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SERIES M: TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

Telecommunications management network

TMN F interface requirements

ITU-T Recommendation M.3300

(Previously CCITT Recommendation)

ITU-T M-SERIES RECOMMENDATIONS

TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

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ITU-T RECOMMENDATION M.3300

TMN F INTERFACE REQUIREMENTS

Summary

This Recommendation provides requirements for the TMN F interface. The F interface is between a Workstation and other TMN physical blocks: an Operations Systems (OS), Mediation Device (MD), or Network Element (NE).

Source

ITU-T Recommendation M.3300 was revised by ITU-T Study Group 4 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 26th of June 1998.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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TMN F INTERFACE REQUIREMENTS

(revised in 1998)

1 Scope

This Recommendation defines the functional requirements for the TMN interface to the Workstation. The F interface requirements imply certain capabilities in Workstations. Note that a Workstation may have capabilities in addition to those that are relevant to the F interface.

The functionality specified at the interface implies there are applications that need that functionality. However, any particular application may not use all of the requirements for this interface.

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 reference listed below. A list of the currently valid ITU-T Recommendations is regularly published.

– ITU-T Recommendation M.3010 (1996), *Principles for a telecommunications management network*.

3 Definitions

This Recommendation defines the following terms:

3.1 user, TMN user: Recommendation M.3020 defines a TMN user as "that which requires the TMN management services in support of its activities. It may be a human user applying for the use of services via some human-machine communication or it may be some computer-based organizational system requiring the capabilities of the TMN." Within this Recommendation, the terms "TMN user" and "user" refer to *a human user at a Workstation* accessing TMN functionality.

3.2 user interface: Human-computer interface or human-machine interface.

3.3 F interface: An interface applied at f reference points. The F interface is between a Workstation and other TMN physical blocks: an Operations System (OS), Mediation Device (MD), or Network Element (NE).

3.4 Workstation: A physical block that performs the workstation function.

3.5 workstation function: A function block that interprets TMN information for the user, and vice versa.

3.6 f reference point: A reference point that is located between the workstation function block and the operations system function block or mediation function block.

3.7 g reference point: A reference point located outside the TMN, between the human user and the workstation function block.

3.8 user interface support function: A functional component that translates information held in TMN information models to a displayable format for the human-machine interface and that translates user input to TMN information models.

3.9 workstation support function: A functional component that provides support for the workstation function block, including data access and manipulation, invocation and confirmation of actions, transmittal of notifications, and that hides the existence of other function blocks from the user.

3.10 **display client**: A "managing" Workstation that makes requests to a display server (another Workstation) to display information in a specific layout and format on the display server's screen.

3.11 **display server**: A Workstation that fulfils requests made by a display client (another Workstation) to display information in a specific layout and format on its screen.

3.12 **F interface instance**: An association between a user and an OS that is characterized uniquely by the combination of the instance of communication, the endpoints (specific WS and OS), and the portion of the agent's MIB made visible.

3.13 **managed objects**: A management view of a resource that may be managed through the use of management protocol(s).

3.14 **management information base**: The visible management information exposed on the F interface by an agent (an OS or WS currently assuming an agent role).

3.15 **Workstation objects**: Objects in the Workstation that have F interface interactions.

3.16 **user-management objects**: Workstation objects that represent managed objects in the Operations System.

3.17 **Workstation support objects** (in this Recommendation, also referred to as **support objects**): Workstation objects that are not user-management objects.

3.18 **OS**: As defined in Recommendation M.3010, with the following addition: Since WSF may communicate with OSF or MF in an OS, MD, or NE, the term "OS" is used for conciseness to represent "OS, MD, or NE" throughout this Recommendation.

3.19 Definitions imported from other Recommendations

This Recommendation uses terms defined in Recommendation M.3010:

– Telecommunications Management Network (TMN);

– TMN physical block;

– TMN function block;

– TMN reference point;

– TMN functional component;

– TMN management service;

– TMN managed area;

– TMN management function;

– operations system;

– mediation device;

– network element;

– operations system function;

– mediation function;

– security function;

– directory access function;

– directory system function;

– message communication function;

– information conversion function.

This Recommendation uses the following terms defined in Recommendations X.701 and X.703:

– manager;

– agent;

– shared management knowledge.

This Recommendation uses the following term defined in Recommendation X.200:

– association.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

DAF	Directory Access Function
DSF	Directory System Function
EFD	Event Forwarding Discriminator
ICF	Information Conversion Function
IT	Information Technology
MCF	Message Communication Function
MD	Mediation Device
MF	Mediation Function
MIB	Management Information Base
MO	Managed Object
NE	Network Element
NEF	Network Element Function
OS	Operations System
OSF	Operations System Function
OSF-MAF (A/M)	OSF-Management Application Function (in agent or manager role)
OSI	Open Systems Interconnection
SF	Security Function
SMK	Shared Management Knowledge
TMN	Telecommunications Management Network
UI	User Interface
UISF	User Interface Support Function
UMO	User-Management Object
WO	Workstation Object
WS	Workstation
WSF	Workstation Function
WSSF	Workstation Support Function

5 Conventions

The following conventions apply:

- Initial capitalization of names is used when introducing terms that are familiar to readers by their acronyms.
- Uppercase letters (F, Q in "Q3", and X) identify TMN physical interfaces.
- Lowercase letters (f, g, q in "q3" and x) identify TMN reference points.

In figures, the following conventions apply:

- Open circles represent TMN physical interfaces.
- Filled circles represent TMN reference points.
- Boxes with labels inside them represent TMN physical blocks.
- Ovals with labels inside them represent TMN function blocks or functional components.

6 Introduction to the F interface

This Recommendation provides requirements for the TMN F interface. The F interface is between a Workstation (WS) and a TMN physical block containing Operations System Functions (OSFs) or Mediation Functions (MFs). Operations Systems (OSs), Mediation Devices (MDs), and Network Elements (NEs) may contain OSF or MF. F interface requirements are independent of which TMN physical block supports them, so this Recommendation will use the term "Operations System" or "OS" to refer to OSs, MDs and NEs alike.

6.1 Why Is The F interface needed?

Recommendation M.3010, *Principles for a Telecommunications Management Network*, introduces the F interface. To enable human operators to interact with the TMN, a Workstation Function (WSF) must be present. When the WSF is implemented on a system physically distinct from an Operations System Function (OSF), those systems communicate via an F interface.

