EG 201 024 V1.1.1 (1997-05)

ETSI Guide

**Human Factors (HF);
User interface design principles for the
Telecommunications Management Network (TMN)
applicable to the "G" Interface**

European Telecommunications Standards Institute

Reference

DEG/HF-01030 (9hc00icq.PDF)

Keywords

HF, MMI, OMAP, TMN

ETSI Secretariat

Postal address

F-06921 Sophia Antipolis Cedex - FRANCE

Office address

650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16
Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

X.400

c= fr; a=atlas; p=etsi; s=secretariat

Internet

secretariat@etsi.fr
http://www.etsi.fr

Contents

Intellectual Property Rights

ETSI has not been informed of the existence of any Intellectual Property Right (IPR) which could be, or could become essential to the present document. However, pursuant to the ETSI Interim IPR Policy, no investigation, including IPR searches, has been carried out. No guarantee can be given as to the existence of any IPRs which are, or may be, or may become, essential to the present document.

Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Human Factors (HF).

The intention of the present document is to highlight key design principles that can be employed with benefit by designers of Graphical User Interfaces (GUI) for the management of telecommunication networks, whilst not constraining the individuality of the offering from various equipment suppliers. Its goal is to provide a reference to facilitate more consistent network management user interface designs.

Table 1: Intended users and potential benefits

	User	ETR used...	Potential benefit
1	Designers of TMN GUI User Interfaces	to highlight key graphical user interface design principles relevant to the management of telecommunications networks.	To facilitate interoperability of TNM user interfaces by the application of consistent design principles.
2	Software Engineers responsible for TNM Software Design	to highlight user interface design principles that may affect the structure of telecommunications network management software.	To facilitate the interworking of TNM software systems.
3	Other ETSI TCs and STCs	to provide a reference document for other ETSI committees relating to telecommunications network management systems.	Increased awareness of user interface design issues related to TNM.

Introduction

Telecommunication networks are invariably populated by a variety of elements and systems supplied by numerous vendors, many of which use their own proprietary approach for the network management user interface. This lack of consistency not only creates a problem in accessing information in these very complex systems but also increases operational and training costs to the users.

Whilst a generic user centred design approach is applicable to the design of the human to machine interface for telecommunication network management applications, its application will be limited due to the specialized and complex nature of the operational environment, and will not provide a complete and optimum solution. This document presents specific design principles that can significantly enhance the impact, usability and power of such user interfaces, as well as providing a degree of across vendor consistency in their operation. It is anticipated that certain specific design principles may impact the requirements, usage and usability evaluation criteria for some network management symbols.

1 Scope

The present document specifies a set of principles for the design of the human to computer interface for telecommunication management networks. It includes recommendations for the development of network symbols impacted by the adoption of specific user design principles.

The present document also recommends the adoption of a user centred design approach as being essential to implementation of these principles.

2 References

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

2.1 Normative references

[1] ANSI T1.232 (1995): "Telecommunications: Operations, Administration, Maintenance and Provisioning (OAMP) - G Interface specification for use with the Telecommunications Management Network (TMN)".

[2] ANSI T1.215 (1990): "Telecommunications: Operations, Administration, Maintenance and Provisioning (OAMP) - Fault management messages for interfaces between operation systems and network elements".

[3] ANSI T1.210 (1993): "Telecommunications: Operations, Administration, Maintenance and Provisioning (OAMP) - Principles of functions, architecture's and protocols for interfaces between operation systems and network elements".

[4] ITU-T Recommendation X.700 | ISO/IEC 7498-4 (1989): "Management Framework for Open Systems Interconnection (OSI) for ITU-T Applications".

[5] Fernandes, T. 1995: "Global Interface Design" Academic Press, Boston, ISBN 0-12-253790-4.

[6] Travis, D. 1991: "Effective colour displays, theory and practice", Academic Press, London, ISBN 0-12-697690-2.

[7] Uren, E., Howard, R. and Perinotti, T 1993: "Software internationalization and localization: An introduction", Van Nostrand Reinhold, N.Y., ISBN 0-442-01498-8.

[8] ETR 070 (1993): "The multiple index approach (MIA) for the evaluation of pictograms".

[9] ITU-T Recommendation X.731 | ISO/IEC 10164-2: "Information Technology - Open Systems Interconnection - Systems Management: State Management Function".

