Management Functional Areas

- Identified in First OSI Systems Management (OSI-SM), also adopted in the TMN
  - **F**ault Management
  - **C**onfiguration Management
  - **A**ccounting Management
  - **P**erformance Management
  - **S**ecurity Management
- A.k.a. '**FCAPS**'

In OSI Systems Management (OSI-SM) standardisation a top-down approach was followed, with a number of management functional areas identified first. The reason for identifying those was not to describe exhaustively all relevant types of management activity but rather to investigate their key requirements and to address those through generic standardised management infrastructure. The identified areas are *Fault*, *Configuration*, *Accounting*, *Performance* and *Security Management* and are collectively referred to as *FCAPS* from their initials. The same functional areas have also being adopted by the TMN.

Fault Management

- Generation of Error Notifications (alarms)
- Logging of notifications at source
- Network Element Testing
- Requirements:
  - Event based operation (including logging)
  - Generic set of Alarms
  - A Testing Framework

Fault Management addresses the generation of error specific notifications (*alarms*), the logging of error notifications at source and the testing of network resources in order to trace and identify faults. Management systems should undertake alarm surveillance activities (analysis, filtering and correlation), perform resource testing and provide fault localisation and correction functions. The key requirements are event-based operation, a well-defined generic set of alarms and a testing framework.

Accounting Management

- Usage Metering for Charging and Billing
- Set accounting limits
- Combining resource usage for complex services
- Requirements:
  - Event-based operation, in particular logging
  - A generic usage metering framework

Accounting Management deals with the collection of accounting information and its processing for charging and billing purposes. It should enable accounting limits to be set and costs to be combined when multiple resources are used in the context of a service. The key requirements are event based operation, in particular logging, and a generic usage metering framework.

Performance Management

- Determine network and system load
- Collection of performance information for capacity planning
- Needs a lot of information, care needed not to overload network with management traffic
- Requirements:
  - Event-based operation
  - Convert raw traffic data to "Rates" and generate QoS alarms
  - Summarise information periodically for trend indication and capacity planning
  - Determine response time between network nodes

Performance Management addresses the availability of information that allows to determine network and system load under both natural and artificial conditions. It also supports the collection of performance information periodically in order to provide statistics and allow for capacity planning activities. Performance management needs access to a lot of network information and an important issue is to provide the latter with a minimum impact on the managed network. Key requirements are the ability to convert raw traffic information to traffic rates with thresholds and tidemarks applied to them; the periodic summarisation of a variety of performance information for trend identification and capacity planning; the periodic scheduling of information collection; and the ability to determine the response time between network nodes.

Security Management

- Management of security – monitor and control the availability of security facilities
- Security of Management:
- Authenticate management applications and users
- Guarantees confidentiality and integrity of management exchanges – FoI issues
- Support access control to management information

Security Management is concerned with two aspects of systems security:

The *management of security*, which requires the ability to monitor and control the availability of security facilities and to report security threats or breaches.

And the *security of management,* which requires the ability to authenticate management users and applications, to guarantee the confidentiality and integrity of management exchanges and to prevent unauthorised access to management information.

What is the Telecommunications Management Network

- Supports administrations in managing telecommunications networks and services
- Does this through a framework to achieve interconnection of operations systems and telecommunication equipment
- Achieved through an agrees architecture with standardised protocols and interfaces

The Telecommunications Management Network (TMN) has as purpose to support telecommunications administrations (i.e. operators) in managing telecommunications networks and services. This means support for planning, provisioning, installing, maintaining, operating and administering these. Within the context of the TMN, management means a set of capabilities that allow to exchange and process management information in order to allow administrations to conduct their business efficiently. There may be multiple TMNs within one administration while a single TMN may span multiple administrations.

The basic concept behind the TMN is to provide a framework to achieve interconnection between various types of management applications, which in TMN parlance are called Operations Systems (OSs), and telecommunications equipment. Management information is exchanged between these to provide the services mentioned. An agreed architecture is used with standardised interfaces in terms of protocols and messages. One of the requirements for such an architecture is that there exists already a large infrastructure of management facilities and telecommunications equipment which must be accommodated. The OSI Systems Management protocols and services (Recommendation X.700) are used within and across TMNs and represent a subset of the TMN provided management capabilities.