The F interface is needed:

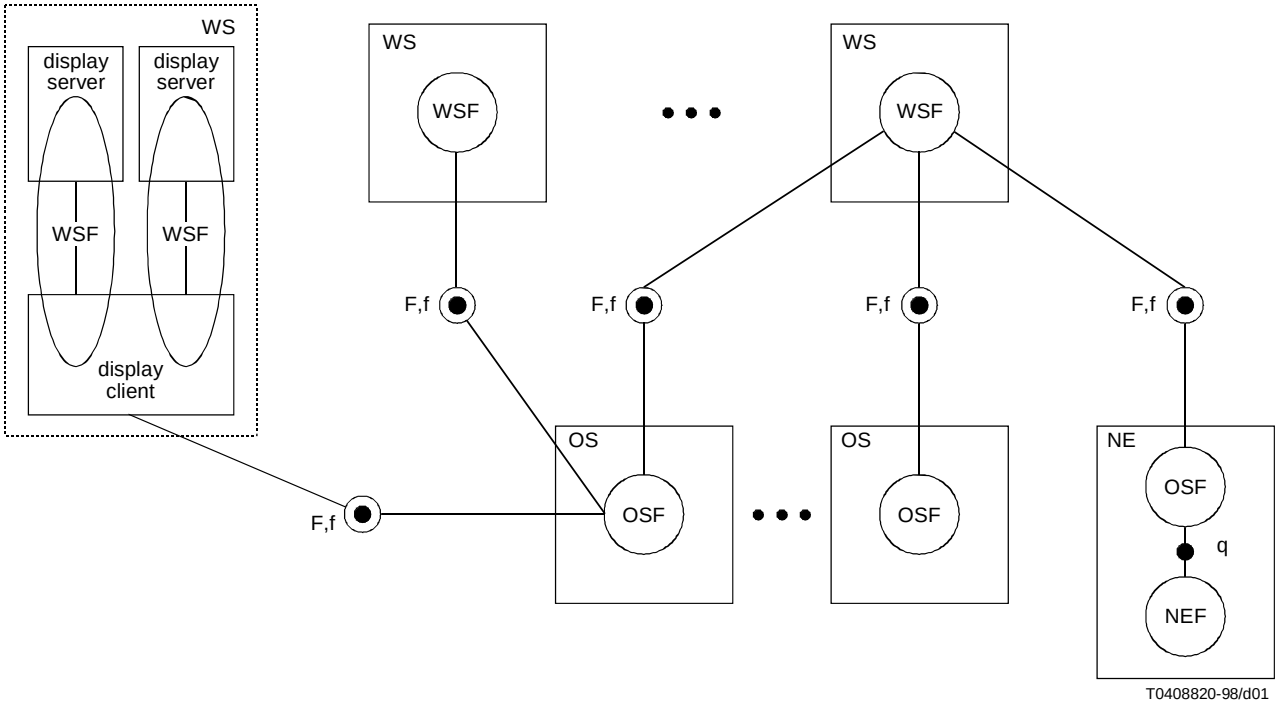
- for TMN interactions between a user and an OS;
- to allow for the interoperability of different systems within a TMN, including systems developed by different suppliers;
- to facilitate work centre re-engineering/consolidation that is taking place in the telecommunications industry;
- to allow for modular implementation of a TMN: an organization can change and upgrade various modules providing specified functionalities;
- to support efficient systems integration in a TMN;
- to allow User Interface (UI) software to be left alone when changes or rearrangements are made to OS functionality;
- to allow OS software to be left alone and changes made to UI software, taking advantage of advances in UI technology;
- to allow UI customization for an individual service provider, supporting a common look and feel.

7 F interface architecture

7.1 The F interface within the TMN architecture

The TMN architecture is defined in Recommendation M.3010. This Recommendation summarizes some of the architecture relevant to the WS and the F interface as an aid to the reader of this Recommendation M.3010 is the authoritative definition of the TMN architecture.

Figure 1 illustrates the relationship between some configurations of workstations and OSs in the physical and functional aspects. Workstation functionality can be distributed (see subclause 7.2, TMN functional architecture and the F interface) as illustrated for the display client and server in Figure 1.



NOTE – The dotted box represents a "distributed WS" that supports the WSF with functionality distributed over multiple physical boxes.

Figure 1/M.3300 – Example TMN F interface configurations

TMN architecture is defined in three aspects: functional architecture, physical architecture, and information architecture.

7.2 TMN functional architecture and the F interface

TMN function blocks provide the TMN with groupings of functions that allow the TMN to perform the TMN management functions. Pairs of TMN function blocks that need to exchange management information are separated by reference points. If the reference points become external, that is, the TMN function blocks are implemented in separate TMN physical blocks, the reference point is implemented as a TMN interface; the f reference point is implemented as an F interface.

The TMN function blocks that exchange information over an f reference point are the Workstation Function (WSF) block and the Operations Systems Function (OSF) block. The f reference point defines the service boundary between the OSF and the WSF.

Each function block contains several functional components, which are the units that provide a coherent set of TMN functionality. Functional components that may be found in a WSF are:

- User Interface Support Function (UISF);
- Security Function (SF);

- Message Communications Function (MCF);
- Directory Access Function (DAF).

Functional components that may be found in an OSF, that may interact with the functional components in the WSF, are:

- Workstation Support Function (WSSF);
- Security Function (SF);
- Message Communications Function (MCF);
- Directory System Function (DSF);
- Operations Systems Function – Management Application Function in manager or agent role (OSF-MAF (A/M)).

Figure 2 shows the functional components that are relevant for the f reference point, and indicates for each whether it is required or optional (from the point of view of the f reference point).

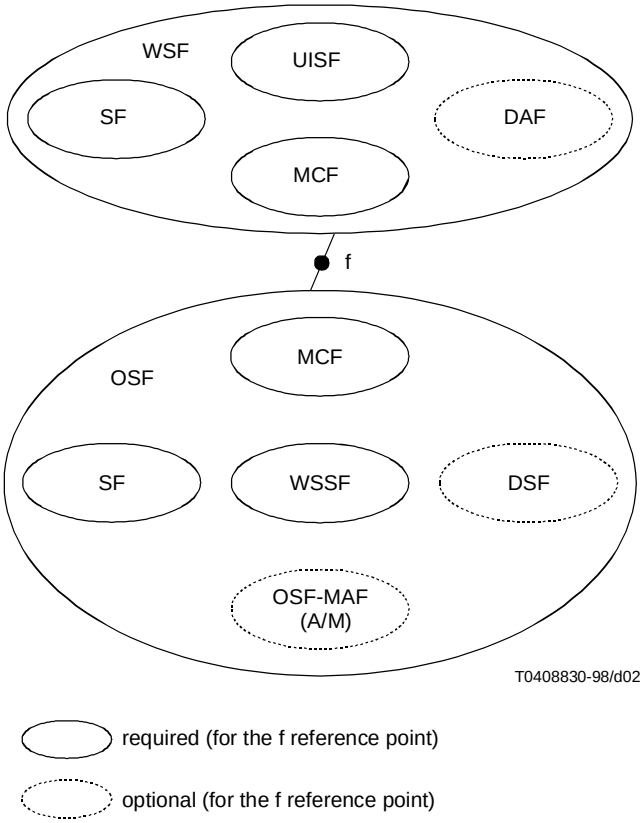


Figure 2/M.3300 – f reference point within the TMN functional architecture

The functional components unique to the F interface are the Workstation Support Function (WSSF), provided in OSF to support the WS, and the User Interface Support Function (UISF), provided in WSF to support the User Interface (UI). The WSSF and the UISF exchange management information in support of their TMN function blocks. The WSSF within OSF provides support for the WSF by:

