four different architecture views as shown in Figure xx below:

– The Business Process Architecture

– The Management Functional Architecture
– The Management Information Architecture~~:~~
– The Management Physical Architecture

These four architectures also take security into consideration.

Figure X describes the workflow in the creation of management specifications, where first the functional architecture is defined, followed by the information architecture and finally the physical architecture. The Business Process is an influence throughout the lifecycle. Note that, in practise, this process is iterative to enable all aspects of the architectures to evolve over time as required.

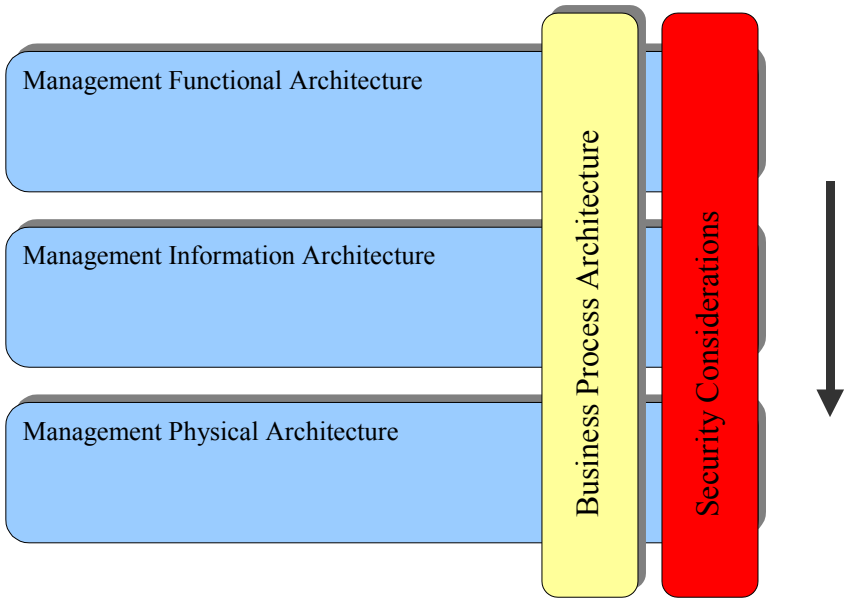


Figure ~~x~~2. NGN Management Architecture

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~~8.1~~9.1 Business Process Architecture

The Business Process Architecture, based on the eTOM model [M.3050 series], provides a reference framework for categorizing the business activities OF a service provider.

~~8.2~~9.2 Management functional architecture

The functional architecture permits the specification of what functions have to be achieved in the management implementation.

~~8.3~~9.3 Management information architecture

The information architecture characterizes the management information required for communication between the entities in the functional architecture to enable the performance of the functions to be achieved in the management implementation.

~~8.4~~9.4 Management physical architecture

The physical architecture describes the varied ways that management functions can be implemented. They may be deployed in a variety of physical configurations using a variety of management protocols.

~~8.5~~9.5 Security consideration

Security is an extensive domain with a mission to protect important business assets against different types of threats. Assets can be of different types such as buildings, employees, machines, information etc. NGN Management is specifically concerned with the management of security aspects of the NGN and with the security of the NGN Management infrastructure. ITU-T Recommendations X.805 and the M.3016 series should be considered for securing the NGN management infrastructure. The management of security aspects of the NGN are for further study.

ITU-T Recommendation X.805 defines the security architecture to achieve end-to-end security of a telecommunications infrastructure. X.805 defines concepts and components intended to provide reusable countermeasures across multiple layers of the infrastructure, including transport and service strata, and is the basis for more specific security specifications.

ITU-T Recommendation M.3016.x series addresses the requirements, services and mechanisms in support of securing the management plane of the NGN infrastructure. In this context the M.3016.x series focuses on end-to-end security both in the case where management traffic is separate from user traffic and when they are mixed together. The reference model for deriving the requirements in the M.3016.x series shows the interfaces where management traffic is to be secured.

To deal with the complexity of securing all of the NGN, including its management plane, there is a need to mechanize the application of various security services, mechanisms, and tools by employing operation systems to automate the process. Requirements and architecture for such operations systems, Security Management Systems (SMS), is for further study.

~~9.6~~9.6 Other Considerations

Other areas with overarching architectural influence are for further study.

~~8.6~~9.7 Relationship to M.3010

Editor Note: M.3010 as generic Functional Architecture to relate combination of logical functions separated by Reference points to Physical Components with Interfaces

Editor Note: Why M.3010 needs to be extended for NGN to cover the full scope of the M.3050 (eTOM)

Note: To increase flexibility in NGNM, the TMN concepts of management application function (MAF) and management function set group are no longer used.

~~10~~10 Business Process Architecture

This NGN architecture is based on business concepts and strategies. These business concepts and strategies are based on the eTOM model [M.3050 series] broken down and summarized by manageable pieces, i.e. architectural principles are described. These principles are by nature short and tangible, like “Lower cost” and “Large scale”, which means that they are easy to understand, but they are also generic and subject to interpretation. These principles, together with established assumptions, have to be weighed, prioritized and sorted under different labels and they form the basis of this architecture, and a framework for the functional architecture view.

The M.3050-series specifies comprehensive examples of business processes and organizes them in the form of a multi-level matrix, the enhanced Telecom Operations Map (eTOM), into process areas, horizontal (functional) process groupings, and vertical (flow-through) process groupings. It also provides basic mappings between business processes and management function sets.

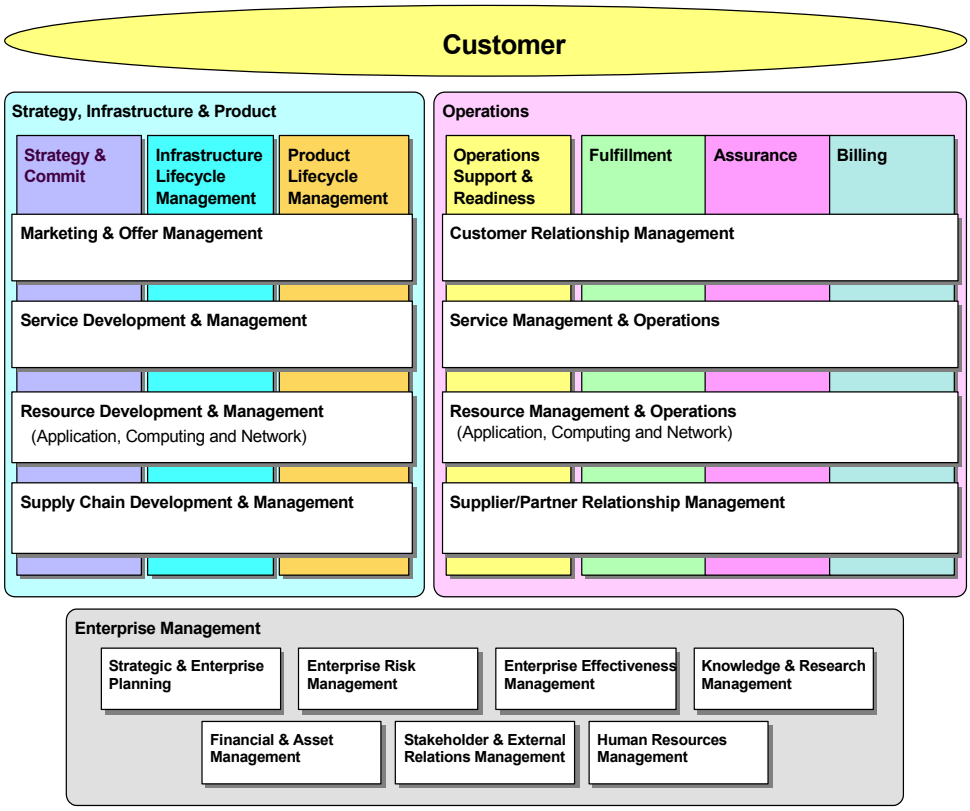

Fig. 3, eTOM model from M.3050.1

The model described by eTOM as shown in Figure 3 is used in this architecture. eTOM is a business process framework that suggests enterprise processes required for a service provider. However it is not a service provider business model.

In this business requirements view, the interaction between actors, information objects and business services has to be described. These information objects and business services derive from the process descriptions in eTOM and business services have to be organized according to eTOM terminology.

~~1~~11 Management functional architecture

The NGN management functional architecture is a structural and generic framework of NGN management functionality that is subject to standardization. A key aspect of NGN management is the functional architecture of the next generation networks management (NGNM). The following figure shows the NGNM function blocks NGN management.

Felix to align the following figure with that from Geoff.

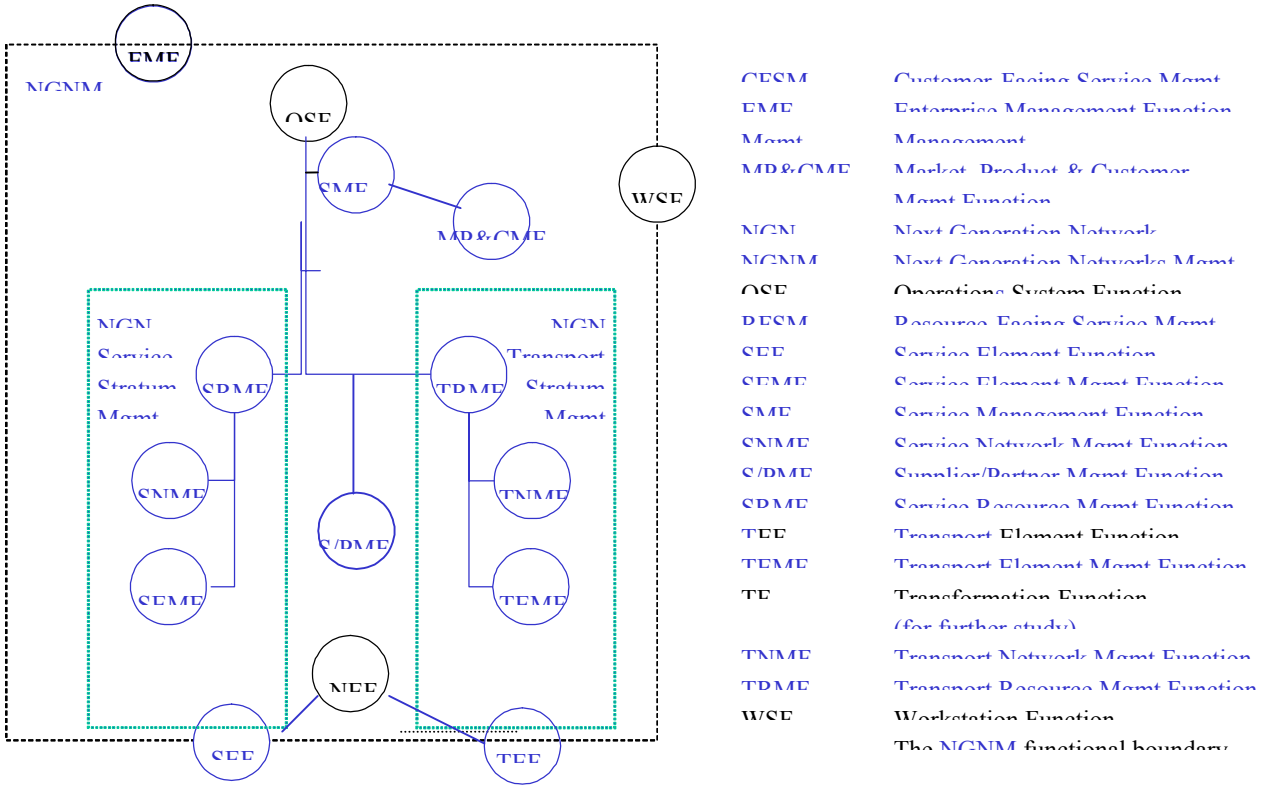

Figure 4/M.NGN-Management – Management function blocks

Figure 4 - Specialization of Function Blocks

The management functional architecture is structured from the following fundamental elements:

- management function blocks
- management functionality
- Management Function Sets and Management Functions;
- Auxiliary Functionality and Auxiliary Functions;
- Reference points.