[10] ISO CD 13407 (Feb. 96): "Human centred design processes for interactive systems".

[11] ETR 116 (1994): "Human factors guidelines for ISDN terminal equipment design".

[12] ISO 9241: "Ergonomic requirements for office work with Visual Display Terminals (VDTs) Part 2: Guidance on task requirements".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following definitions apply:

G interface: A term used within ANSI T1.232 [1], ANSI T1.215 [2] and ANSI T1.210 [3] to describe the interface provided for the human user to perform OAM&P functions within the TMN.

graphical user interfaces: A user interface that supports graphical objects, symbols and windows, and uses direct manipulation for the control of the graphical objects. They may also support textual displays.

workstation: A device that supports the Work Station Function (WSF) as specified in ANSI T1.210 [3]. This includes but is not limited to personal computers and intelligent workstations, as well as equipment configurations with fewer or no graphical capabilities (ANSI T1.232 [1]).

Work Station Function (WSF): As specified in ANSI T1.210 [3].

3.2 Symbols

For the purposes of the present document, the GUI symbols recommended in annex B are defined in ANSI T1.210 [3].

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ANSI	American National Standards Institute
ATM	Asynchronous Transfer Mode
FCAPS	Faults, Configuration, Accounts, Performance, Security
GUI	Graphical User Interface
HF	Human Factors
ISBN	International Standard Book Number
ISO	International Organisation for Standardisation
NE	Network Element
OAM&P	Operations, Administration, Maintenance and Provisioning
OS	Operations Systems
OSI	Open Systems Implementation
SDH	Synchronous Digital Hierarchy
TMN	Telecommunication Management Network
UI	User Interface
VDT	Visual Display Terminals
WSF	Work Station Function

4 Design issues relating to network management applications

Network management application design issues are often specific to the domain due to the nature and requirements of telecommunication systems that are very different from those associated with word processing, for example. The key issues are:

- the time critical nature of telecommunication network management UIs;

- the need for a rigorous approach to ensure errors do not go undetected;
- users handle large volumes of data in real time (ANSI T1.232 [1]);
- handling multiple object types in a complex application environment.

4.1 Time criticality

The design of a fault management application should take into consideration that networks are real time systems. When system faults do occur they may be crucial to the continued operation of a sub-network or service and therefore demand immediate attention. It is essential that such information is proactively raised by the functional system and highlighted at the user interface for the attention of the network operator. This shall be done in a way that it minimizes the need for searching, reduces cognitive overload and optimizes user response time.

4.2 Rigorous approach

Because of the real time and complex nature of telecommunication networks, care should be taken in defining a coherent metaphor that matches the user's view of the tasks they need to perform. For example the metaphors based on a clerical interaction concepts such as "desktops", "folders", etc. may be of restricted use in this environment. Within networks carrying large amounts of traffic a failure to highlight a key fault could result in large areas of the network being taken out of service.

4.3 Large volumes of real time data

Network control centres can be likened to traffic control centres where from time to time large numbers of apparently isolated events may occur. Providing the user with assistance in prioritizing, filtering and managing these external asynchronous inputs is paramount in the design of effective network control applications.

4.4 Handling multiple objects

Typical network control applications for say configuration could encompass: central office switches, SDH equipment and, increasingly broadband access and ATM switches, together with a whole range of equipment within a network that can have diverse functionality and capabilities. As an entity they form the network and as such providing ways to deal with such complexity is essential.

4.5 Experience in the operations domain

Today many people are familiar with applications such as word processing and drawing packages. However, very few will have had the opportunity and insight gained by controlling an operations network in an on-line environment where it is required to handle "live" problems and events. A full understanding of the requirements for network management requires many years of experience. Developers may not have this experience, however, this disadvantage can be overcome by adopting a user-centred approach in which all stake holders, including representative network operator staff are involved.

5 Key network management design principles

This clause presents the design principles that should be applied to graphical user interfaces used for accessing and controlling telecommunications management networks.

5.1 Match functionality to the users' view

In the domain of TMN it is an essential requirement for the functionality provided in the interface to match closely to the users view and understanding of the management tasks. This principle has implications for both the type of functions provided for the user to perform their tasks and also the means with which they can access that functionality.