- allowing data access, data manipulation;
- invocation and confirmation of actions;
- transmittal of notifications;
- hiding existence of Network Element Function(s) (NEFs), OSFs, MFs from WSF user communication with a specific OSF or MF;

- provides administrative support for WSF and access for administering the OSF.

The UISF within the WSF:

- translates information held in an information model to a displayable format for the Human-Machine Interface (HMI) or User Interface (UI);

- translates user input to a form used for information models;

- is responsible for integrating information from one or more sessions with one or more OSs such that information is presented in a correct and consistent form at the UI;

- functions similar to MAFs may be provided;

- functions similar to ICFs may be provided.

These WSSF and UISF functions impact F interface requirements as will be described in later subclauses of this Recommendation. As an example, the first three UISF functions enumerated above suggest the need for information structures within the WSF to allow the appropriate information to flow towards the user, appropriate information to flow towards the management system, and for management information to be retrievable in such a manner that its source is transparent to the user. See clause 10, Object management requirements, for requirements for such information structures.

The DSF is a local or globally available distributed directory system, which may be in any function block except WSF. It contains some portion of the directory information base. The DAF may be found in all function blocks; it is used to access TMN information in directory information bases. This interaction between DAF and DSF must also take place over a physical interface between a WSF and an OSF in separate TMN physical blocks. See clause 13, Location transparencies requirements, for more details.

There is an MCF associated with every function block with a physical interface. It generates application protocol messages, receives replies, receives events, matches up requests and replies, and knows the difference between a reply and an event. The implementation of the MCF is specific to the type of protocol exchanged over the interface. Communications across the F interface may be transaction-oriented or file transfer; the need for other communications styles is for further study.

The SF may be found in both WSF and OSF. See clause 16, Security requirements, for more details.

The WSF can be distributed such that different parts of the WSF can reside on different hardware. For example, detailed layout information (colours, pixels, etc.) can be sent to a terminal by a more powerful managing workstation. In this case the managing workstation acts as a "display client", issuing requests to update the display, and the terminal acts as a "display server" that responds to those requests. Examples of distributed WSF are provided in Appendix III/M.3010.

7.3 TMN Physical architecture and the F interface

The F interface is a physical interface that is manifested between two TMN physical blocks, i.e. a WS physical block containing a WSF and a TMN physical block containing at least one OSF. Note that if a physical block contains OSF as well as WSF, the physical block is not a WS, but an OS (or NE or MD).

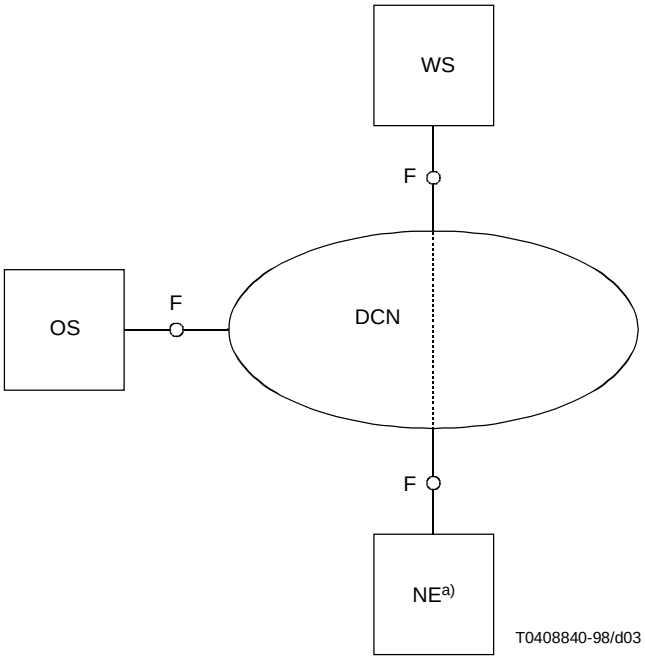
In Recommendation M.3010 a WS is defined as a terminal that has sufficient data storage, data processing, and interface support to translate the information between f and g reference points. The terminal provides the user with the capability to manipulate objects in a TMN Management Information Base (MIB), along with many other capabilities.

A WS can access several OSs and an OS may serve several WSs.

A WS communicates with another physical block (providing OSF) within a TMN. If a WS communicates with a TMN physical block it is by an F interface. This does not preclude a specific WS from participating in different TMNs in different instances of communications.

A WS may use both transaction-oriented and file-transfer styles in communicating with other TMN physical blocks. Most communication between the WS and other blocks is transaction-oriented.

Figure 3 illustrates the F interface physical architecture. (Note that the Q3 Interface is not shown.)



a) An NE may communicate with a WS over an F interface, if the NE contains OSF.

Figure 3/M.3300 – F interface within the TMN physical architecture

7.4 TMN information architecture and the F interface

There is management information exposed on the F interface by the OS and there may be, in some cases, management information exposed on the F interface by the WS. The latter is for further study.

This Recommendation will discuss manager/agent requirements on the WS and OS sides of the F interface. Manager/agent terminology is used in the discussion of Network and Systems Management. Managers make requests for operations of agents, and receive notifications from agents.

In this Recommendation, the term Management Information Base (MIB) is used to represent the visible management information exposed on the F interface by an agent. Management information and its representation in the WS or in the OS may be involved in exchanges over other interfaces or reference points. These uses are beyond the scope of this Recommendation.

The OS predominantly assumes an agent role, and the WS predominantly assumes the manager role, at the F interface. The system assuming the agent role at the F interface makes a MIB visible at the F interface. The system assuming the manager role at the F interface presents requests to the agent and receives notifications from the agent.

The information entities relevant at the F interface are discussed in clause 10, and illustrated in Figure 4.

7.5 F interface/f reference point and the g reference point

The g reference point represents an information exchange between a WS and a human user at the UI. It is outside the TMN. The g reference point conveys a translation of the information in a form that can be delivered to the user, and also brings input from the user. Layout of the data, colour, fonts, pictures, graphs, lists, etc, as UI objects are important. Also,

providing different representations of the same data based on user's requests is important.