Management functionality to be implemented can then be described in terms of these fundamental elements.

~~10.1~~11.1 Management function blocks

Figure 4 illustrates the different types of management function blocks and indicates that only the functions that are directly involved in management are part of the scope of standardization. Some of the function blocks are partly in and partly out of this scope; these management function blocks also perform functions outside of the management functional boundaries as discussed and defined in the subclauses below. The management function block is the smallest *deployable* unit of management functionality that is subject to standardization.

~~10.1.1~~11.1.1 Operations System Function block (OSF)

The OSF processes information related to the next generation networks management for the purpose of monitoring/coordinating and/or controlling next generation networks functions including management functions (i.e., the NGNM itself).

An OSF may but need not be decomposed into service-related components (SMF, SRMF) and transport-related block (TRNF, [Editor's Note: Do this need updates] NMF, EMF).

The *NGN Basic Reference Model* according to Y.2011 requires the separation of services from transport and defines the *NGN Service Stratum* and the *NGN Transport Stratum*. To cope with this model from the management point of view, the OSF is decomposed into functions of a service stratum and functions of a transport stratum. Y.2011 also defines a *general functional model*, based on Y.110, which consists of services, service resources with management and control functions, and transport network resources with management and control functions. Compliance with these two NGN models can be achieved by decomposing the OSF into a service management function (SMF), a service resource management function (SRMF) and a transport resource management function (TRMF). A further decomposition option of the TRMF into network management function (NMF) (which corresponds to the N-OSF) and element management function (EMF) (which is corresponds to the E-OSF) takes care of backward compatibility.

~~10.1.1.1~~11.1.1.1 Service Management Function block (SMF)

The SMF is a management function block that is dedicated to service instance management. Its functionality comprises, but is not limited to, the following management tasks:

- management of service life cycles;
- B2C and C2B (i.e., stakeholder-facing and customer-facing) roles involving
  - management of contractual aspects of services (SLAs) that are being provided to customers or available to potential new customers such as ordering/delivery (service order handling), assurance of service instances (complaint handling) and associated consequences for billing/invoicing, including operational monitoring and maintenance of statistical data (e.g., QoS);
  - management of association between customers and their subscribed service profiles;
- management of service profiles (requirements on network and service resources);
- management of service and network resources necessary for service enabling activation including connectivity, bandwidth, QoS requirements;
- on creation of service instances
  - allocation of user-specific service instantiation identifiers;
  - request to SRMF to create user-specific service-related data;
  - in case of fixed access, request to TRMF to configure the user's access line;
  - in case of cross-domain connectivity, a request to TRMF to secure E2E configuration of required network resources.

~~10.1.1.2~~11.1.1.2 Service Resource Management Function block (SRMF)

The SRMF is a management function block whose functionality comprises, but is not limited to, the following management tasks:

- logical service infrastructure management including network resources and mechanisms required to
  - manage service applications (software life cycle) and data, application technologies, open APIs and associated security mechanisms;
  - support subscription and controlled access to services;
  - allow routing and billing services to end-users taking into account network and terminal capabilities;
- mapping of SMF requirements into data interpretable by the underlying NMF/EMF;
- management of

- the actions of end-users on their profiles;
- aspects related to service capabilities (e.g., presence, location, nomadism) from a user perspective;
- subscriber data and user profile database and its content.

The SRMF is described in terms of FCAPS management functional areas.

~~10.1.1.3~~11.1.1.3 Transport Resource Management Function block (TRMF)

The TRMF is a management function block whose functionality comprises, but is not limited to, the following management tasks:

- realization of the requested connectivity, including selection of network technologies, routing, network inventory (e.g., network topology, geographical information, logical addresses);
- mapping of SMF requirements into network service profiles interpretable by the underlying NMF/EMF;
- management of connectivity across multiple networks, taking into account the multiple vendor contexts;
- management of network resources (e.g., admission control configuration, QoS mechanisms, mappings at inter-network borders);
- provision of network to service correlation.

~~10.1.1.4~~11.1.1.4 Network Management Function block (NMF)

The NMF has the responsibility for the management of a network as supported by the EMF.

The NMF addresses the management of a wide geographical area. Complete visibility of the whole network is typical and, as an objective, a technology independent view will be provided to the TRMF.

The NMF has the following five principal roles:

- The control and coordination of the network view of all network elements within its scope or domain.
- The provision, cessation or modification of network capabilities for the support of service to customers.
- The maintenance of network capabilities.
- Maintaining statistical, log and other data about the network and interact with the TRMF on performance, usage, availability, etc.
- The NMFs may manage the relationships (e.g., connectivity) amongst NEFs..

Thus, the NMF provides the functionality to manage a network by coordinating activity across the network and supports the "network" demands made by the ~~NRMF~~TRNF. It knows what resources are available in the network, how these are interrelated and geographically allocated and how the resources can be controlled. It has an overview of the network. Furthermore, this OSF is responsible for the technical performance of the actual network and will control the available network capabilities and capacity to give the appropriate accessibility and quality of service.

~~10.1.1.5~~11.1.1.5 Element Management Function block (EMF)

The EMF (or Element OSF, E-OSF for short) is responsible for the management of network elements on an individual or group basis and supports an abstraction of the functions provided by the network element function.

The EMF has one or more element OSFs, that are individually responsible, on a devolved basis from the network management function, for some subset of network element functions. As an objective, a vendor independent view will be provided to the network management function.

The EMF has the following three principal roles:

- Control and coordination of a subset of network elements on an individual NEF basis. In this role, the EMFs support interaction between the NMF and the NEF by processing the management information being exchanged between NMFs and individual NEFs. Element OSFs should provide full access to NE functionality.
- The EMF may also control and coordinate a subset of network elements on collective basis.
- Maintaining statistical, log and other data about elements within its scope of control.

~~10.1.2~~11.1.2 Service Element Function block (SEF)

The SEF is a function ~~component~~ block that communicates management information for the purpose of being monitored and/or controlled. The SEF provides telecommunication and support functions which are required by the NGN service stratum of the NGN being managed.

The SEF includes the telecommunication functions of the NGN service stratum that are the subject of management. These functions are not part of the scope of standardization but are represented to the management system by the SEF. The part of the SEF that provides this representation in support of the management is part of the scope of this framework, whilst the telecommunication functions themselves are outside.

~~10.1.3~~11.1.3 Transport Element Function block (TEF)

The TEF is a function block which communicates management information for the purpose of being monitored and/or controlled. The TEF provides telecommunication and support functions which are required by the NGN transport stratum of the NGN being managed.

The TEF includes telecommunication functions of the NGN transport stratum which are the subject of management. These functions are not part of the scope of standardization but are represented to the management system by the TEF. The part of the TEF that provides this representation in support of the management is part of the scope of this framework, whilst the telecommunication functions themselves are outside.

~~10.1.4~~11.1.4 Workstation Function block (WSF)

Editor's Note: Text from Dave on HMI within WSF

The WSF block provides the means to interpret management information for the human user, and vice versa.

The responsibility of the WSF block is to translate between a within-scope reference point and a not-within scope reference point and hence a portion of this function block is shown outside the scope boundary.

~~10.2~~11.2 Auxiliary functions

~~10.2.1~~11.2.1 Transformation Function block (TF)

<Keep this section ?/>

The Transformation Function block (TF) provides functionality to connect two functional entities with incompatible telecommunication mechanisms. Such mechanisms may be protocols or information models (see clause 11.3) or both.

The TF may be used anywhere within an administrative domain or anywhere at the boundary of a administrative domain. When used within an administrative domain, the TF connects two function blocks, each of which supports a standardized, but different, communication mechanism.

When used at the boundary of an administrative domain, the TF may be used either as communication between two compliant administrative domains or between a compliant and a non-compliant environment.

When used at the boundary of two administrative domains the TF connects two function blocks, one in each administrative domain, each of which supports a standardized, but different, communication mechanism.

When the TF is used between a compliant and a non-compliant environment, the TF connects a function block with a standardized communication mechanism to a functional entity with a non-standardized communication mechanism in the non-compliant environment.

NOTE – Within a TMN the TF consolidates and extends the functionality and scope associated with the Mediation and Q Adaptation function blocks in Recommendation M.3010 (05/96).

~~10.3~~11.3 Management Functionality

M.3050.0 describes two complementary ways of defining management functionality:

- the Management Service/Function approach of M.3200 and M.3400 that has been built on the requirements to manage network equipment and networks (bottom up);
- the Business Process approach of M.3050 (eTOM) that has been built on the need to support processes of the entire Service Provider enterprise (top down).

Both approaches can be used to identify generic and specialized management function sets to support management activities as defined in M.3400. The Management Service/Function approach captures a technology- and resource-oriented view of the management domain, and this is often valuable and relevant when considering the structure and organisation of a management solution. The Business Process approach provides an additional business-oriented viewpoint that is important in considering the business requirements of the Service Provider, as the user of a management solution, and in ensuring that the arrangement of management functions is meaningful and useful for the way that the Service Provider does business.

The relationship between both approaches for defining management functionality is shown in Figure 1/M.3050.0:

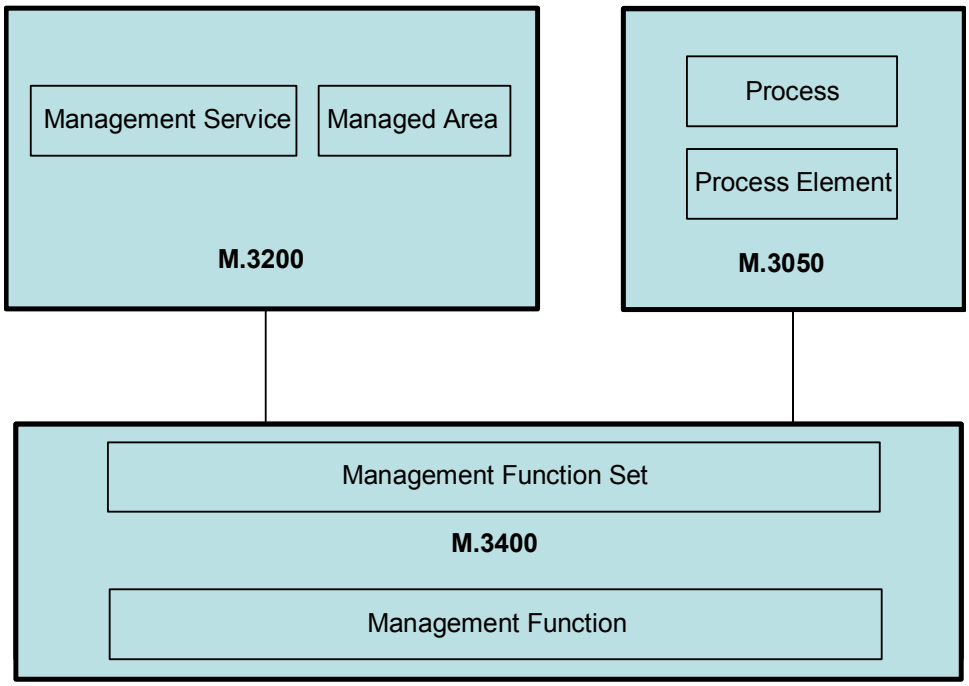

Figure ~~X~~ 5 – Relationship between the Management Service/Function and Business Process approaches to define management functionality (M.3050.0)

This figure represents the current dual approach for defining management functionality. It is expected that both approaches will eventually converge into an implementable Business Process approach. A first step in this direction is the initial mapping of M.3400 to M.3050 and vice versa given in M.3050/Suppl.3 that turned the Business Process approach into a Business Process/ Management Function approach. However, until the vision of an implementable Business Process approach becomes a reality, the proven and standardized management interfaces built around the Management Service/Function approach are the state of the art. Therefore the Management Service concept cannot yet be replaced by the Business Process concept but complements it very usefully.