Application of TMN

- Mainly in telecommunication networks
- Public Switch Telephone Network (PSTN)
- Intelligent Networks (IN)
- Transmission Networks, e.g. SDH, SONET
- Broadband, multi-service switched networks, e.g. ATM
- Mobile Networks

The following are examples of networks, telecommunications services and types of equipment that may be managed by the TMN:

public and private telecommunications networks, including PSTN, ISDN, IN, mobile networks, virtual private networks

transmission equipment (multiplexers, channel translation equipment, etc.), mainly for SDH and SONET

packet switched networks e.g. X.25

future broadband multi-service networks i.e. ATM

digital and analogue exchanges, PBXs, PBX accesses and customer terminals

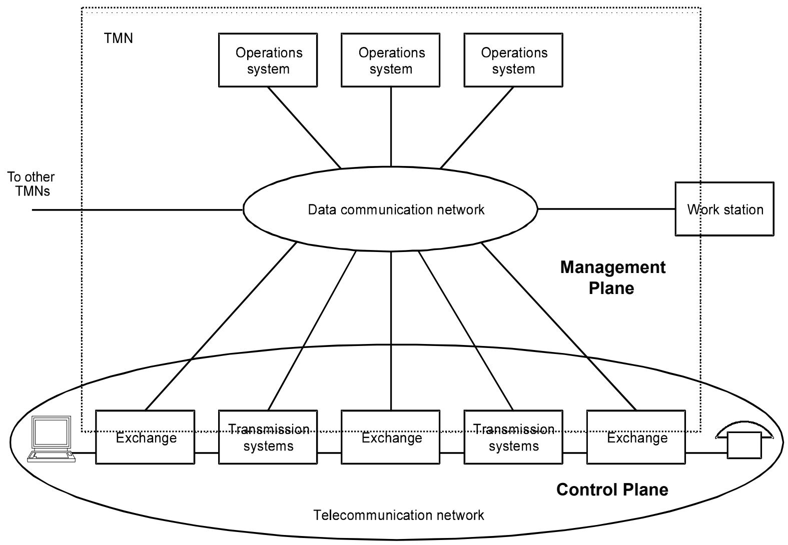
bearer services and teleservices

mainframes, front-end processors, cluster controllers, file servers

signalling terminals and systems including signal transfer points and real-time data bases

software associated with telecommunications services e.g. switching software, directories, information data bases

Relationship of TMN to the Telecoms Network



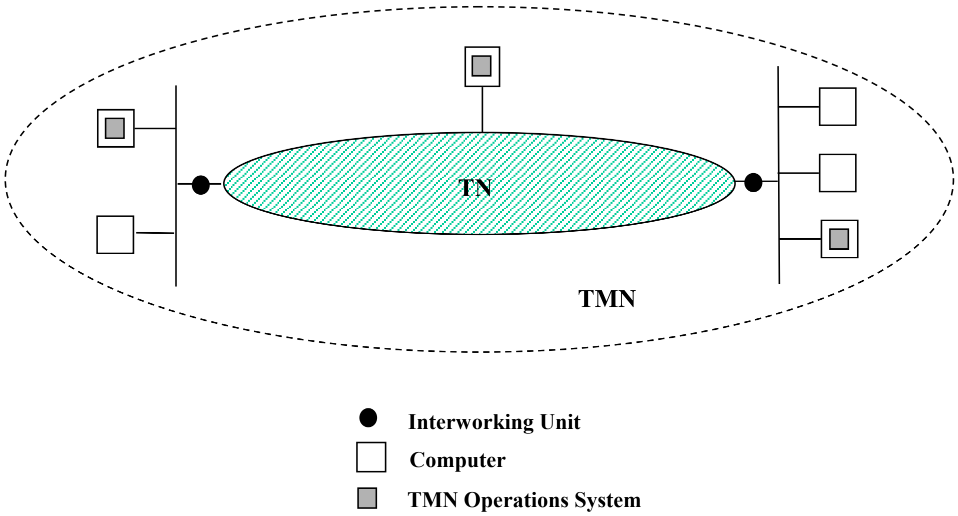
A TMN may provide management functions and offer communications between OSs themselves and between OSs and the various parts of the telecommunications network. The latter may consist of many types of analogue and digital telecommunications and support equipment, such as transmission and switching systems, multiplexers, signalling terminals, front-end processors, workstations, file servers etc. All this equipment is generically referred to in the TMN context as Network Elements (NEs).

The current generation of telecommunications networks are plain transmission networks, so a data network capability needs to be provided over them for communicating management traffic. If ATM becomes the core technology of the next generation as part of the Broadband ISDN (B-ISDN) introduction, the telecommunications network will be an inherently data network.

The figure above shows the general relationship between a TMN and the telecommunications network it manages. The TMN is conceptually a separate network that interfaces to the latter at various different points in order to communicate management information and to control its operations. In reality, the TMN may use parts of the telecommunications network to provide its communications. Thus, the TMN sometimes manages (parts or all of) the TMN network.