Standardizing and optimizing the presentation of data to users is dependent on a multitude of parameters where each parameter can take on different values depending on the current situations. Some of the parameters involved are: UI software packages, Workstation hardware, user task requirements, user preferences, user training/expertise (in the task and also with the UI), user multitasking, software and hardware costs, etc. Therefore, it is not feasible to fully standardize the information exchange over the g reference point.

In contrast, the data involved in the management information exchange at the F interface is still at an internal representation level (not in human-usable form), being exchanged between an OS and a WS. The requirements for this internal representation level may be standardized and possibly the mechanisms of exchanging data in this internal representation between physical blocks may be standardized as well.

Language, character sets, culturally defined conventions, dynamic switching between languages/cultural conventions, turn-of-the-century dates and formats are all seen as important activities within the UI of a system. All of these information transformations will occur over the g reference point. The internal representation of data will be impacted only by requirements necessary to maintain that data in the most efficient manner. Converting that data to multiple display representations is most efficiently done in the UI of the WS and involves the g reference point.

7.6 Summary of architectural implications for requirements

The information on the F interface is object-oriented. The OSF, and the F interface, do not know what kind of user interface is used; it may be graphical, menu-based, command-line, etc. Therefore the information at the F interface is not the detailed specification of layout, colour, pixels, etc. provided by some graphical windowing capabilities. (The role of such a detailed presentation specification in the TMN architecture is described in *Distributed Workstation Function* in 6.8/M.3010 and III.1.3/M.3010.)

The F interface must allow the WS to access and manipulate data, issue commands and receive confirmation, receive notifications, access location transparency services, etc. (See lists in subclause 7.2, TMN functional architecture and the F interface.)

The F interface must support distinct associations between a workstation and one or more physical blocks containing OSF in one or more TMNs, and between a physical block containing OSF and one or more workstations.

8 TMN user's requirements impacting the F interface

Recommendation M.3020 defines a TMN user as "that which requires the TMN management services in support of its activities. It may be a human user applying for the use of services via some human-machine communication or it may be some computer-based organizational system requiring the capabilities of the TMN". For the purposes of this Recommendation, the TMN user is a human user. The requirements in this clause are based on the human users' needs which need to be supported via the F interface.

The TMN user exerts control over processes in the TMN; feedback must also be provided indicating the results/status. The functions required by the TMN user must be available at the workstation. But not all TMN tasks require the involvement of a human user. The F interface is not used in cases where there is no need for interaction between a human user and an OS.

In addition, work centre consolidation and re-engineering issues will significantly affect the F interface, since the sources of network management functionality will vary and content of network management functionality will vary. It is not productive to rebuild user interfaces to OSs with every work centre consolidation or re-engineering. It is also not productive to have human users interacting with multiple user interfaces either on separate workstations or on the same workstation.

Hence, it is desirable to present the TMN user with allowable services which the TMN user requests over an external interface. This permits modularization of OSs providing those services. Modification of the services can also be provided without a need to change the TMN user's UI software.

The TMN user's interests as a manager are embodied in the WS. The services that the TMN user requests will be those necessary to perform the tasks for which the TMN user is responsible.

8.1 General requirements

The TMN user needs a mechanism to generate a view of the physical and logical resources upon which the TMN user will make requests for services to be provided by those resources. The TMN user shall be able to request a view of the resources of interest on the WS.

The TMN user shall be able to request a view of resources that are physically or logically contained within a selected resource currently represented on the workstation (zoom function).

The TMN user shall be able to request the view of resources which have an explicit relationship with a resource currently represented on the workstation (e.g. retrieve resources that are explicitly supporting the represented resource).

The WS must allow the TMN user to set up at least one association with an OS. Some WSs may also support the ability to set up associations with more than one OS. Each of these associations is an F interface instance.

The TMN user shall be able to initiate and terminate an F interface instance.

The TMN user must be able to send a request for an operation, and to receive a response, across the F interface.

The TMN user must be able to receive event notifications (e.g. state changes) from the OS. The OS must be able to make event notifications available to the WS.

The TMN user needs to be able to request notification if certain events occur, e.g. creation of new objects that fit a certain pattern, alarms, state changes, etc.

The TMN user must be able to control the event notification mechanisms residing in the OS.

The TMN user needs a set of scheduling services to manage activities such as generating reports and testing activities. Scheduling services should minimally include creating, displaying, modifying, listing, and cancelling schedules or schedule entries.

The TMN user needs the ability to define and control the delivery of various reports. Report services should minimally include creating, displaying, modifying, listing, and deleting reports. Controlling the delivery of reports may be handled by scheduling services.

WS and OS Administration requirements are for further study.

The TMN user needs access to help facilities and on-line documentation. Whether this is a capability that crosses or impacts the F interface, or instead is more like access to screen definitions (which is not typical "management information" but may be a WS Administration issue), requires further study.

The WS may have capabilities that allow it to directly access the emergency action capabilities built into NEs. This capability is not necessarily within the scope of the F interface.

8.2 Task-related user requirements

There is a need to minimize management reaction times to network events; therefore, information needs to flow over the F interface in both directions most efficiently. This impacts event notification requirements, message transfer requirements, etc.

There is a need to minimize management traffic load on the telecommunications network.

There is a need to allow distribution of control over the network and control over portions of the network. Note, for example:

- Users can be in different geographical locations.

- Different users can be controlling different geographical portions of the network, or different technologies/services of the network, or applying different management functions to the network or portions thereof.

- Different users may also need to control the same set of resources.

There is a need to be able to locate and contain network faults.

There is a need to improve service assistance and interaction with customers.

There is a need to allow management of heterogeneous networks, equipment, and services.

Any TMN user may need access to any TMN management service for any TMN managed area. To execute these TMN management services, the TMN user will need to invoke TMN management functions as defined in Recommendation M.3400.

The UI software may use higher-level functions representing aggregations or sequences of TMN management functions, or may use TMN management functions directly. This does not imply that any single implementation of a TMN F interface must support all services and functions, but the F interface definition must encompass all such access.

9 Initialization requirements

At initiation of each instance of communication over the F interface, there may be an initial exchange of SMK (see Recommendation X.701). The ongoing exchange of SMK over the F interface is dynamic rather than static.

Associations must be established and terminated in real time and at the direction of the user.

10 Object management requirements

As noted in Recommendation M.3010, the information flowing across the F interface is object-oriented. There are Managed Objects (MOs) in the TMN that represent resources. These MOs themselves may be represented in the WS by additional objects which are referred to in this Recommendation as *User-Management Objects (UMOs)*. The UMOs, along with support objects in the WS, are *Workstation objects (WOs*; objects in the WS that have F interface interactions). Wos: communicate with MOs by operation invocations/responses sent/received over the F interface.