To perform management, interactions take place between two or more function blocks. These interactions are referred to as Management Functions. Management Functions, that collectively define a single management capability, are grouped together and referred to as a Management Function Set. The Management Function Sets used to specify the Management Services and Business Processes, and thereby the required management functionality, are either taken from an MFS library such as M.3400 or are newly developed and then added to an MFS library.

Management functionality is a collection of management function sets and possibly other management functionality which groups related and complementary management functions.

Management functionality is defined to be recursively composed for flexibility during the evolution of a complex NGNM and backwards compatibility with TMN.

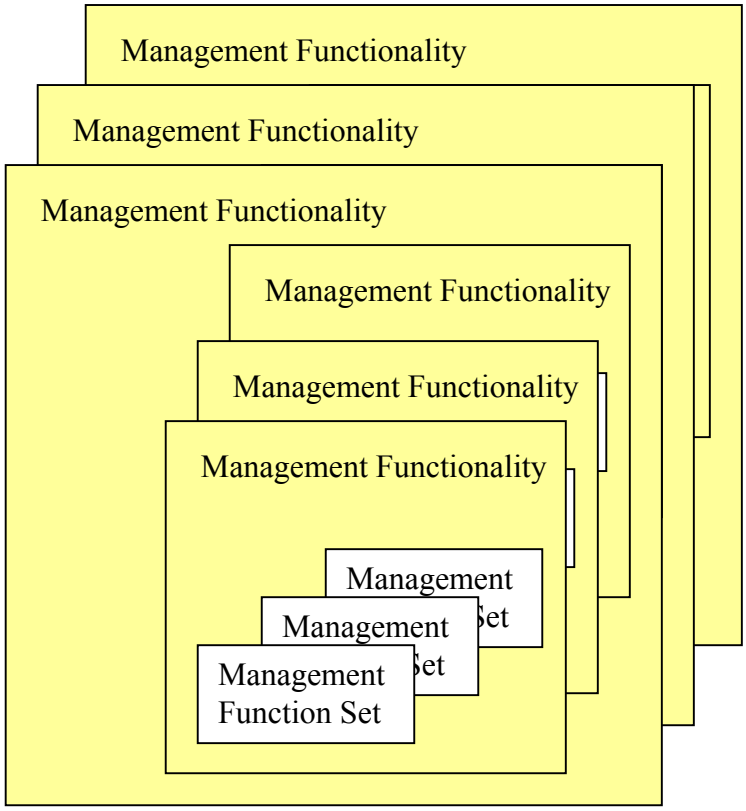

Figure ~~Y~~ 6 – The recursive structure of management functionality

A Management Function is defined as the smallest part of a Management Service or Business Process as perceived by the user of the service or process. A Management Function Set (MFS) is a grouping of management functions that contextually belong together, i.e. are related to a specific single management capability. Management functionality is a grouping of management function sets and other management functionality of a smaller scope that contextually belongs together. See figure ~~Y~~6.This recursive definition allows for the introduction of as many levels of functional granularity as appropriate between the user of the management functionality and the managed resources used to specify or realize the management functionality.

Figure ~~Z~~ 7 depicts that

- management functionality for some management solution is defined by Management Services and/or Business Processes, which are comprised of Management Function Sets;
- any management functionality is structured (from its specification) into Operations System Function (OSF) blocks;
- management functionality is realized by Operations Systems, which are composed of Operations System (OS) components that realize one or more OSF components.

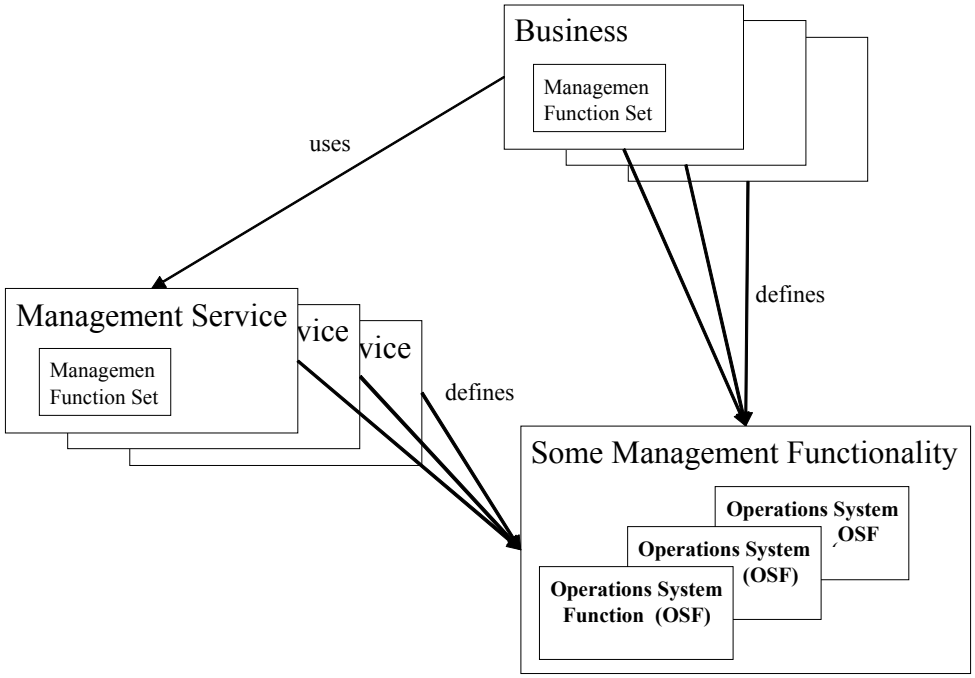

Figure ~~7~~ 7 – Definition and realization of management functionality

Management functionality is considered to consist of management functionality proper and auxiliary functionality. While the proper functionality is directly concerned with telecom management the auxiliary functionality only assists in telecom management.

~~11.3.1~~11.3.1 Support Functionality

Support functions may optionally be found in a management or auxiliary function block. The support functionality is potentially common to more than one management function block within an implementation. Some support functionality assist the MAF within a management function block in its interactions with other function blocks.

Examples of such functionality include the following:

– Data Communication Functionality (DCF);

– workstation support functionality;

– user interface functionality;

– directory system functionality;

– database functionality;

– security functionality;

– message communication functionality.

~~10.5~~11.4 Management Function Sets and Management Functions

To perform management services, interactions take place between OSF-MAFs in different management function blocks, with the help of the support functions. These interactions between cooperating MAFs are referred to as Management Functions. Management Functions, that collectively are all of the potential interactions that a single MAF will support, are grouped together and referred to as a Management Function Set. The library of general Management Function Sets and their Management Functions members can be found in ITU-T Recommendation M.3400.

~~10.6~~11.5 Reference points

A management reference point delineates one of several external views of functionality of a function block; it defines that function block's service boundary. An external view of functionality is captured in a set of Management functions that will have visibility from the function block.

Reference points have meaning in functional specifications leading to an implementation. A reference point may represent the interactions between a particular pair of function blocks. Table 1 shows the relationships between the function blocks in terms of the reference points between them. The reference point concept is important because it represents the aggregate of all of the abilities that a particular function block seeks from another particular function block, or equivalent function blocks. It also represents the aggregate of all of the operations and/or notifications (as defined in the X.700 series) that a function block can provide to a requesting function block.

A management functionally specified reference point usually corresponds to a to-be-implemented physical interface, in the physical architecture, if and only if the function blocks are implemented in different physical blocks.

The following clauses describe the reference points that are subject to standardization in this document. Note that ‘other’ reference points are not precluded by this architecture but are outside the scope of this document.

~~10.6.1~~11.5.1 Classes of reference points

Four classes of management reference points are defined, these are:

q	Class between OSF, TF and NEF.
f	Class between OSF and a WSF.
b2b/c2b	Class between OSFs of two administrative domains or between the OSF of a administrative domain and the equivalent OSF-like functionality of another network.
hmi	Class between a WSF and users.

Table 1 – Relationships between logical function blocks expressed as reference points

	SEF	TEF	OSF [b)]	WSF	non-compliant
SEF			q		
TEF			q		
OSF [b)]	q	q	q, b2b/c2b [a)]	f	
WSF			f		hmi
non-compliant				hmi	

[a)] b2b/c2b reference point only applies when each OSF is in a different administrative domain.

[b)] OSF can be SMF, SRMF, or TRMF. TRMF in turn can be NMF or EMF

NOTE – Any function may communicate at a non-compliant reference point. These non-compliant reference points may be standardized by other groups/organizations for particular purposes

~~10.6.2~~11.5.2 Reference point descriptions and usage

The management functional architecture, and the reference points it contains, gives a framework to the task of deriving the requirements for the specification of management interfaces. Each reference point requires different interface characteristics for the information exchange. However, a reference point does not itself determine the protocol suite. Protocol specification occurs as a latter task in the management interface specification methodology.

The protocol definition should seek to minimize the differences between the management interfaces and thus the requirements leading to protocol differences need to be clearly defined.

~~10.6.2.1~~11.5.2.1 q reference points[1]

The q reference points are located between the function blocks NEF and OSF, NEF and TF, TF and OSF, and OSF and OSF either directly or via the DCF.

The q reference points may be distinguished by the knowledge required to communicate between the function blocks they connect. The distinction is for further study.

~~10.6.2.2~~11.5.2.2 f reference points

The f reference points are located between the WSF and the OSF blocks.

~~10.6.2.3~~11.5.2.3 Business to Business/Customer to Business reference points

The B2B/C2B reference points are located between the OSF function blocks in different administrative domains. Entities located beyond the B2B/C2B reference point may be part of an actual compliant environment (OSF) or part of a non-compliant environment (OSF-like). This classification is not visible at the B2B/C2B reference point.

~~10.6.2.4~~11.5.2.4 Human Machine Interface reference points

The HMI reference points are located outside the scope of standardization between the human users and the WSF. It is not considered to be part of the scope of standardization even though it conveys management information. The detailed definition of this reference point is outside the scope of this Recommendation and can be found in the Z.300-series Recommendations [19].

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[1] The q reference point includes the old q3 and qx reference points.