In this figure it is shown that the TMN boundary is restricted to the telecommunications network it manages. In reality, this boundary may also be extended to also manage equipment in the customer premises e.g. computer terminals for multimedia services..

Relationship of TMN to the Telecoms Network : An example physical view



TMN and the Control Plane

- The TMN realises the management plane in the Broadband ISDN reference model
- The control plane is responsible for the set-up and release of on-demand calls for:
  - Bearer services, e.g. POTS through SS7 or B-ISDN variants
  - Enhances services, e.g. in telephony – IN
- TMN does not support on-demand services, so thus has less stringent real-time requirements
  - Management services for the operator
  - Management services for the end-users

The distinction between the TMN and the telecommunications network it manages maps exactly to the distinction between the *management* and *control* planes of the Broadband ISDN Reference Model. The latter categorises activities into three *planes*:

> the *User Plane*, which is involved with the transfer of user information (audio and video streams, packet data);
>
> the *Control Plane*, which is responsible for the establishment, operation and release of on-demand calls and connections; and
>
> the *Management Plane*, which is involved with the planning, installation, configuration, provisioning and supervision of the network infrastructure in order to allow the user and control planes to function as efficiently and smoothly as possible.

According to this categorisation, the control plane supports end-user services and has also two distinct aspects. Support for *bearer* services, such as basic telephony through the Signalling System No. 7 (SS#7) or, in the future, support for bearer ATM virtual channel connections through B-ISDN signalling. And also support for *enhanced* services, such as Intelligent Network (IN) based telephony or multimedia services based on the emerging Telecommunications Network Information Architecture (TINA).

It is should be clear that the TMN does not aim to support *on-demand end-user* services which are the subject of the control plane. The TMN supports management services which are primarily used by the operators and human managers of the telecommunications network. It also supports management services which are used by end-users, such as service subscription, accounting, service profile customisation and the provision of Virtual Private Network (VPN) services. Since the TMN is not involved in on-demand end-user service control, it has less stringent requirements on real time response than control plane functions.

TMN and the Control Plane(cont'd)

- TMN is orthogonal to the control plane, but its decisions effect the way the latter operates
- In initially configured the network based on planning considerations
- It subsequently monitors the network and makes decisions based on the network conditions, management policy and knowledge of future events
- Management intelligence operates largely 'outside' the network – similar to IN.

The relationship between the TMN and the control plane, the latter providing either bearer or enhanced services, bears a very good analogy to the relationship between a managed object and the associated real resource. The TMN provides management functions and facilities in an orthogonal fashion to the operation of the control plane but these management functions affect the way in which the control plane operates. The TMN influences operation of the latter by configuring operational parameters, for example routing table entries, according to management decisions. The TMN monitors the network, makes decisions based on network conditions and other information, such as management policy and knowledge of future events, and feeds back management actions to the control plane in order to influence its future behaviour. This relationship allows the network to operate as intelligently as possible without burdening the network elements with sophisticated features. In essence, management intelligence operates "outside" the network, in a similar fashion to enhanced service control frameworks such as IN and TINA.

Basic TMN Objectives

- Generic Management Models
  - Management of diverse equipment through standard interfaces
- Distributed functionality
- Security and Data Integrity
- OSI application layer services used

The objective for the TMN specifications is to provide a framework for telecommunications management. By introducing the concept of generic network models for management, it is possible to perform general management of diverse equipment using generic information models and standard interfaces.

The principle of keeping the TMN logically distinct from the networks and services being managed introduces the prospect of distributing the TMN functionality for centralised or decentralised management implementations. This means that from a number of management systems, operators can perform management of a wide range of distributed equipment, networks and services.

Security and distributed data integrity are recognised as fundamental requirements for the definition of a generic architecture. A TMN may allow access and control from sources considered outside the TMN (e.g. inter-TMN cooperation and network user access). Security mechanisms may be needed at various levels (managing systems, communications functions, etc.).

The TMN Recommendations make use of OSI-based application services where appropriate. The object-oriented approach, that is a prerequisite in OSI management, is used to represent the TMN environment in terms of the resources and the activity of management function blocks performed on such resources.

Distributed telecommunications management environments may require the use of emerging object-oriented Open Distributed Processing (ODP) techniques.