WOs, which may be thought of as application objects in the WS, are not subject to standardization. A WO may support multiple interfaces. The interface between the WOs and objects in the OS is subject to standardization. All other WO interfaces are not subject to TMN standardization.

The human user of the TMN, at the WS, interacts with a UI which may be graphical or character-based. The UI software interacts with WOs, translating user inputs to the WOs and translating WOs' information to a displayable form for the human user. WOs in turn interact across the F interface with the MOs in one or more physical blocks.

The concept of WOs in the WS must not require extensive information modelling comparable to that which has already been done for the Q3 interface. The WS must understand the information that already exists elsewhere in the TMN (in the OS). Therefore the critical definition is how the WOs relate to, how they are derived from, and how they create, MOs in the managed systems in the TMN.

The nature of the UMOs is critical to understanding the F interface requirements. From the point of view of the TMN user, they are managed objects (that is, they are managed by the UI software). From the point of view of the f reference point, they are managers (or manager-side objects). From the latter point of view, these are a new kind of object for the TMN, although objects that can both make requests and fulfil requests are in widespread use in other IT domains.

The factors that differentiate between UMOs and MOs, including their respective attributes and especially behaviours, as well as cardinality, are discussed in the following subclauses.

10.1 Relationships between WOs and MOs

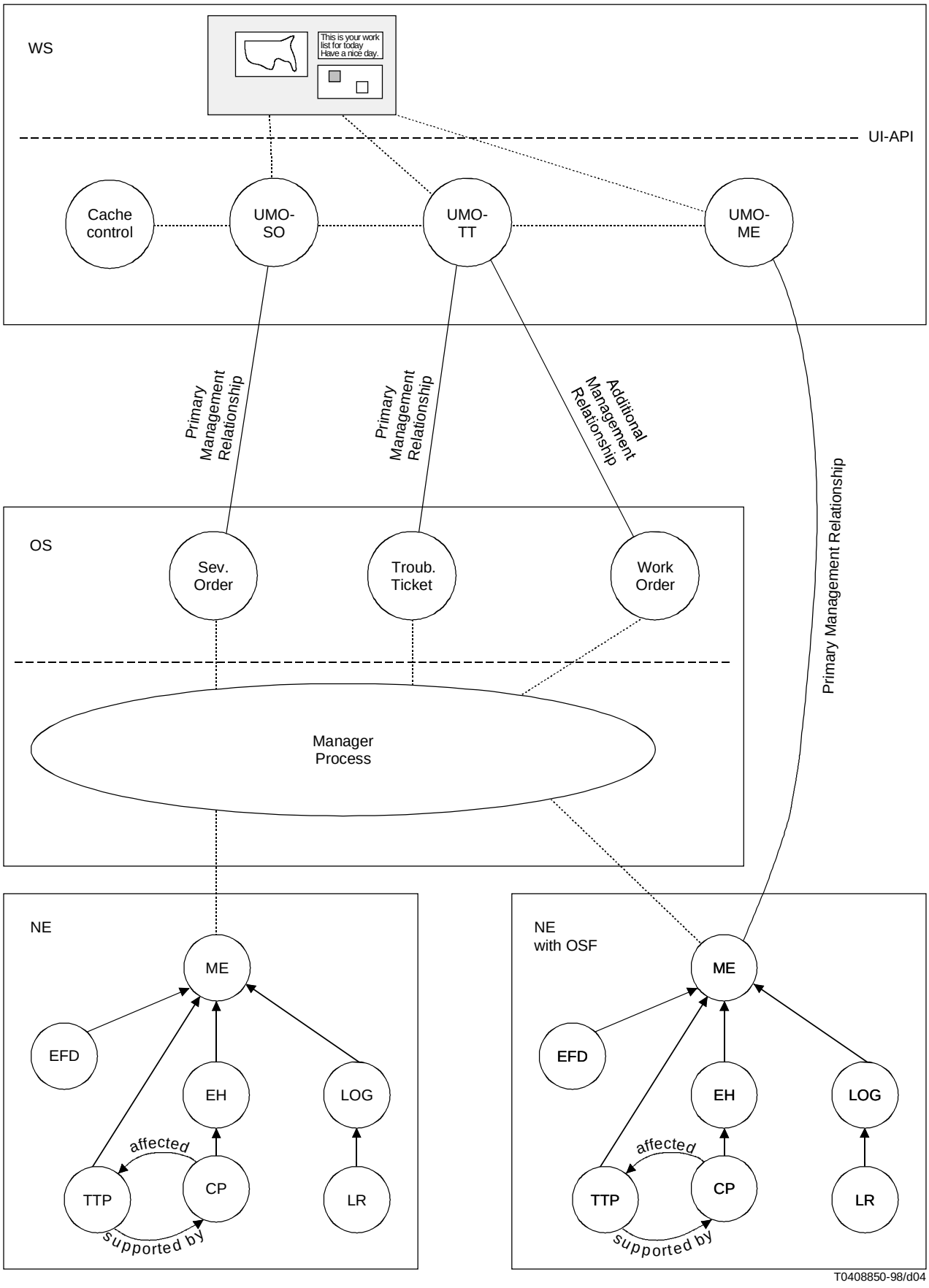


Figure 4/M.3300 – Object relationships between WS, OS and NE

Figure 4 illustrates a typical UI screen, interacting with some typical WOs in the WS, which interact with some common MOs in an OS and an NE; a manager process in the OS also interacts with MOs in the NE. Several of the possible relationships among these object types are shown.

In Figure 4, the light or dashed lines are for clarification only; they are outside the scope of the F interface requirements. The heavy lines represent interactions over the F interface.

The labels in Figure 4 are interpreted as follows:

In WS:

UI-API: the Application Programming Interface between UI software and the WOs.

Cache control: an object or process that controls caching behaviour (see below).

UMO-SO: a manager UMO representing a Service Order object in the OS.

UMO-TT: a manager UMO representing a Trouble Ticket object in the OS.

UMO-ME: a manager UMO representing a Managed Element object in the NE.

In OS:

Service Order: an agent MO representing a Service Order.

Trouble Ticket: an agent MO representing a Trouble Ticket.

Work Order: an agent MO representing a Work Order.

Manager process: a process in the OS that acts as manager to Agent MOs in the NE.

In NE*:*

ME: an agent MO representing a Managed Element resource.

EFD: an agent MO providing an Event Forwarding Discriminator.

TTP: an agent MO representing a Trail Termination Point resource.

EH: an agent MO representing an Equipment Holder.

CP: an agent MO representing a Circuit Pack resource.