[Editor's Note: A contribution is required to determine if HMI should still be considered out of scope]

The m reference points are located outside the compliant management interfaces between the QAF and non-compliant managed entities or managed entities that do not conform to management Recommendations.

~~10.6.3~~11.5.3 Relationship of reference points to function blocks

Figure 8 illustrates an example of possible reference points between function blocks. In particular, it demonstrates communication between different administrative domains as illustrated by the network cloud. The dashed line contains the function blocks and reference points within the scope of standardization. Those function blocks only partially contained within the dashed line are not fully within the scope of standardization.

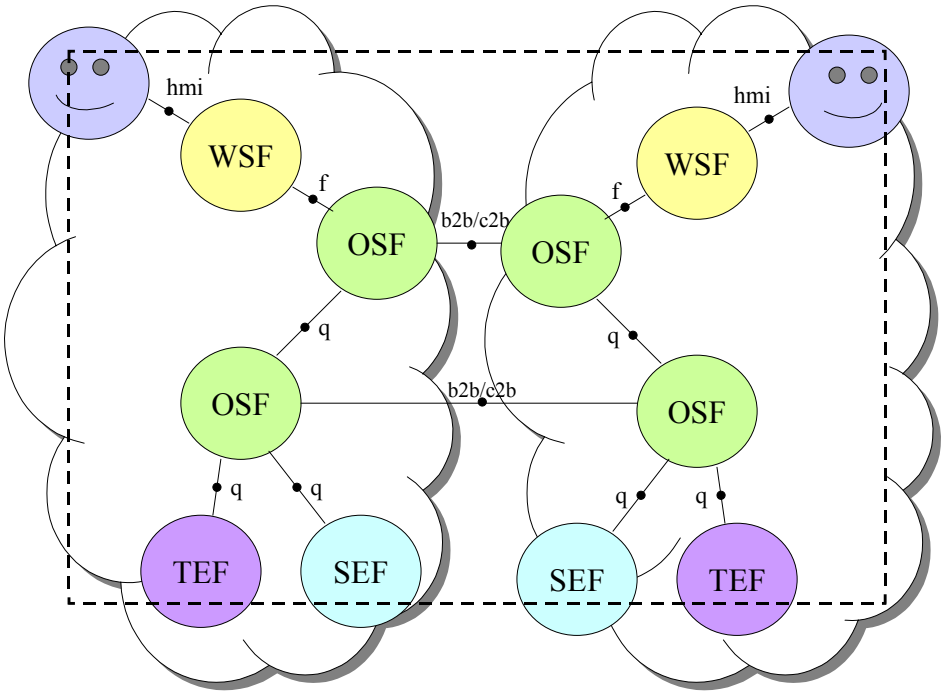

Figure 8 – Illustration of reference points between Function Blocks

~~11.6~~11.6 Management Layers within the Management functional Architecture

To deal with the complexity of telecommunications management, management functionality may be considered to be partitioned into logical layers. The Logical Layered Architecture (LLA) is a concept for the structuring of management functionality which organizes the functions into groupings called "logical layers" and describes the relationship between layers. A logical layer reflects particular aspects of management arranged by different levels of abstraction (i.e. Business Management Layer, Service Management Layer, Network Management Layer, Element Management Layer and Network Element Layer). This concept of layering is described in ITU-T Recommendation M.3010 [x] and has been further developed in Recommendation M.3050 [y] (eTOM).

The NGN Management Layered Architecture is illustrated in Figure 9, which also provides a mapping to M.3010 logical layers.

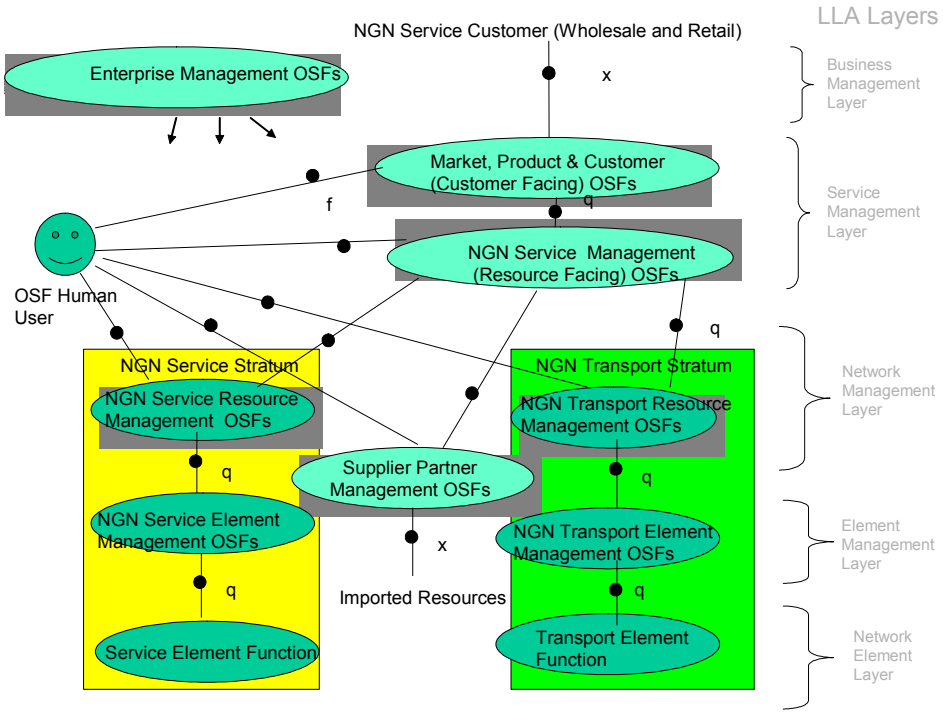

Figure 9 – NGN Management Layered Architecture

~~11.6.1~~11.6.1 Management function layers of abstraction

The grouping of management functionality implies grouping OSF function components into layers. A specialization of OSF function components based upon different layers of abstraction is:

- Enterprise
- Market Product and Customer (Customer Facing)
- NGN Service management (Resource Facing)
- Resource Management
- Service and Transport Element Management
- Service and Partner Management

These layers of abstraction are depicted in Figure 9.

Management implementations may include Enterprise OSFs that are concerned with a total enterprise and carry out an overall business coordination. Market Product and Customer OSFs and Service Management OSFs are concerned with services offered by one or more networks and will normally perform a customer interfacing role. NGN Resource Management OSFs are concerned with the management of networks, and Element management OSFs with the management of

individual elements. Service and Partner management OSFs are concerned with the management of the enterprise's interaction with its suppliers and partners.

The layering of OSFs shown in Figure 9, although widely accepted, should not be regarded as the only possible solution. Additional or alternative layers may be used to specialize functionality.

The following subclauses describe a typical allocation of functionality amongst the management layers based in the reference model.

~~11.6.1.1~~11.6.1.1 Enterprise Management

Editor's Note: Need text

~~11.6.1.2~~11.6.1.2 Market Product and Customer Management

The Market Product and Customer Domain is the top layer in the NGN Management layered architecture. It is responsible for creating, managing and maintaining Product objects.

A Market Product and Customer Object is the OSS representation of a SP or ISP product. When a customer orders a product, a Product Object Instance has to be created. The Product Instance represents a customer's instance of the ordered Product Object. It will exist until it is cancelled or expires. A Product Object is composed of a number of componentsof the Service Management Domain (Connectivity Components and/or Service Components).

The main purposes of Market Product and Customer Management Domain are:

- Management of instances of Product Objects during their whole lifecycle.
- To provide common functionality for order management of SP's or ISP's products.
- To provide functionality to handle the dialog with customers through a well-defined business interface.
- To administer and manage functionality that uses information from the Service Management Domain. For example trouble ticket handling, collection and processing of accounting data on a product- and/or customer level.

As examples, the functions that would need to be covered in the MPCM include the following:

  - Definition of the product itself from a marketing and commercial perspective, how to bill, to whom the service is adressed, are there specific geographical areas where the service cannot be offered, bundle of services …..

In terms of comparison with the M.3050 (eTOM) framework, similarities can be expressed as follows

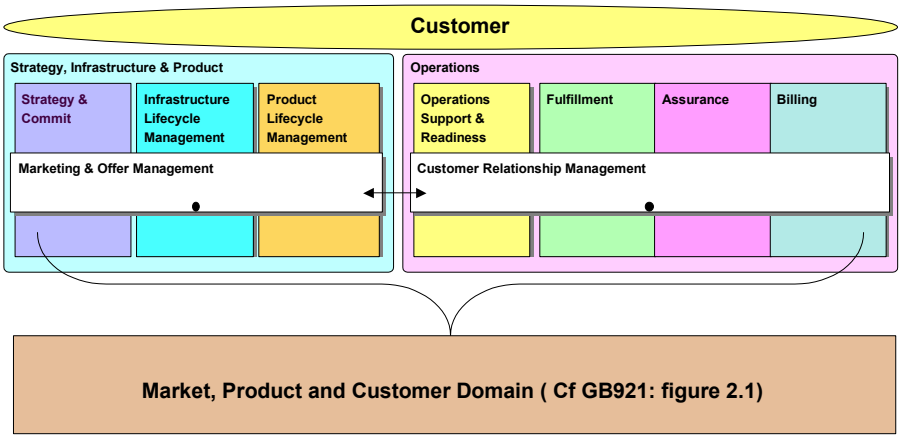

Figure 10 – Market Product and Customer Management

~~11.6.1.3~~11.6.1.3 Service management

The Service Management (SM) Layer supports the functions for managing the delivery and assurance of services to end-users according to customer expectations. It includes the functions for:

- The management of service profiles: each service profile expresses the network and service resources requirements needed to activate the service. The underlying SRM and NRM Domains map these requirements into network parameters of the underlying network elements
- The management of the association of actual subscribers to the set of profiles corresponding to this subscribers service contract
- The management of the service and network resources required for enabling the activation of services according to the end-user contract, including the required connectivity and its associated characteristics: bandwidth, QoS, level of SLA.
- The supervisioin of active services to guarantee meeting the contractual SLA and the impact of non-respect on the billing functions (delivery of information to the operator, rebate indications to billing system in case of too low QoS, etc)

In terms of comparison with the M.3050 (eTOM) framework, similarities can be expressed as follow:

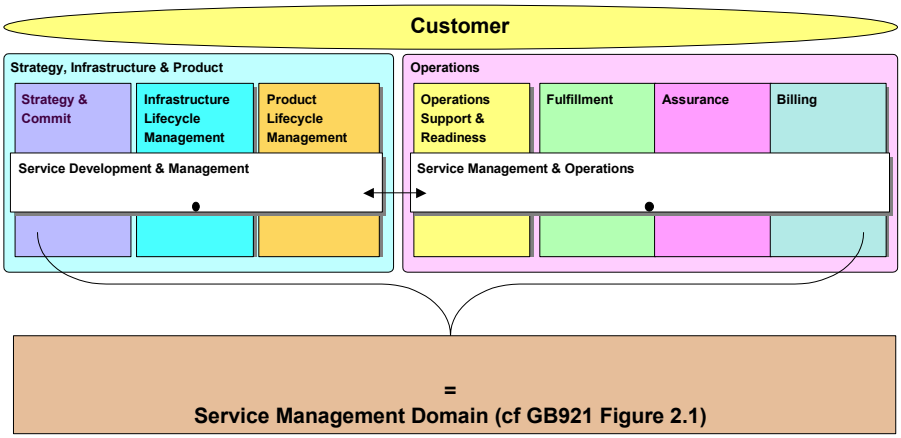

Figure 11 – Service Management

To achieve the above functions, the Service Management Domain introduces the notions of service and connectivity components. The SM Domain handles the management of service and connectivity components, the management of the association of these components to actual subscribers, as well as general functions concerning subscribers and components. Service and connectivity components are independent of the technology and platform used and of the information carried over the network.