Architectural Requirements

- Minimise reaction times to network events
- Minimise load caused by management traffic
- Allow for geographic dispersion of control
- Provide isolation mechanisms for faults
- Improve service assistance and interaction with customers

The TMN needs to be aware of telecommunications networks and services as collections of cooperating systems. The architecture is concerned with orchestrating the management of individual systems so as to have a coordinated effect upon the network. Introduction of TMNs gives administrations the possibility to achieve a range of management objectives including the ability to:

minimise management reaction times to network events

minimise load caused by management traffic

allow for geographic dispersion of control over aspects of the network operation

provide isolation mechanisms to minimise security risks

provide isolation mechanisms to locate and contain network faults

improve service assistance and interaction with customers

To take into account the above objectives the TMN architecture should offer the following: it should make various implementation strategies and the distribution of management functionality possible. It should allow for management of heterogeneous networks, equipment and services. It should allow a domain-oriented structure, with autonomous functions within domains. It should allow for technological changes and include migration capabilities to enhance early systems. It should provide an appropriate degree of reliability and security. It should address the requirements of both small and large networks. It should allow for interoperation between administrations. It should allow flexibility in the degree of reliability/cost trade-off in network management components.

TMN Architectures

- TMN Functional Architecture
- TMN Information Architecture
- TMN Physical Architecture

Within the general TMN architecture there are three basic aspects which can be considered separately when planning and designing a TMN. These are:

TMN functional architecture

TMN information architecture

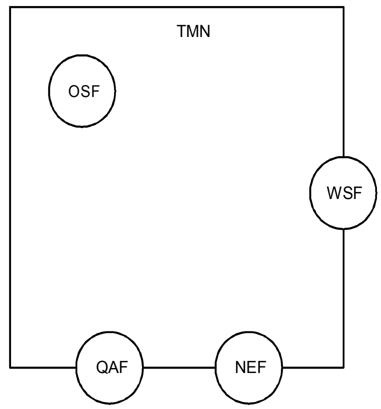
TMN physical architecture

The *functional* architecture describes the appropriate distribution of functionality within the TMN to allow for the creation of function blocks from which a TMN of any complexity can be implemented. The definition of function blocks and reference points between function blocks leads to the requirements for the TMN interface specifications.

The *information* architecture takes an object-oriented approach and is based on Open System Interconnection (OSI) Systems Management principles. Recently, OSI Directory (X.500) principles have been included in the information architecture for shared management knowledge and distribution (naming, discovery) services. In the future, TMN information architecture may benefit from the emerging techniques developed for distributed applications i.e. the Open Distributed Processing.

The *physical* architecture describes how functional blocks are grouped together in physical entities which communicate through open interoperable interfaces.

TMN Functional Architecture



The TMN functional architecture is based on a number of function blocks which provide the TMN general functions. The overall functionality is broken down into two main components: the Operations System Function (OSF) and the Workstation Function (WS). A Network Element Function (NEF) and Q Adaptor Function (QAF) are also used to provide a view of the telecommunications network and services being managed.

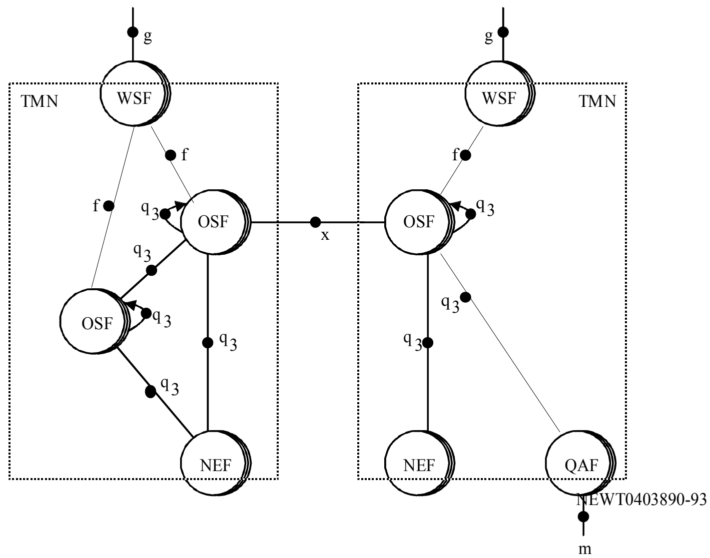
The *Operations Systems Function* enables the management of the network elements and services. It processes management information for monitoring, coordinating and controlling the telecommunications functions through management policies. In terms of the management model an OSF is usually a hybrid unit (manager/agent), it may also be a manager only but it is never a plain agent.

The *Network Element Function* allows the communication with the TMN for the purpose of being monitored and controlled. The NEF includes those functions which are the subject of management. The latter are not part of the TMN but are represented to the TMN by the NEF. In terms of the management model, a NEF is an agent.

The *Q Adaptor Function* is used to connect to the TMN network and management equipment (NEF-like and OSF-like) that does not support the standard TMN interfaces. This is the reason for being partly outside the TMN. In terms of the management model, it is a conversion unit (application gateway).