Log: an agent MO providing a Log.

LR: an agent MO providing a Log Record.

NOTE – Some UMOs have a one-to-one relationship with MOs. The UMOs may have all the same attributes as their MOs. UMOs may also have more or fewer or different attributes than their MOs, but this relationship requires further study. In the simplest case a UMO represents its corresponding MO with the same attributes. But often, to meet the needs of the human user and support the UI, UMOs will have different behaviours than their MOs. For example, an MO may represent a work order. A UMO represents the same work order, but may include a behaviour that "reloads" or refreshes the information, either on-demand (requested by the user at the UI) or autonomously after the information has reached a specified "age" in the WS.

Some UMOs will not have a one-to-one relationship with MOs. For example, one UMO might represent all the MOs that meet a certain criteria, such as "all the switches in Kansas City". A UMO must have a means of identifying which MO(s) it represents.

10.1.1 UMO/MO cardinality

Some possible cardinalities of UMOs and their related MOs are shown in Figure 5.

In the One-to-One illustration in Figure 5, the UMO and MO are one-to-one. This may be the most common case where UMOs are used. This relationship is shown in Figure 4 between the SO-UMO and the SO-MO.

In the One-to-Many Primary/Secondary illustration in Figure 5, one UMO maps to many MOs. In this case the UMO is most directly related to, and representative of, one of the MOs. In Figure 4, this is illustrated by the Trouble Ticket UMO’s relationship to the Trouble Ticket MO. The TT-UMO might be created by the user, and cause the TT-MO to be created; or if the TT-MO is created by some other agency it might cause the TT-UMO to be created, or the UMO might be created by a user’s request to view a Trouble Ticket. The TT-UMO is also related to another MO. In Figure 4 this is

illustrated by the TT- UMO's relationship to the Work Order MO. If the user's creation of the TT-UMO caused the TT-MO to be created, the TT-UMO might also cause a corresponding Work Order MO to be created. The Work Order MO is not the primary relationship of the TT-UMO but a relationship does exist.

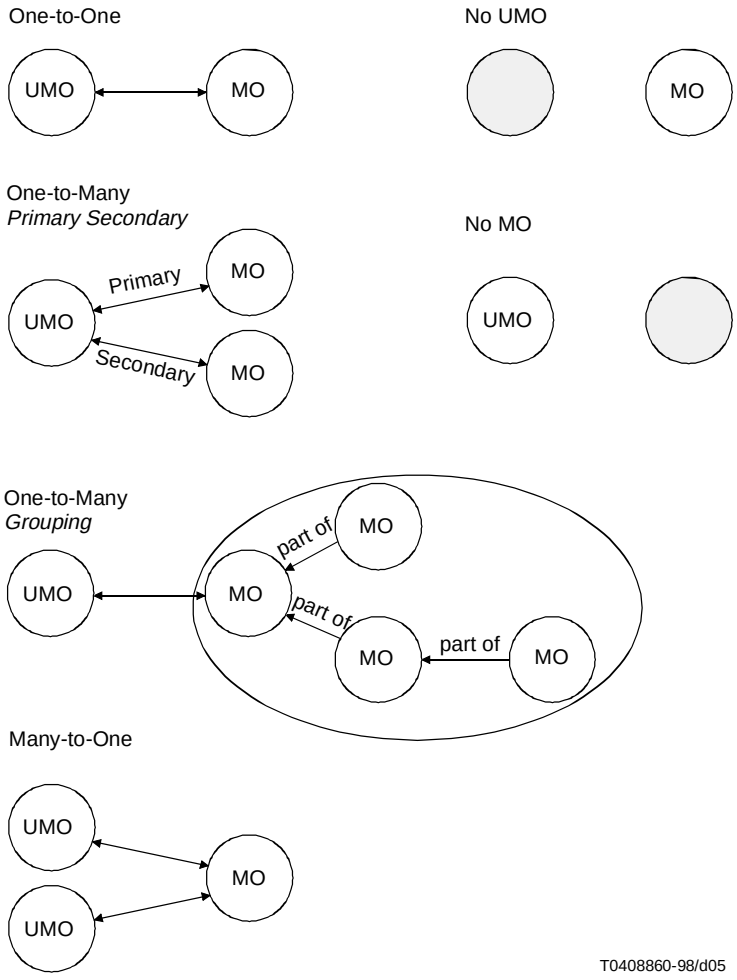


Figure 5/M.3300 – UMO/MO relationships

In the One-to-Many Grouping illustration in Figure 5, again one UMO maps to many MOs. However, in this case the relationship is hierarchical: the UMO's primary relationship is to one particular MO, but encompasses other MOs contained by the primary MO. This is illustrated in Figure 4 by the relationship of the ME-UMO to the ME-MO (in an NE with OSF functionality). In this case, the ME-UMO may provide a view of other MOs (EH-MOs, CP-MOs, etc.) contained in the ME-MO.

In the Many-to-One illustration in Figure 5, multiple UMOs map to a single MO. An obvious case of this situation is when multiple users, on independent WSs, have views of the same MO. However it may also occur within a single WS for design and implementation reasons (as discussed below).

In the No-UMO illustration in Figure 5, an MO exists without any UMO being related to it. This may be the most common case with respect to MOs. At any given time, most of the MOs in a system need no representation in anyone's WS, and many MOs may never need a representation in a WS.

In the No-MO illustration in Figure 5, a UMO exists without any corresponding MO. This occurs in the case of UMOs that do not correspond to MOs, but are needed to interact with other UMOs or other software in the WS or OS. Examples of these UMOs include test control objects, scheduling objects, and user access privilege objects.

The decisions regarding the appropriate relationships, when multiple UMOs or single UMO-to-multiple-MOs or other options are needed, are design and implementation decisions. Important factors in this decision include:

- the user tasks being supported;
- the structure of the MOs (the MIB) in the managed system.

When the WS receives a notification of interest, one or more UMOs may be created or modified. In some cases, such as a state change notification regarding an alarm or element, the UMO could maintain a "handle" or pointer to additional relevant information (such as a detailed alarm report) because it is likely the human user will shortly request the additional information. Whether a handle is maintained permanently or for a specified time is a design issue that should be driven by the expected demand for the handle's target.

10.2 Naming

There must be methods to map between names present within the WS manager and resources that can be managed.

There must be support for the introduction of objects associated with new versions of software.

The WS must support functionality that allows access to the MOs that are represented by UMOs.

Names must be appropriate for use by automated equipment/systems.