Service components handle the management of signalled services, such as voice, e-mail, messaging, video on demand and other services initiated by end-users. A service component is the OSS's representation of a specific service and its specific characteristics. As it is important to keep the service components independent from the realizing technology, no information about technology or service platforms are available in the SM Domain. There is no information about the real network resources or technologies in this part of the OSS architecture. The actual management of the delivery of the service to the requesting user is performed in the Service and Network Resource Management Domains; only end-user contracted chararcteristics of the service and an identifier of its instantiation for a particular user are stored in the Service Management Domain.

Connectivity components handle the management of provisioned services that are configured through network management applications and transport services. They also manage the network resources required for enabling signalled services, including the provisioning of fixed access lines and related end-to-end connections through. A connectivity component is the OS's representation of a connection between endpoints, from point A to Z with defined characteristics. There is no information about the real network resources in this part of the OSS architecture. The actual build-up of the network connection between point A and Z is performed in the Network Reource Management Domain; only a reference to the connection is stored in the Service Management Domain.

The contracting of access to a given signalled service or of a provisioned service by an end-user will result in the following:

- the creation in the Service Management Domain of a unique identifier for the new service instance that will associate the results of creating the required service and connectivity components to this service instance
- a request to the Network Resource Management Domain for checking availability of required network resources

- in case of signalled services, a request to the Service Resource Management Domain for creating all service related data for this user in the relevant network databases (using appropriate service components)
- if appropriate, a request to the Service Resource Management Domain for triggering / checking the configuration of the CPE equipement (using appropriate service components)
- in case of fixed access, a request to the Network Resource Management Domain for configuring this end-users' access line according to the technical requirements corresponding to the service contract (using appropriate connetivity components)
- if required, a request to the Network Resource Management Domain for the end-to-end / cross-application configuration of required network resources. For this, the appropriate connectivity components shall be involved (using appropriate connetivity components)

11.6.1.4 Resource Management

While the Service Management Layer (SML) has the responsibility for managing the service lifecycle and the delivery and assurance of service instances, the Resource Management Layer is responsible for the management of the logical service and transport infrastructures.

~~11.6.1.4.1~~11.6.1.4.1 Service Resource management

The logical service infrastructure includes the network resources and mechanisms required

- To manage service applications (software versions, upgrade, …)
- To manage application data
- To support the service applications in the network
- To support controlled access to services
- To guarantee that services are delivered with the requested characteristics
- To allow routing and billing accessed services to the requesting end-users taking into account network and terminal capabilities.

Further, the logical service infrastructure includes the information infrastructure required to enable the functioning of the services with

- associated mechanisms used by the services to access the data
- the management of the contained data.

~~11.6.1.4.2~~11.6.1.4.2 Transport Resource management

The Transport Resource Management layer is responsible for the realisation of the connectivity and for the configuration of other service related aspects in the network. This includes functions such as selection of network technologies, routing, network resource management, inventories etc. The Network Resource Management domain mainly consists of FCAPS Managers and a Network Inventory.

- The mapping of the SM Domain requirements into network service profiles interpretable by the underlying TEMF/TNMF.
- The management of the connectivity aspects related to inter-operator connectivity or connectivity over multiple networks taking into account the multi-vendors contexts in which NGN networks will operate.

- The management of the network resources in the network, such as QoS mechanisms and mappings at inter-network borders, NAT/firewall configuration, signalling network configuration

The Network Inventory stores information about network resources, their relations and locations. The Network Inventory provides Management Functions with necessary information about how the real network is built and configured. The Network Inventory has to consist of a network technology independent and a network technology dependent part. The independent part manages

- Information that describes the management view of the network topology
- Connectivity Paths describing installed connectivity's
- Logical addresses
- Geographical information (where network resources and entities are located)
- Naming

The network technology dependent part manages

- Information about physical equipment
- Information about logical equipment
- The topology of how these equipments (physical and logical) are connected to each other

~~11.6.1.5~~11.6.1.5 Element Management

The element management layer has one or more element OSFs, that are individually responsible, on a devolved basis from the Resource management layer, for some subset of network element functions. As an objective, a vendor independent view will be provided to the resource management layer.

~~11.6.1.6~~11.6.1.6 Supplier Partner Management

The Supplier Partner Management Layer communicates with Suppliers and Partners for the purpose of importing external transport or service resources for use by the enterprise. The Supplier Partner Management Layer provides the service and support functions which are required to support the supplier supply chain processes/services being managed. The Supplier Partner Management Layer includes the service functions described in the Supplier /Partner Relationship Management, Supply Chain Development management process grouping of M.3050.

~~11.6.2~~11.6.2 Functional interaction between management layers

While OSF will typically interact with management function components in logical adjacent management layers, operational and management considerations may support the need for interactions between non-adjacent layers. For example, due to management traffic considerations, the service management layer may wish to interact directly with the element management layer for the exchange of accounting data.

~~11.6.3~~11.6.3 Relationship between multiple NGN Management Layered Architectures

In the case where enterprises buy resources or sell products to other enterprises, the NGN Layered Architectures of the enterprises need to be link together.

Products, sold both to the end customer and to other enterprises, are exported through the Product Market and Customer layer. Purchased Transport and Service Resources are imported theough the Supplier Partner management Layer.

Figure Z illustrates an example of interconnected NGN Management Layered Architectures where an NGN Service provider imports Transport Resources and Location Service Resources in order to supply NGN service customers.

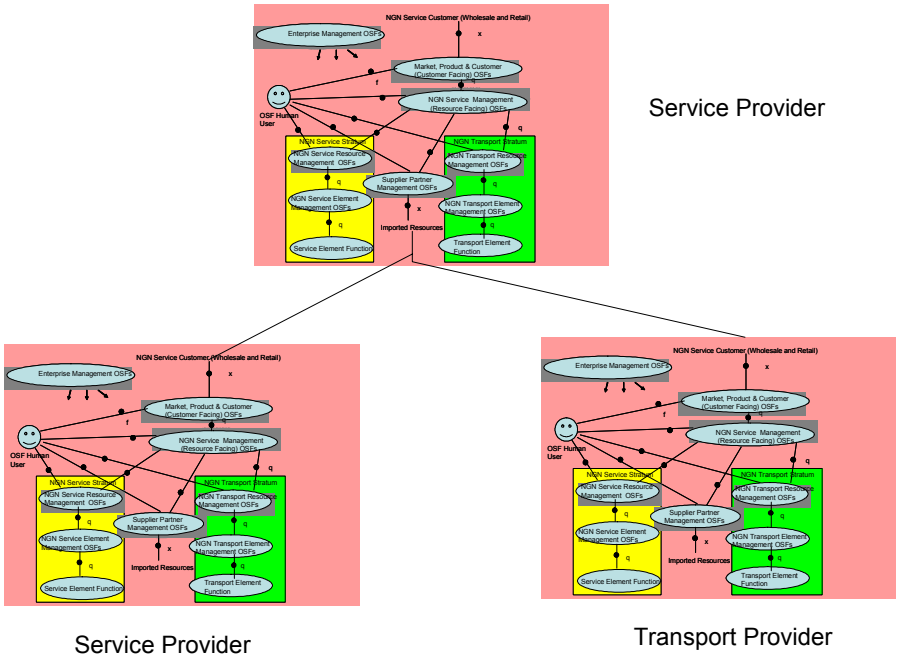

Figure ~~xx~~ 12 – Example of interconnected NGN Management Layered Architectures

~~11~~12 Management information architecture

~~11.1~~12.1 Principles

Management of a telecommunications environment is an information processing application. To effectively manage complex networks and support network operator/service provider business processes, it is necessary to exchange management information between management applications implemented in multiple managing and managed systems. Thus telecommunication management is a distributed application.

The management information architecture, in order to promote interoperability, is based on standardized open management paradigms that support the standardized modelling of the information to be communicated. Management standardization activities will not develop a specific management paradigm but build upon industry recognized solutions, focusing primarily on object-oriented techniques. Specific management paradigms may be used in management standards when judged to be adequate.

Management standardization favours the reusability of standardized information definitions to reduce the overall standardization effort. Object-oriented techniques such as encapsulation, inheritance, and specialization are preferred. Where information is expected to be utilized in conjunction with more than one management paradigm, the information should first be defined in a paradigm-neutral manner utilizing industry-recognized techniques after which it would then be mapped onto paradigm-specific formats.

It must be noted that the techniques, e.g. object-oriented, applied to define information to be exchanged should not constrain the internal implementation of the telecommunications management or managed systems.

As management information and actions play crucial roles for administrations, security techniques have to be applied in the management environment in order to assure the safety of the information exchanged over the interfaces and residing in the management application. Security principles and mechanisms are also related to the control of access rights of the management users to information associated with management applications.

Internal system implementations are outside the scope of management standardization.

Management information architectural principles are applied to interface specifications using the methodology and techniques specified in Recommendation M.3020 [9].

The management information architecture is structured from the following fundamental elements: reference points, information models, information elements, information model of a reference point and interaction models. Management information exchange to be implemented can then be described in terms of these fundamental elements.

~~11.2~~12.2 Interaction model

A management interaction model provides the rules and patterns that govern the flow of information between Management function blocks at a reference point.

For the exchange of management information, management processes will take on one of two possible roles:

- managed role: a process that manages the management information elements associated with managed resources. The process acting in this role responds to directives issued by the process acting in the managing role. It will also reflect to the process acting in the managing role a view of these information elements and provide information reflecting resource behaviour (e.g. information source);
- managing role: a process that issues management operation directives and receives information from the process acting in the managed role (e.g. information user).

It is the responsibility of the information user to be able to address the information source in a manner that the information source will respond properly. In addition, the information user is responsible for parsing what the information source provides.

A manager is defined to be a management process acting in the managing role, while an agent is defined to be a process acting in a managed role. The interaction model relevant to a manager/agent pair is determined by the management paradigm selected.

~~12.2.1~~12.2.1 Communication pattern

Two parties involved in a management communications will exchange messages according to a Communication Pattern. A communication pattern identifies the actors and their role in the communication, as well as the sequence and cardinality of messages sent and/or received. A simple request-response, multiple batch response, or notification, are examples of Communication Patterns. The design of a business activity will reference one of this pattern. For example, the getInventory activity will probably carry out partitioning the result set in several segments to be forward to the service consumer according to a multiple batch response.

Four distinct Communication patterns:

– Simple response (a simple invoke/response pattern)

- Multiple batch response (to be used to handle significant large result data set)
- Bulk response (file transfer in off-band communication channel)
- Notification (to disseminate information to subscribers)

These Communication patterns address different communication needs: while the first three are oriented towards an exchange of information between two parties in an activity (P2P), the notification communication is designed to disseminate information to a set of recipient (publish and subscribe), possible greater than one.

Additional communication patterns are for further study.