The *Workstation Function* enables the human manager to interact with the QAF and the MF. The support for interfacing to the human user is not considered part of the TMN, this is why it is shown partly outside the TMN boundary. In terms of the management model, it is a manager.

TMN Reference Points



The TMN function blocks exchange management information through reference points. The latter are conceptual points and they only become interfaces when the connected function blocks are embodied in separate pieces of equipment. The key classes of TMN reference points are identified in the above figure.

The *q3* reference point connects the function blocks OSF to QAF, OSF to NEF and and OSF to OSF.

The *x* reference point connects TMNs with each other, usually realising inter-TMN OSF to OSF communication. As such, x reference points are also interfaces.

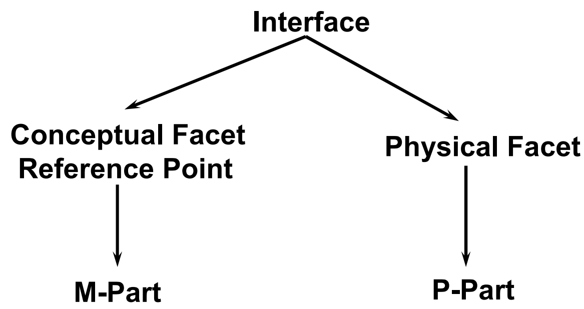
The *m* reference point stands between the QAF and the non-TMN equipment or systems connected to the TMN. It is outside the TMN.

The *f* reference point connects the WSF to the OSF.

The *g* reference point stands between the WSF and the human user and it is outside the TMN.

The m and g interfaces are outside the TMN and, as such, outside the scope of standardisation.

Interoperable Reference Points and Interfaces



Interfaces supporting interaction between function blocks may be characterised as having two facets: a Conceptual Facet and a Physical Facet. The conceptual facet is effectively defined by the reference point. Adding the physical facet would permit the definition of an interface. It is reminded here that reference points define conceptual points of information exchange and they become interfaces only when the connected function blocks are realised in separate pieces of equipment. The conceptual facet of an interface appears in the conceptual or logical architecture while the physical facet appears only in the physical architecture as a possible physical manifestation.

In the Network Management Forum (NMF) approach, the conceptual facet of an interface (or reference point) is characterised by the M-Part (message part) alone while the physical facet of an interface is characterised by the P-Part (protocol part) alone. In the case of the OSI management model which is adopted by the TMN, the M-Part defines the data structure that conveys the message to be applied to a managed object or the result of an operation. When CMIS/P is being used, this is conveniently specified in ASN.1. The P-Part defines the protocol stack used to transfer the message and this will involve the selection of the OSI profile to support the CMIP protocol stack.

TMN Interoperable Interfaces

- Make possible the management of a multi-vendor, multi-capability network
- An interface is defined by a protocol suite and a set of messages
- Messages in transactions-oriented interfaces manipulate objects, hence:
  - Interface = access service/protocol + information model
- Shared management knowledge ensures that each end understands the exact message meaning

In order for two or more TMN building 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. Using the concept of an interoperable interface to simplify the communications problems arising from a multi-vendor, multi-capability 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 generalised mechanism for managing the objects defined for the information model. As part of the definition of each object there is a list of the type of management operations which are valid for the object. In addition, there are generic messages which 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 which the communication at the interface must support. This common understanding of the scope of operation is termed Shared Management Knowledge (SMK). This includes an understanding of the information model of the managed network (object classes supported, functions 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.

TMN Interface Specification

- TMN management services are decomposed top-down to result in interface specification
  - TMN management service
  - TMN management service component
  - TMN management function
  - TMN management function set
- Management functions are used for object modelling and results in TMN interface models

TMN interfaces are specified in a top-down fashion, starting from management services to be provided and breaking those down to management service components, management functions and management function sets.

TMN MANAGEMENT SERVICE: A TMN management service addresses, in a uniform way, the relevant information on the management of a certain telecommunications area. It is always described from the user perception of the management requirements.

TMN MANAGEMENT SERVICE COMPONENT: The TMN management service component is a constituent part of a TMN management service. The MSC uses some of the TMN management functional components and/or the TMN management function sets to fulfil the specific requirements of the TMN management service.

TMN MANAGEMENT FUNCTION: A TMN management function is the smallest part of the TMN management service perceived by the user of the service. In reality it will generally consist of a sequence of actions on a defined managed object or objects.

TMN MANAGEMENT FUNCTION SET: A TMN management function set is a grouping of management functions that logically belong together.