10.3 Retrieval services

The manager role can request of the agent role (which may require more than one interaction across the F interface):

- all data on a named object instance;
- all data on object instances related to the named object instance on the basis of a well-formed query. Examples of such queries include:
  - all data on next level of contained object instances of a named object instance (logical zoom or telescoping);
  - all data on n levels of contained object instances of a named object instance (discovery).
- attribute(s) values of named object instance(s);
- a named object to perform a chosen operation from a set of revealed operations/behaviours retrieved with the data on the named object instance.

The agent role responds to the manager role with at least one of the following:

- the requested data;
- request failed message with reason;
- an acknowledgement of the request along with a status of the request (e.g. still working on it).

10.4 Modification services

The manager role can request of the agent role:

- the named object's data be changed according to the manager's request.

The agent role responds to the manager role:

- Acknowledgement that the named object's data was changed accordingly

  This information could be used in the WS to maintain data integrity in its UMO: only upon receipt of this acknowledgement would the manager make the change in its representation of the management information (in its UMO).

- Request failed message with reason

  This information could be used in the WS to maintain data integrity in its UMO: the manager would make no change in its representation of management information (in its UMO).

10.5 Notification services

The agent role communicates spontaneously with the manager role to report notifications of events, alarms, state changes, etc.:

- Any changes in managed objects encompassed by the F interface instance that are registered with a notification service (e.g. an Event Forwarding Discriminator (EFD), in the OSI systems management paradigm) associated with the F interface instance.

Requirements for manager acknowledgement of receipt of the notification are for further study.

10.6 Create services

There are two categories of create services.

In the first case the creation of objects (MOs) is requested by the manager.

The manager role can request of the agent role:

- to create managed object(s) with the appropriate attributes.

The agent role responds to the manager role, either:

- acknowledgement that the object was created with the appropriate attributes;
- request failed message with reason.

An example of the first case will occur if the user requests the creation of logical objects to implement service for a customer over existing physical resources in the network being managed.

In the second case the creation of objects (MOs) has occurred in a managed system and the agent notifies the manager that the new objects (MOs) have been created.

The agent role communicates asynchronously to the manager role (if the manager has previously indicated a desire to receive these notifications that meet certain criteria):

- notifications that a new object has been created.

The manager role responds to the agent role, either:

- requests retrieval services on the new object(s) for the purpose of creating a UMO;
- makes note of the existence of the new object so that retrieval can be requested at a later time if needed.

An example of the second case will occur if a new circuit pack is put into service. A notification is sent over the appropriate F interface, if the manager role has requested notifications of new resources being made available that match whatever criteria the manager has specified, such as the identity and status of equipment within some geographical area. The agent is obligated to inform the manager only of the existence of the new object; the manager will determine what to do with the information.

NOTE – There is an additional create service that needs to be mentioned, where the user requests the creation of a UMO which will not in turn cause a request for the creation of an MO over the F interface. The UMO may be created to facilitate display purposes, to enable the storage of object relationship data, or to represent attributes and functionality of support resources needed within the workstation e.g. timers, schedulers, etc. These UMOs may certainly make requests to MOs over the F interface. How the UMOs are created is not subject to standardization at the F interface.

10.7 Destruction services

As with creation, destruction services can be initiated on either side of the F interface depending on different circumstances.

In the first case, the manager role requests destruction of MO(s).

The agent role responds to the manager role, either:

- acknowledgement that the object was destroyed. The manager may await receipt of this acknowledgement before updating its representation of the management information (destroy the corresponding UMO).
- request failed message with reason. Manager makes no change in its representation of management information (UMO not destroyed).

In the second case, the agent role communicates asynchronously to the manager role notifications that an object(s) has been destroyed, with reason if provided.

The manager role may respond by destroying the corresponding UMO(s) if they exist.

Destruction of MOs and the UMOs representing them involves destroying all subordinate objects, cancelling event notifications; all other references to objects in models are deleted.

NOTE – There is another case where UMOs are destroyed at the request of the user, but there is no request made of the agent over the F interface. The user may delete the UMO(s) if the user has no more need of a management view of the objects at the current time. The user requests closing that view of resources. The resources continue to exist and may be viewed by other users currently or by the same user at some future time. How the deletion is accomplished is not subject to standardization at the F interface.

11 Shared Management Knowledge requirements

11.1 Roles

The possible relationships between WS and a TMN physical block containing OSF are manager and agent. The roles may reverse between WS and OS depending on task.

One manager may be involved in information exchange with more than one agent. A separate manager role for each information exchange is needed. A TMN system may play the manager role to many systems seeing as many different information models; therefore, coordination and access issues are critical.

One agent may be involved in information exchange with more than one manager. A separate agent role for each information exchange is needed. A system in a TMN may play an agent role to many systems presenting different information models to each; therefore, coordination and access issues are critical.

An F interface instance must have a unique manager role and a unique agent role associated with it.

Shared Management Knowledge must exist between a manager role and an agent role.

The shared management knowledge can consist only of the functional view of objects present in the agent system which are visible over the interface and thus are visible to the managing system.

11.2 Establishment of Shared Management Knowledge

Shared Management Knowledge can be established and updated for an interface at the following times:

- prior to communication (system design or build time, or remembered from a previous association);
- during the interface instantiation phase;
- during the lifetime of the interface instance (discovery).

Prior to communication: Examples of shared management knowledge that can be present before the initialization of an F interface instance include:

- WO and/or MO version of support object classes (e.g. timers, schedulers, test control objects, etc.) may exist as templates;
- MIB schema information (e.g. class templates, relationships between object classes);
- support information (e.g. addressing/location information).

During the interface initialization phase: for example, UMOs within the manager role in the WS may be created representing resources or abstractions of resources or data/information synthesis objects within the agent role.

During the lifetime of the interface instance (discovery):

- requests by the manager role – initially by location transparency services or by retrieval of a containment hierarchy;
- events passed asynchronously to the manager role by the agent role.

Manipulating these UMOs will cause activity over the F interface so that the appropriate activity will occur on MOs, if it is allowed, based on access permissions.

Location transparency services (see clause 13) will allow for additional SMK to be obtained from the agent role over the life of the F interface instance.

12 Event registration/notification requirements

Event notification services must be provided by the F interface protocols to allow asynchronous communications between managed resources found in the MIB of the agent role and the corresponding manager role. Event notification services are a major mechanism in managing data consistency between different TMN physical blocks.

12.1 Receiving event notifications

Events will be passed to UMOs from MOs by some event distribution mechanism, if necessary, over the F interface if the UMO has been instantiated and is registered for/subscribed to the events. Examples of events include autonomous notification of configuration changes, state changes, and alarms.

Once the UMO has been created in the WS, it continues to receive event notifications, if registered for them, until the UMO is destroyed (this destruction does not imply the destruction of the MO). Distribution of subscribed events may occur within the WS; the managed object triggering the event does not need to know what objects (UMOs or other MOs) are going to receive the events.