~~11.3~~12.3 Management information models

The management information architecture contains constructs called information models that are supported by function blocks' managed roles and shared management knowledge that is known by function blocks' managing roles. As examples, information models can be found in ITU-T series Recommendations: M.31xx [15], X.73x [16], G.85x [17], and Q.82x [18].

A management information model presents an abstraction of the management aspects of network resources and the related support management activities. The model determines the scope of the information that can be exposed and exchanged in a standardized manner. This activity to support the information model takes place at the application level and involves a variety of management applications such as storing, retrieving and processing information.

Multiple information models are necessary to describe the full range of information to be exchanged for telecommunication management. The relationships between these different information models needs to be document and understood.

~~11.4~~12.4 Management information elements

Management information models consist of management information elements. Management systems exchange information modelled in terms of management information elements. Management information elements may be conceptual views of the resource types that are being managed or may exist to support certain management functions (e.g. event forwarding or event logging). Thus, an information element is the abstraction of such a resource that represents its properties as seen by and for the purposes of management. In object-oriented paradigms, management information elements are modelled as objects.

~~11.5~~12.5 Information model of a reference point

A subset of this exposed information, which can be considered the information model of a reference point, is mapped to each reference point, based on the functional interactions defined for the reference point. This information model of a reference point is the minimum cluster of exposed management information that may be specified on a management function block.

~~11.6~~12.6 Reference points

This management information-specified reference point further defines the concept of reference point (beyond the management functional architecture definition); the reference point concept unifies the management functional and information architectures. Management function blocks interact via management functions over a reference point. Over the same reference point, the management function blocks communicate the appropriate management information in order to perform the specified management functionality.

Reference points have meaning in functional and information-exchange specifications leading to an implementation. A reference point represents the functional interactions and information exchange between function blocks. The reference point concept is important because it represents the aggregate of all of the abilities with associated information exchange that a particular function block seeks from another particular function block, or equivalent function blocks. It also represents the aggregate of all of the operations and/or notifications (as defined in ITU-T Recommendation X.703 [3]) that a function block can provide to a requesting function block.

A management functionally-specified and information-specified reference point usually corresponds to a to-be-implemented physical interface, in the management physical architecture, if the function blocks are implemented in different physical blocks.

~~11.7~~12.7 Management logical layered architecture within the management information architecture

As introduced in clause 10, the Logical Layered Architecture (LLA) is a concept for the structuring of management functionality which organizes the functions into groupings called "logical layers" and describes the relationship between layers. A logical layer reflects particular aspects of management arranged by different levels of abstraction. Functional interactions between OSF function blocks within different logical layers are described by the reference point. Over the same reference point, the management function blocks communicate the appropriate management information in order to perform the specified management functionality.

The relationship of the Logical Layered Architecture and the management Information Architecture can be described by projecting the management Information Architecture through a series of views. Each view represents the information elements from the information models that may be exposed or exchanged at reference points between function blocks in layers of the LLA. The view encompasses the necessary level of abstraction necessary for the exchange of management information at the level of abstraction captured in the layer.

The exchange of management information between logical layers employs the managing roles and managed roles of the management interaction model. This allows management activities to be clustered into layers and to be decoupled. The managed roles will be associated with a set of information elements from information model(s) exposing a view at the layer's level of abstraction (e.g. equipment, element, network, service). Generally, managing and managed roles may be placed in logical layers without restriction. A managed role may be associated with a set of information elements from any layer. Managed roles may be placed in any layer and invoke operations associated with any other managed roles.

~~11.~~812.8 Designing Information Models for Scalable & Low Cost Management

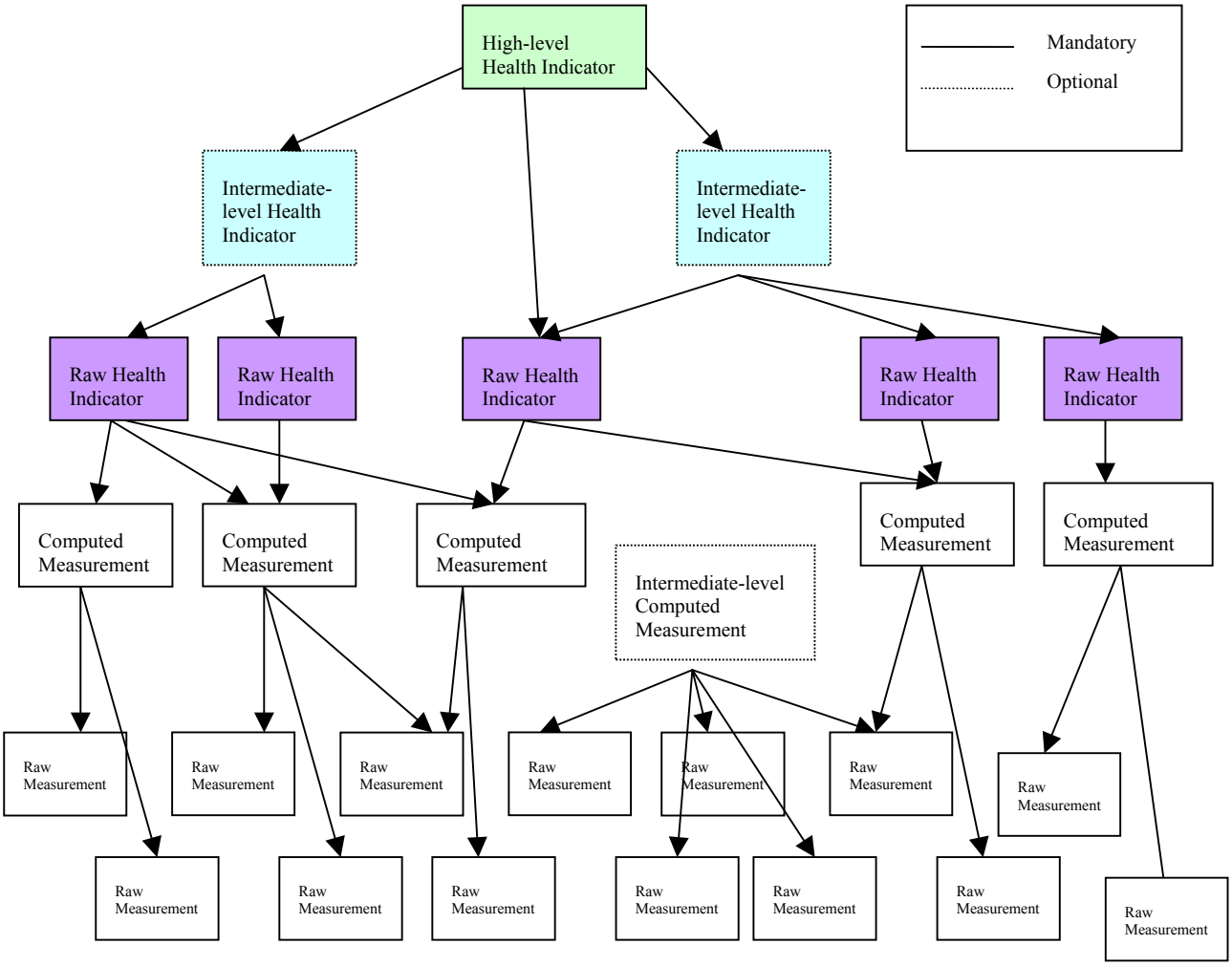

Figure ~~11~~ 13 – XXX

When designing information models, it is easy to simply look at what data can be observed rather than what information network operators need to make decisions and take corrective action on the network. The result can be too much data and not enough information. Providing measurements at too low of a granularity results in complex and network traffic intensive forms of network management. Proving information at a high level of abstraction greatly simplifies the task of operating a network, but this information must be related to the more detailed network measurements in order to enable trouble shooting and debugging. It is therefore recommended that care be taken when designing information models to ensure both scalable management and the availability of more detailed information in a predicable manner.

The recommended approach is through the definition of high-level health indicators, raw health indicators, computed measurements and raw measurements with well defined relationships between these objects. In addition, additional layers of intermediate heath indicators and computed measurements may be used as deemed appropriate. These high-level health indicators should be provided by the NEF.

~~12~~13 Management physical architecture

The management physical architecture is structured from the following fundamental elements: physical blocks and physical interfaces.

Figure ~~12~~ 14 shows an example of a simplified physical architecture for a management implementation. This example is provided to assist in understanding the management physical blocks described below.

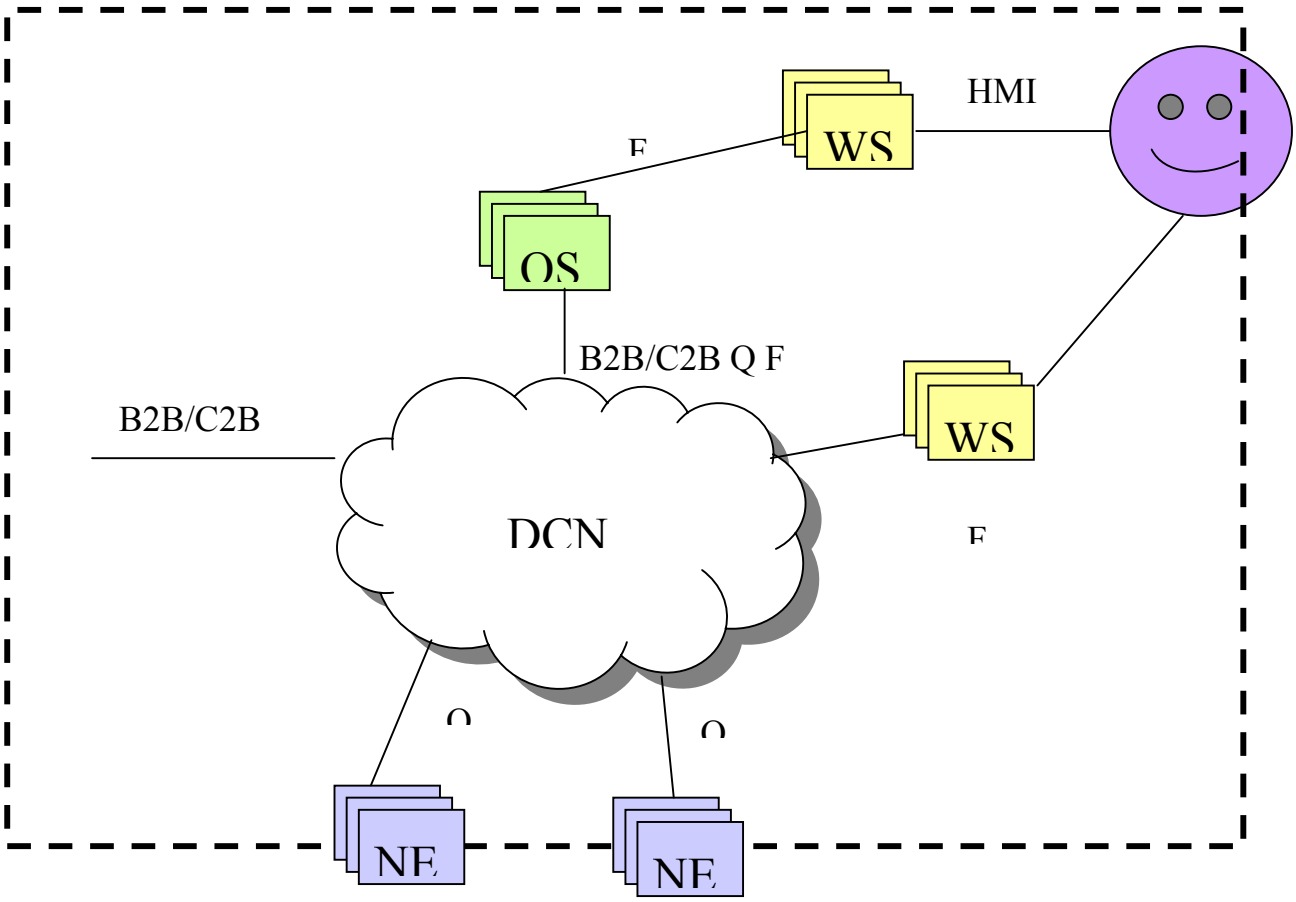

Figure ~~12~~ 14 – An example of a physical architecture

~~12.1~~13.1 Management physical blocks

Management functions can be implemented in a variety of physical configurations. The relationship of the functional blocks to physical equipment is shown in Table 2 which names the management physical blocks according to the set of function blocks which each is allowed to contain. For each physical block there is a function block which is characteristic of it and is mandatory for it to contain. There also exist other functions which are optional for the physical blocks to contain. Table 2 does not imply any restriction of possible implementations, but defines those identified within this Recommendation.