TMN Interface Realisation

- Q3 - CMIS/P, FTAM
- X – same as Q3 but needs security
- F – not yet standardised
- M - non-TMN management protocols e.g. SNMP (outside of TMN)
- G - the GUI functional specification (outside of TMN)

The TMN uses the OSI Systems Management standards wherever possible. This means that interfaces for intra- and inter-TMN communication are based on OSI management standards, with the exception of the F interface which may or may not have explicit management semantics.

The Q3 interface is going to be implemented using the Common Management Information Service (CMIS), supported by a CMIP protocol stack with an agreed profile. The Commitment Concurrency and Recovery (CCR) and Transaction Processing (TP) OSI services may be also used in conjunction to CMIS. Finally, the OSI File Transfer Access Method (FTAM) may be used for bulk data transfer.

The X interface is likely to be very similar to Q3 with the addition of strict security mechanisms as it is likely to cross administrations.

The M interface is outside the TMN and as such not subject to standardisation. The most likely non-OSI management protocol supported by a number of devices is the Internet Simple Network Management Protocol (SNMP).

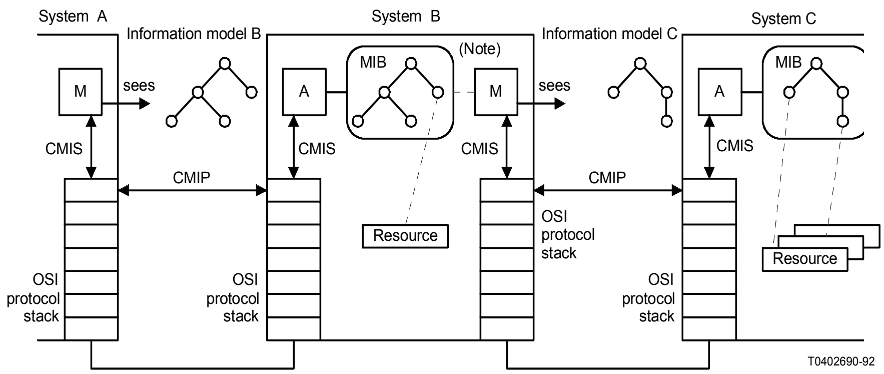
There are many approaches for the F interface e.g. a “stringified” set of CMIS messages over the Internet HTTP to drive WWW-based displays. No F interface has been standardised yet.

Finally, the G interface relates to the functional specification of the GUI, but it is outside the TMN and, as such, not subject to standardisation.

Existing standardised TMN Interfaces

- Generic Management Interface Standards:
  - Object, state, alarm, event, log management: X.721
  - Metric monitoring: X.739, summarisation: X.738
  - Alarm surveillance: Q.821, Performance Mgmt: Q.822
  - Generic Network Element information model: M.3100
- Element management interface standards:
  - SDH: G.774
  - ATM. I.751
  - GSM: GSM12
  - PSTN / SS#7: Q.751
- Network Management Interface Standards
  - ETSI GOM, equivalent ITU-T model

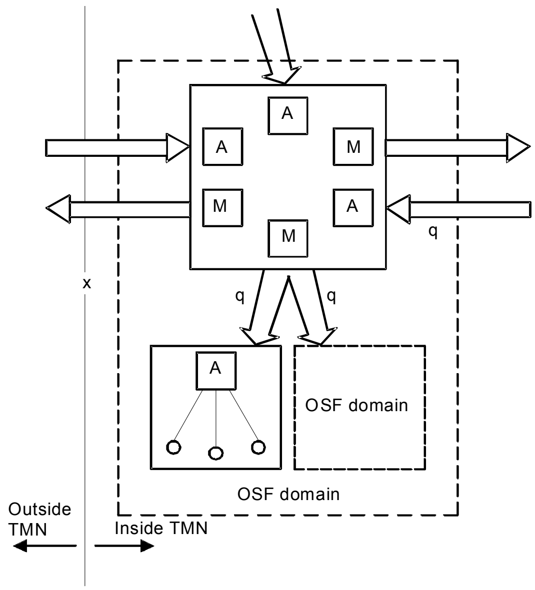
Cascading manager/agent Interactions



The above figure depicts an ordered, possibly hierarchical, relationship of three management applications with different shared management knowledge between each of them. Note that the information model each manager sees is different, reflecting the functional or organisational structure of this ordered relationship. System A manages system B which manages system C (cascading of systems). System A interacts with system B by reference to the information model supported by system B at its interface to system A. Similarly for system B to system C.