12.2 Controlling event notification

Control of event notification should be similar to the usage described in Recommendation X.734.

UMOs must be available in the WS to manage event notification functions located in the agent.

Management of event notification management functions involves the following:

- begin, terminate, suspend, resume event forwarding;
- modify event forwarding conditions, retrieve event forwarding conditions;
- scheduling (on-duty/off-duty).

13 Location transparencies requirements

Since TMN architecture allows for distribution of TMN functions over multiple TMN physical blocks, it is necessary to provide mechanisms for locating essential information about network resources and their attributes. TMN systems need to know which other systems to associate with in order to accomplish their management functions. This information will need to flow between a WS and an OS via the F interface. These mechanisms need to provide:

- Naming/Addressing Support: the capability to refer to managed resources by name rather than address, the ability to determine the TMN elements involved in the management subsystem, the ability to identify an NE based on specific attributes.

- Association Resolution: determining the application entity title (or application binding handle) of an entity with which a management association may be established, presentation address of the entity, given a managed resource and the name of the management capability – being able to find the management agent that can provide the management functions.

These services can be provided using a request/reply communications model.

Some form of directory services will meet these needs. In this Recommendation, references to directory services (lower case) are generic and do not imply that X.500 Directory Services need to be employed.

14 Data consistency requirements

Over an F interface instance, the values of attributes in representations of the same resource (UMO versus MO) either physical or logical should be logically equivalent. Attribute synchronization is needed at the time of object creation, modification and destruction. Event notification requirements should handle some cases of modifications.

In addition, audit functions are usually provided in systems where it is necessary to verify that inherited or related data are in synchronization. Further study is needed to define the appropriate audit requirements for the F interface.

15 Quality, performance, and OA&M requirements

The items discussed in this clause represent some areas that need to be considered in architecting an F interface. Some examples include: performance, reliability, robustness, throughput, transit delay, scalability, software failure, backup/restoration/recovery, time stamping, dynamic software upgrades, other WS software management. It is not clear at this time whether any or all of these items will be requirements on the F interface.

15.1 Initialization performance

It is an objective that the initialization of SMK should occur within one minute.

15.2 Message transfer

The following items may affect F interface message transfer.

- Frequency – how often data is transferred across the interface boundary;
- Quantity – amount of data that is transferred over the interface at a given time;
- Throughput – how many simultaneous requests/responses can be handled;
- Transit delay – how long does it take for a user request to occur; determine buffering that may be tolerable;
- Accurate time stamping – time stamps should be accurate within five (5) seconds.

Data that is defined by application requirements (by human factors/ergonomics requirements, systems engineers, etc.) to require "immediate" availability, such as alarms in a critical monitoring situation, should have a latency (delay after occurrence in the agent) of no more than ten (10) seconds.

All data that is currently being "viewed" on the WS (whether a window is open or iconified; that is, when a UMO is alive and responsible for the user's access to that data) should have a latency (delay after its occurrence in the agent) of no more than one (1) minute. Note that a UI may indicate that data is "static" (i.e. a "snapshot") and give the user a means to refresh the data.

15.3 Reliability, availability, survivability

For further study.

15.4 Software management

For further study.

15.5 Real-time message management

For further study.

16 Security requirements

Security for the F interface is intra-TMN security. Physical equipment security, environmental threats and other security issues are not addressed.

The following subclauses present partial lists of security requirements but more may be appropriate.

16.1 User identification requirements

The TMN must provide a mechanism to uniquely identify all human users (user ID) within the TMN.

The TMN user's user ID is linked to all the user's auditable actions for an audit trail.

16.2 Authentication

Authentication services are necessary when initializing an F interface instance.

Authentication information is accessible only by privileged users such as security administrators.

During an authentication procedure no feedback other than valid or invalid will be provided over the F interface.

Further study is needed to identify the type(s) of authentication mechanisms to employ.

16.3 Access control

A TMN user cannot access any TMN physical block over the F interface unless the TMN user has been successfully identified and authenticated.

Access control is the responsibility of the TMN physical block serving in the agent role. Note that the WS may act as the "agent" to the UI software.

The TMN needs to provide access control to various classes of TMN users, where the class of TMN user is determined by the TMN user role.

Access control of resources is needed at different levels of granularity. There should be control over access to an individual attribute or operation on a specific resource.

16.4 Data integrity

The TMN must be able to reliably associate any communication over an interface with the origin of the communication.

16.5 Privacy

The TMN must provide confidentiality of information communicated over the F interface.

The TMN must support secure distribution of authentication material (e.g. keying material).

16.6 Auditing

The TMN must provide capabilities to track potentially unauthorized user activities after their occurrence. These capabilities are usually provided by the generation of security logs and audit trail reports.

17 Physical implementation requirements

If an f reference point becomes an F interface, the physical implementation of the WSF shall not affect the F interface. (It could be a distributed client server architecture or there may be multiple F interfaces to a WS.)

18 What's part of WSF but not part of the F interface

The interaction between the WOs and the UI software is beyond the scope of the F interface and this Recommendation.

Services to build relationships between WOs, that form part of the same F interface instance or form parts of different F interface instances, may be needed but are not the responsibility of the F interface.

The F interface is not responsible for integrating the information from more than one session/association.

The F interface requirements do not ensure that the user is accessing the correct set of managed objects (e.g. if one resource is affected, which results in an impact on another resource, will the object representing the affected resource appear on the user's screen?)

There are no F interface requirements on the relationship or dependency between F interface instances terminating on the same WS. (e.g. the user could be performing tasks in two completely disjoint OSs or areas of the network: alarm surveillance on subnetwork A and traffic studies on subnetwork Z.)

The user's view of objects and the user's desired interface to an object on the WS depends on the task context of the interaction between the user and the object.

Appendix I

Recommendation M.3300 (1992)

This Recommendation has evolved in scope and content since the previous version was published. To aid the reader, a mapping from M.3300 (1992) to this revised version is provided.

Previous clause	Revised version
1 – Introduction	Introductory material is provided in a new clause, Introduction to the F interface.
2 – Scope	Present in revised version
3 – Functional architecture	TMN architecture is defined in Recommendation M.3010. For the convenience of the reader and to highlight some implications on requirements, it is summarized in a new clause F interface architecture.
4 – Management capabilities	Discussed in a new clause, TMN user's requirements impacting the F interface.
5 – Management services	Discussed in a new clause. TMN user's requirements impacting the F interface.
Annex A – Management capabilities	TMN capabilities supported by management functions are identified in Recommendation M.3400. In this revision, no attempt is made to describe all the M.3400 capabilities (> 200) as they are reflected at the F interface.

Appendice II

Bibliography

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