The subclauses below give the definitions for consideration in implementation schemes.

Table 2 – Relationship of management physical block names to management function blocks (Notes 1, 2)

(Notes 2 and 3)	TEF	SEF	OSF	WSF
NE	M*	M*	O	O (Note 3)
OS			M	O
WS				M

M Mandatory
O Optional

NOTE 1 – Within this table, where more than one name is possible, the choice of the physical block name is determined by the predominant usage of the block.

NOTE 2 – Management physical blocks may contain additional functionality which allows them to be managed.

NOTE 3 – For the WSF to be present the OSF must also be present. This means that the WSF must address an OSF. The local human-machine access is considered out of scope of standardization.

* that the NE needs to support at least one of the TEF or SEF

~~12.1.1~~13.1.1 Operations System (OS)

The OS is the system which performs OSFs. The OS may optionally provide QAFs and WSFs.

.

~~12.1.3~~13.1.2 Network Element (NE)

The NE is comprised of telecommunication equipment (or groups/parts of telecommunication equipment) and support equipment or any item or groups of items considered belonging to the telecommunications environment that performs NEFs. The NE may optionally contain any of the other management function blocks according to its implementation requirements. The NE has one or more standard Q-type interfaces and may optionally have F and B2B/C2B interfaces.

Existing NE-like equipment that does not possess a standard interface will gain access to the management infrastructure via a Q Adapter Function, which will provide the necessary functionality to convert between a non-standard and standard management interface.

~~12.1.5~~13.1.3 Workstation (WS)

The WS is the system which performs WSFs. The workstation functions translate information at the f reference point to a displayable format at the HMI reference point, and vice versa.

If equipment incorporates other management functionality as well as the WSF, then it is named by one of the other names in Table 2.

~~12.2~~13.2 Data Communication Network (DCN)

The DCN is a support service that provides paths for information flow between physical blocks in a management environment. It provides functionality within the transport service of the lower four layers of the OSI Reference Model defined in Recommendation X.200. Refer to Recommendations Q.811 [12] and Q.812 [13] for specific interface protocols for information transfer through a DCN.

The DCN may consist of a number of individual subnetworks of different types, interconnected together. The DCN may be a local path or a wide-area connection among distributed physical

blocks. The DCN is technology independent and may employ any single or combination of transmission technologies.

~~13.3~~13.3 Support Physical Blocks

~~13.3.1~~13.3.1 Transformation

Transformation provides conversion between different protocols and data formats for information interchange between physical blocks. There are two types of transformation: adaptation and mediation that can apply at q or B2B/C2B reference points.

~~13.3.1.1~~13.3.1.1 Adaptation device

An adaptation device (AD), or adapter, provides transformation between a non-compliant physical entity to a NE to OS within an administrative domain. A Q-adapter (QA) is a physical block used to connect NE-like or OS-like physical blocks with non-compatible interfaces (at m reference points) to Q interfaces. A B2B/C2B-adapter is a physical block used to connect non-compatible physical entities having a non-compatible communication mechanism in a non-compatible environment to an OS at the edge of an administrative domain.

~~13.3.1.2~~13.3.1.2 Mediation device

A mediation device (MD) provides transformation between management physical blocks that incorporate incompatible communication mechanisms. A Q-mediation device (QMD) is a physical block that supports connections within one administrative domain. A B2B/C2B-mediation device is a physical block that supports connections of OSs in different administrative domains

~~13.3.2~~13.3.2 Distributed Multi-element Structure

A distributed multi-element structure is an architectural concept that represents a grouping of network elements that must be managed as a single entity for operational efficiency sake. Examples include Optical Bidirectional Line Switched Ring (BLSR) or an entire MPLS network when viewed from the perspective of an edge router. Due to the distributed nature of their blocks and the complexity of their internal make up, it is sometimes difficult to distinguish between Distributed multi-element structures and a sub-network.

~~12.3~~13.4 Management logical layered architecture within the management physical architecture

Four specializations of the OS physical block are defined to support a physical realization of function blocks in logical layers. The four specialized OS physical blocks are the Business (B-OS), the Service (S-OS), the Network (N-OS) and the Element (E-OS) Operations Systems. These physical blocks are named according to the predominant function block they contain. Specifically, B-OS, S-OS, N-OS and E-OS predominantly contain B-OSF, S-OSF, N-OSF and E-OSF respectively. When physical blocks contain more than one kind of specialized OS function block that provide substantial functionality to the physical block, thus spanning more than one logical layer, the physical block is named according to the highest hierarchically layered function block. For example, a physical block containing both N-OSF and E-OSF, providing substantial network functionality, is called an N-OS.

~~12.4~~13.5 Interoperable interface concept

In order for two or more management physical blocks to exchange management information, they must be connected by a communications path and each element must support the same interface onto that communications path.

It is useful to use the concept of an interoperable interface to simplify the communications problems arising from a multivendor, multicapability network.

The interoperable interface defines the protocol suite and the messages carried by the protocol. Transaction-oriented interoperable interfaces are based upon an object-oriented view of the communication and, therefore, all the messages carried deal with object manipulations. It is the formally defined set of protocols, procedures, message formats and semantics used for the management communications.

The message component of the interoperable interface provides a generalized mechanism for managing the objects defined for the information model. As part of the definition of each object there is a list of management operations types that are valid for the object. In addition, there are generic messages that are used identically for many classes of managed objects.

In the architecture, what predominantly distinguishes one interface from another is the scope of the management activity that the communication at the interface must support. This common understanding of the scope of operation is termed Shared Management Knowledge. Shared Management Knowledge includes an understanding of the information model of the managed network (object classes supported, functions supported, etc.), management support objects, options, application context supported, etc. The Shared Management Knowledge ensures that each end of the interface understands the exact meaning of a message sent by the other end.

~~12.5~~13.6 Management standard interfaces

Figures 8a, 8b and 8c show the interconnection of the various management physical blocks by a set of standard interoperable interfaces. The allowable interconnections of these standard interfaces within a given administrative domain may be controlled by both the actual interfaces provided and/or by security and routing restrictions provided within the various physical block entities (e.g. passwords, log-ons, DCN routing assignment, etc.).

Management standard interfaces are defined corresponding to the reference points. They are applied at these reference points when external physical connections to them are required. See Figure 7.

~~12.5.1~~13.6.1 Q interface

The Q interface is applied at q reference points.

To provide flexibility of implementation, the class of Q interfaces is made up of the following subclasses:

– the interface Q is applied at the q reference point;

– the Q interface is characterized by that portion of the information model shared between the OS and those management elements to which it directly interfaces.

~~12.5.2~~13.6.2 F interface

The F interface is applied at f reference points. The F interfaces connecting workstations to the management physical blocks containing OSFs or MFs through a data communication network are included in this Recommendation. Connections of implementation specific, WS-like entities to OSs or NEs, are not the subject of this Recommendation.

~~12.5.3~~13.6.3 Business to Business/Customer to Business interface

The B2B/C2B interface is applied at the B2B/C2B reference point. It will be used to interconnect two administrative domains or to interconnect a compliant environment with other networks or systems which accommodate a compliant-like interface. As such, this interface may require increased security over the level which is required by a Q-type interface. It will therefore be

necessary that aspects of security are addressed at the time of agreement between associations, e.g. passwords and access capabilities.

The information model at the B2B/C2B interface will set the limits on the access available from outside the administrative domain. The set of capabilities made available at the B2B/C2B interface for access to the administrative domain will be referred to as administrative domain Access.

Additional protocol requirements may be required to introduce the level of security, non-repudiation, etc. which is required.

~~12.5.4~~13.6.4 Relationship of management interfaces to management physical blocks

Table 2 defines the possible interfaces, which each named TMN physical block can support. It is based upon the function blocks which Table 2 associates with each physical block and the reference points between function blocks, defined in Table 2.

~~12.5.5~~13.6.5 Management standard interfaces

Management standard interfaces provide for the interconnection of NEs, QAs, OSs, MDs and WSs through the DCN. The goal of an interface specification is to ensure compatibility of devices interconnected to accomplish a given management function independent of the type of device or of the supplier. This requires compatible communication protocols and a compatible data representation method for the messages, including compatible generic message definitions for management functions. A minimum set of protocol suites to be applied to management standard interfaces should be determined according to Recommendation M.3020 [9].

It is recognized that NEs, QAs, OSs, MDs and WSs may have other interfaces in addition to the Q, F and B2B/C2B interfaces defined in this Recommendation. It is also recognized that this equipment may have other functionality in addition to that associated with information sent or received via Q, F and B2B/C2B interfaces. These additional interfaces and related functionality are outside of the scope of standardization.