In this cascaded environment, system B presents the information model B to system A. To do this it uses information from information model C. System B processes the operations from system A on objects in its MIB. This may involve further operations on information model C. System B processes the notifications from system C, and this may involve further notifications to system A. In system B, the relationship between the Manager, Agent and the MIB is not subject to standardisation and is purely an implementation issue.

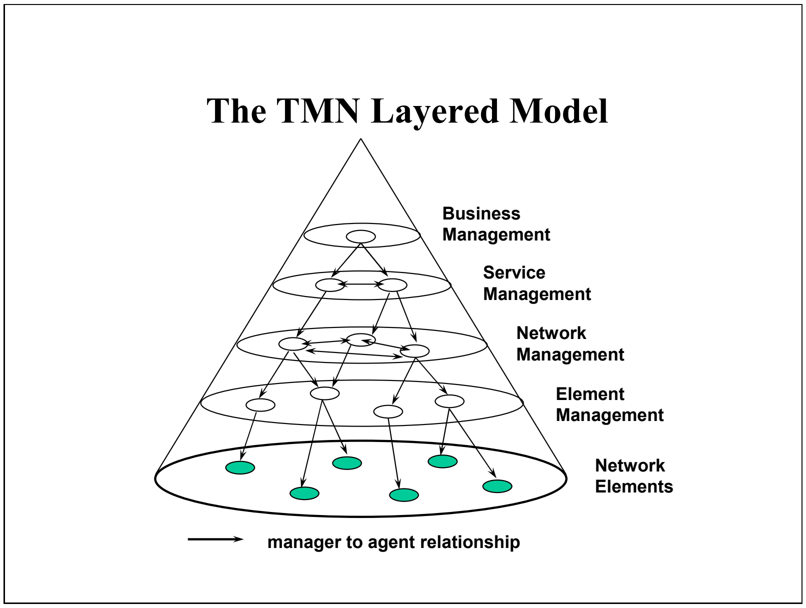
Logical Layered Architecture



The Logical Layered Architecture (LLA) is a development concept based upon hierarchical design principles in which the architecture can be thought as being based on a series of layers. The scope of each layer is broader than the layer below it, more generic in functionality and its managed objects provide higher levels of abstraction e.g. services instead of transport connections.

The LLA uses a recursive approach to decompose a particular management activity into a series of nested functional domains. Each functional domain becomes a management domain under the control of an Operation System Function (OSF) and thus each domain is called an OSF domain. A domain may contain other OSF domains to allow further layering and/or it may represent logical or physical resources as managed objects at the lowest level of the hierarchy within that domain. When the OSF domain is at the top of the layered architecture there is no superior OSF.

All interactions within a domain take place at generic q reference points. Interactions between peer domains i.e. crossing the OSF domain boundary can take place at a q or x reference point depending upon the business strategy applicable for that interaction. Reference points may become interfaces depending on the physical realisation as explained.



The TMN Recommendation M.3010 suggests the layering of Operations Systems Functions in a logical layered fashion. It suggests there are at least three types of OSFs, basic, network and services. Basic OSFs perform TMN application functions related to NEFs in specific regions. Network OSFs realise the network aspects of the TMN application functions by communicating with basic OSFs. Service OSFs perform specific TMN application functions by managing services. Basic and Network OSFs share infrastructural aspects of a telecommunication network while Service OSFs are concerned with service aspects of one or more telecommunications networks.

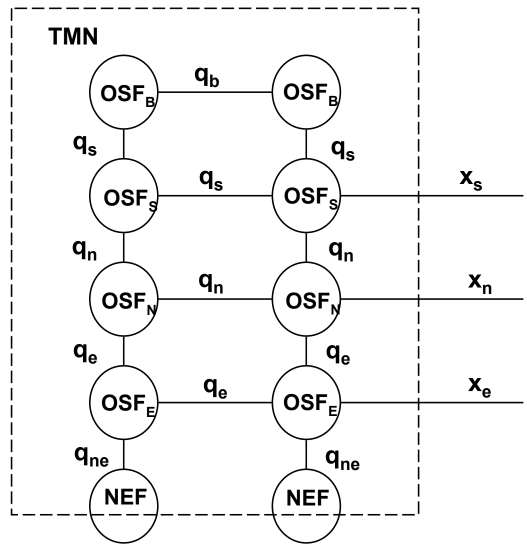
The Element Management layer comprises functions related to a number of NEs in a region, similar to the Basic TMN OSFs. These have a limited visibility of the network and focus on maintenance, configuration and statistics. They may be predominantly network technology dependent.

The Network Management layer comprises functions addressing the management of the network as a whole, similar to the Network TMN OSFs. Configuration of the network as a whole is performed at this level together with planning etc. Some of these functions can be independent of the underlying network technology.

The Service Management layer comprises functions that manage services which may be implemented across several networks, similar to the Service TMN OSFs. At this level customer related functions are to be found including usage records, accounts, agreed quality of service etc. as well as functions related to establishing and maintaining the facilities provided by the service. A service can span from a switched voice telephone service to a packet switched data service; it could also be a Message Handling Service or Video-Conferencing service.

Finally, the Business Management layer comprises a set of functions necessary for the implementation of policies and strategies within the administration which owns and operates the services and possibly the network. These might include tariffing policies, guidance on service operation when quality of service degrades and so on.

Classes of Q and X Reference Points



The TMN functional architecture defines generic classes of q and x reference points for management information exchange. Given the hierarchical decomposition of the TMN into element, network, service and business management layers, specific classes of those reference points can be defined between layers and within a layer. The figures depicts a hierarchical taxonomy of the relevant classes.

An interesting aspect that deserves some discussion is that an "horizontal" intra-layer reference point, e.g. q_n, is in principle the same with the inter-layer interface to the layer above. This is because only one information model is typically standardised for the whole layer, addressing the "agent profile" to the layer above.

It is unlikely that an "horizontal" q_e reference point will exist in reality. This is because element management OSFs typically follow strict hierarchical as opposed to peer-to-peer relationships. In addition, it may be the case that there will exist x reference points between different TMN layers and not only between the same layer. As an example, there may be network providers that offer pure transport only, with service providers buying those transport facilities to offer services. A service provider's TMN SM layer will need to interact with the network provider's TMN NM or even EM layers through xsn and xse reference points respectively.

The Network Element Management Layer

- Comprises a set of element management OSFs
- These control and coordinate a subset of elements
- Allow the network layer to access them
- Maintain element related data
- Provide an abstraction of the services provided to the network layer (unified view)

The element management layer manages each network element on an individual basis and supports an abstraction of the functions provided by it to the layer above i.e. the network management layer. It comprises a set of element management OSFs that are individually responsible on a devolved basis from the network management layer for a subset of network elements. Each such OSF has the following three major roles:

> to control and coordinate a subset of network elements; in this role, they support interactions between network OSFs and the elements under their control
>
> to control and coordinate their elements on a collective basis; in this role, they may provide a single entity view of a group of elements
>
> to maintain statistical, log and other data about network elements

All the mediation functions, including those physically located elsewhere (e.g. in a network element), belong logically in this layer.

The Network Management Layer

- Controls and coordinates network elements within its scope
- Provides, ceases or modifies the network's capabilities for service provision
- Maintain the network capabilities
- Interacts with the service management layer

The network management layer has the responsibility to manage all the network elements, as presented by the element management layer, both individually and as a set but it is not concerned with how a particular element provides its services. Functions addressing the management of a wide geographical area are located in this layer and a network technology and vendor independent view needs to be maintained.

The network management layer has four principal roles:

to control and coordinate the network view of all the network elements within its scope or domain

to provide, cease or modify the network capabilities for the support of service to customers

to maintain network capabilities

to maintain statistical, log or other data about the network and interact with the service management layer on issues regarding performance, usage, availability etc.

Thus, the network management layer provides the functionality to manage a network by coordinating activity across the network and supports the "network" demands made by the service management layer. 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 layer 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.

The Service Management Layer

- Customer facing – service provision, cessation, QoS agreement etc
- Interaction with service providers
- Interaction between services
- Maintaining statistical data
- Interaction with the Network and Business Management Layers

The service management layer is responsible for the contractual aspects of services that are being provided or are potentially available. It has the following principle roles:

customer facing (provision, cessation, accounts, QoS, fault reporting) and interfacing with other administrations

interaction with the service providers

interaction between services

maintaining statistical data e.g. related to QoS

interaction with the network and business management layers

The service management layer is responsible for all negotiations and resulting contractual agreements between a (potential) customer and the service(s) offered. Service order, complaint handling and invoicing are also tasks addressed.

The Business Management Layer

- Responsibility for the total enterprise
- Proprietary functionality
  - No X interface supported
- Setting rather than achieving goals
  - The 'what' rather than the 'how'

The business management layer has responsibility for the total enterprise.

The business management layer comprises proprietary functionality. To prevent access to its functionality, business OSFs do not normally support x reference points. Business OSFs access the information and functionality in the other management layers. The business management layer is included in the TMN architecture to facilitate the specification of capability that it requires of the other management layers.

This layer normally carries out goal setting tasks rather than goal achievement but can become the focal point for action in cases where executive action is called for. This layer is part of the overall management of the enterprise and many interactions are necessary with other management systems.