<Need text for the following figure />

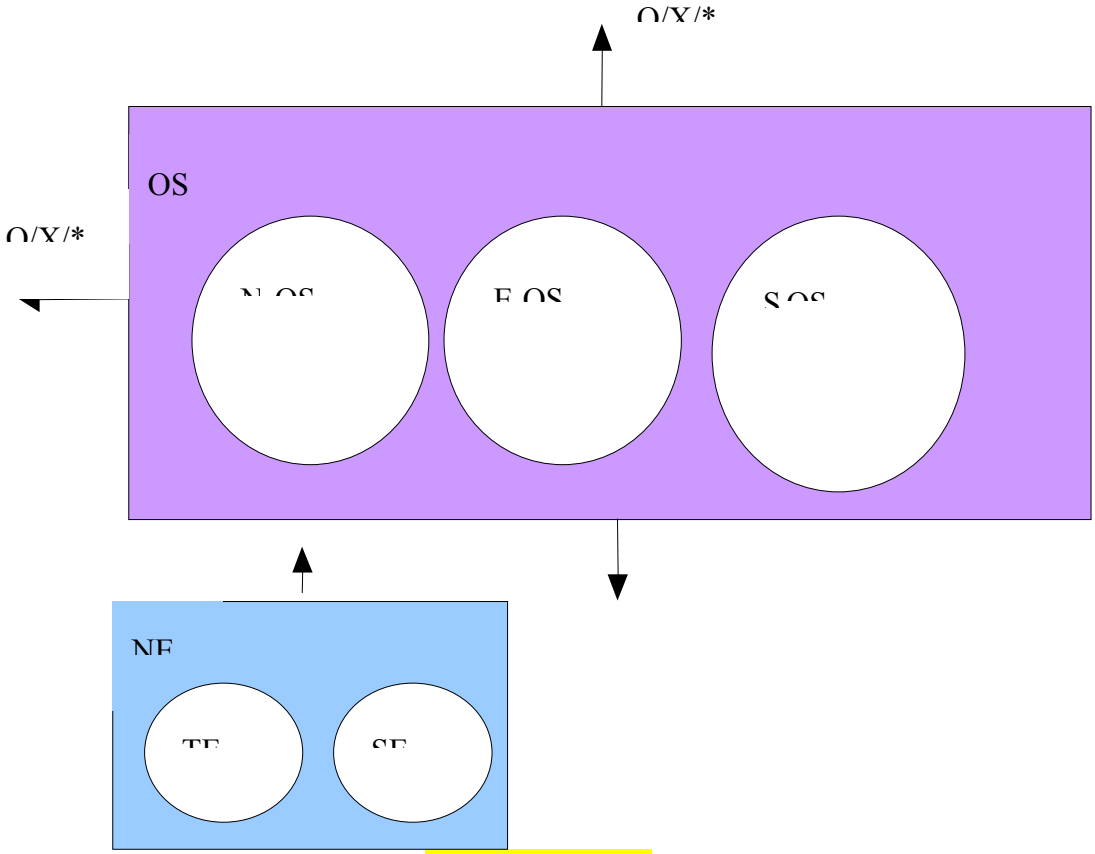

Figure 15 – xxxx

~~13~~14 Relationships between management architectures

A business process provides a set of requirements that defines management functionality in the functional architecture. This management functionality is composed of management function sets that are composed of management functions. Operations systems realize a number of functional blocks, deployable units of management functionality, in the physical architecture. The functional architecture defines reference points that involve interaction between functional blocks. The information architecture constrains the data and interaction patterns of the interface between operations systems components that are physical realizations of function blocks. Figure A shows this relationship between management architectures and their components.

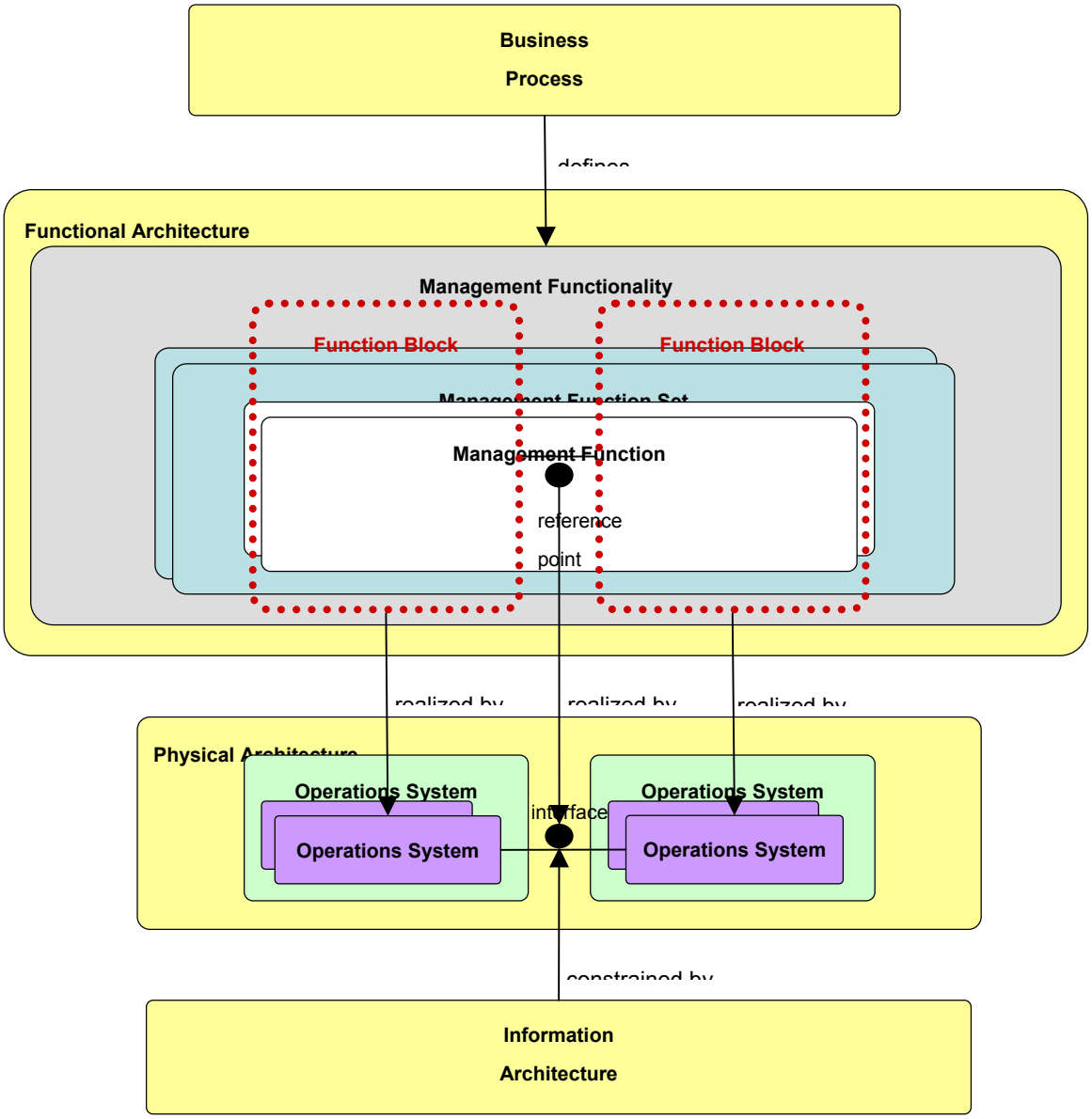

Figure ~~A~~ 16 – Relationship of management architectures and their components

<Need update to the above figure: (a) change OS component to OS block, (b) move the line and the reference point between the two Function Blocks higher so that outside of the Management function Set box to avoid confusion. />

The management implementation is realized from four different, but interrelated architectures. These are the business process, functional, information and physical architectures.

Three of these architectures (business process, functional and information) provide a framework that allows requirements to be documented about *what* a management implementation should do.

The business process architecture …. [Editing instruction Need text here]

The functional architecture framework permits the specification of what functions have to be achieved in the management implementation. The information architecture permits the specification of what information (i.e. data) has to be stored so that the functions defined in the functional architecture can be achieved in the management implementation. The management implementation, that meets the requirements of the management functional and information specifications, may vary

greatly from one management solution to another. Management implementations are not currently a subject for standardization.

Management implementations have to blend and balance a number of divergent constraints such as cost, performance, and legacy deployments, as well as new functionality being delivered. Since every management implementation will have different sets of these constraints to cope with, reality dictates that there will be many physical architecture implementations. These implementation architectures are the result of different distributions of the fundamental elements.

~~15~~15 Management conformance and compliance

For further study

Open Issues

16 Temporary Appendix (Informative) – Open Issues

16.1 General Document Clean up

16.1.1 Ensure all references are in sited and vice versa

Delete and add as appropriate

16.1.2 Delete definitions not used in document

This has been done, but I'm keeping it here since we may need to do look through this again.

16.1.3 Are we randomly capitalizing things

16.1.4 Update cross references

16.1.5 Test print document in black and white to ensure readability

I've done this and things look good from a color perspective, but some of the text in figures is a bit small.

16.2 Terms requiring definition

16.2.1 QAF used but not defined

Is it still needed and if so do we need to import it from M.3010. Or delete it?

16.2.1.1 Proposed Resolution

Remove QAF

16.2.2 Expand or don't use terms SP and ISP (mainly in functional architecture discussions)

16.2.3 Product Object Instance, Product Instance and Product Object

16.2.4 MPCM

16.3 HMI within scope of standardization and implications on WSF

Action Dave

16.4 Impact on interfaces/reference points as a result of business processes explained

Is this the document for this? Relationship with M.3010 section?

So the issue is how does this increase in architectural viewpoint now being supported – show itself in the interfaces and reference points? Do we leave the interfaces as are – eg "q", and somehow state that the scope of this has been extended to include, say, business process flow support. Or do we rename the interface and state it supports previous viewpoints (eg"q" capability) + additional viewpoint support?

Within TMF we have the concept of a "lifecycle" being supported by a "contract interface" associated with "management system components". This contract interface has various parts - according to the lifecycle or viewpoints supported. So for example the contract would have parts that support the business viewpoint, information viewpoint, implementation viewpoint etc. (To a certain extent this approach has been based upon ODP viewpoints)

Action Tony

16.5 Vocabulary inconsistencies

Action Ken to provide list of terms in question

16.6 Need text for 'Enterprise Management' Section

16.7 Summary section needs updating

There are 4 architectures. Need to add business process one. Do we need new keywords too?

17 Is defining the architectures in both 9.0 and then again in 9.1, 9.2, 9.3 and 9.4 necessary

If so, the information architecture needs a definition in 9.0

17.1 Need content for 'Relationship with M.3010 section

17.2 Should add 'See M.3050 for more detail at end of section 10.

17.3 Terminology

17.3.1 We import, but don't use the term transport plane

17.3.2 Can we reuse the term 'Support Function' from M.3010 instead of introducing 'Auxiliary Functions'

17.3.3 The definition of Management Function Set's last sentence isn't helpful is it?

17.3.4 Do we really need to define both 'Management function" and "Management functionality"?

17.3.5 We use SM Layer instead of SML. Is this useful?

17.3.6 How does a Service management domain differ from an administrative domain applied to the service bit?

It is different. We need a different term.

17.3.7 When to use transport and when to discuss connectivity?

17.3.8 What is a 'signaled' service? Can we just call it a service

17.3.9 Sender instance?

17.3.10 Why do we use both terms NMF and N-OSF and EMF and E-OSF

Good point. Let's just use E-OSF; N-OSF? Some compatibility issues with eTOM?

17.3.11 Service and connectivity Componet?

17.3.12 Support functionality versus auxiliary functionality

Action R.

17.4 Editorial Nits

17.4.1 In section 5, second last paragraph discusses 'most industries'

17.4.2 In section 5, last paragraph – high versus highly

17.4.3 In section 6, the last two areas for further study now have been covered in the document so should be moved up

17.4.4 Figure 1 (The NGN Architecture Overview) has lost the white box within the pink box of the management functions. It will not be different from other figure in Y.NGN.FRA

17.4.5 The first editor's note in section 9 (NGN Management Architecture Overview) has been executed so should be removed

17.4.6 In section 11.1.1.1. (SMF), second bullet is the bit in brackets after C2B/B2C helpful?

17.4.7 Figures Y, Z too small

17.4.8 Security Considerations in figure X prints too dark

17.4.9 Figure 9 has font and colour (green too dark) issues

17.4.10 Figures in 10.6 need titles

17.5 Review requirements and determined which need to be put for ' further study'

17.6 Section 10 needs to be wordsmith

Action Geoff

17.7 Do we still need a separate 11.4 'Management Function Sets and Management Functions' given the current 11.3?

17.8 In section 10.6, there is text that duplicates discussion in the OSF section.

17.9 OS component used in relationship between function and physical architecture, but not in physical architecture

Is it really needed?