An approach that is widely adopted is the internationally recognized OSI 7 layer model for network management provides a list of five key user management task groupings within its Application Layer, see ITU-T Recommendation X.700 | ISO/IEC 7498-4 [4]. The users task groupings are defined as:

- faults management;
- configuration management;
- accounts management;
- performance management;
- security management.

This grouping is commonly known as FCAPS.

Adopting these categories as key functions within TMN systems can be beneficial as they are becoming well defined, are comprehensive, and may be applied across OSI and non OSI networks. In addition, these functions are widely accepted within the industry and can be considered as an important constituent of the user's view of the network management task.

Under the individual FCAPS menu bar heading, related functional groupings that match the users view of the network can be partitioned to effect management of the network. For example, in figure 1, the alarm monitor, fault verification, trouble reports and testing functions are grouped under the faults menu item. Adopting such partitioning benefits the users in terms of reduced search and learning times as they know at a glance where to access key functionality. Reference is made to annex A of the present document that outlines an approach that could be used to determine functional groupings and thereby enable provision of categories of user tool sets with appropriate partitioning.

NOTE: In the future with the ever changing technologies and services that may be run over telecommunication networks alternative approaches to the FCAPS scenario may evolve, however, it is considered that the high level principles contained within the present document should remain applicable.

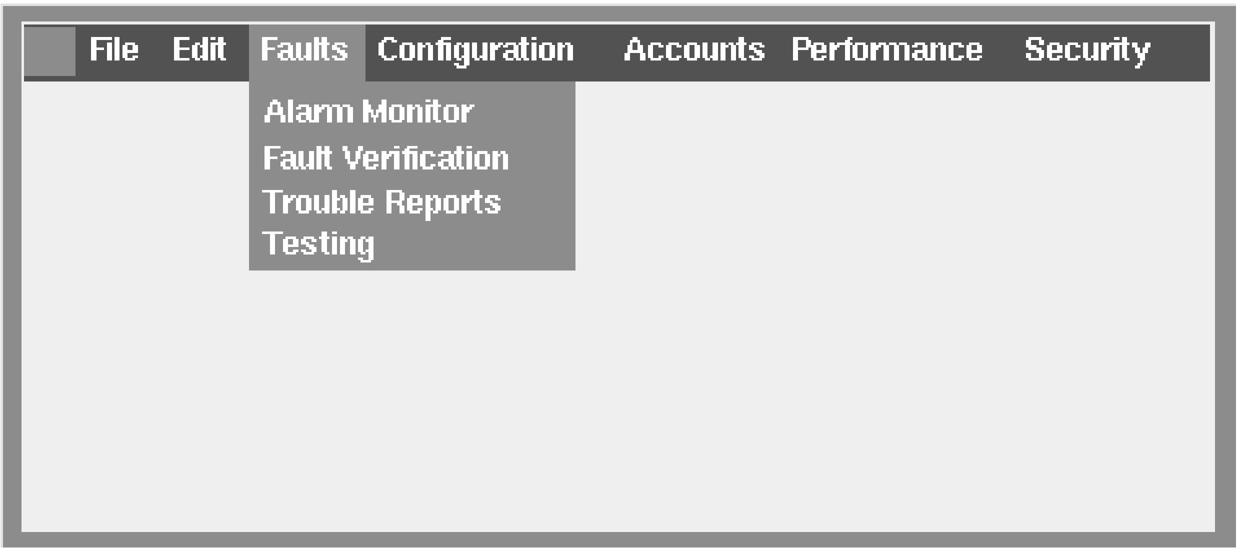


Figure 1: The FCAPS menu bar

5.2 Avoid information overload

The task of managing telecommunications networks is highly complex. With networks generating many thousands of events per hour, significant quantities of information need to be absorbed and processed by the user before decisions can be made and appropriate actions initiated.

One means of assisting the user in this complex task is to reduce the quantity of information to be absorbed by simply not presenting unnecessary and irrelevant information, or to filter out information that is not needed within a given context.

For example, when presenting a high level graphical overview of the network to a user performing a monitoring task, the key information elements required are a representation of the network elements, their status and some illustration of their geographical relationship and an indication of any alarms (see figures 2 and 3). Whilst figure 2 presents the network elements, their geographical location and relevant alarm warnings, the level of geographical detail overloads the user with information which serves only to dilute the visibility of the alarm indicator. A clearer representation is given by figure 3 without the loss of any information necessary for the users to perform their task.

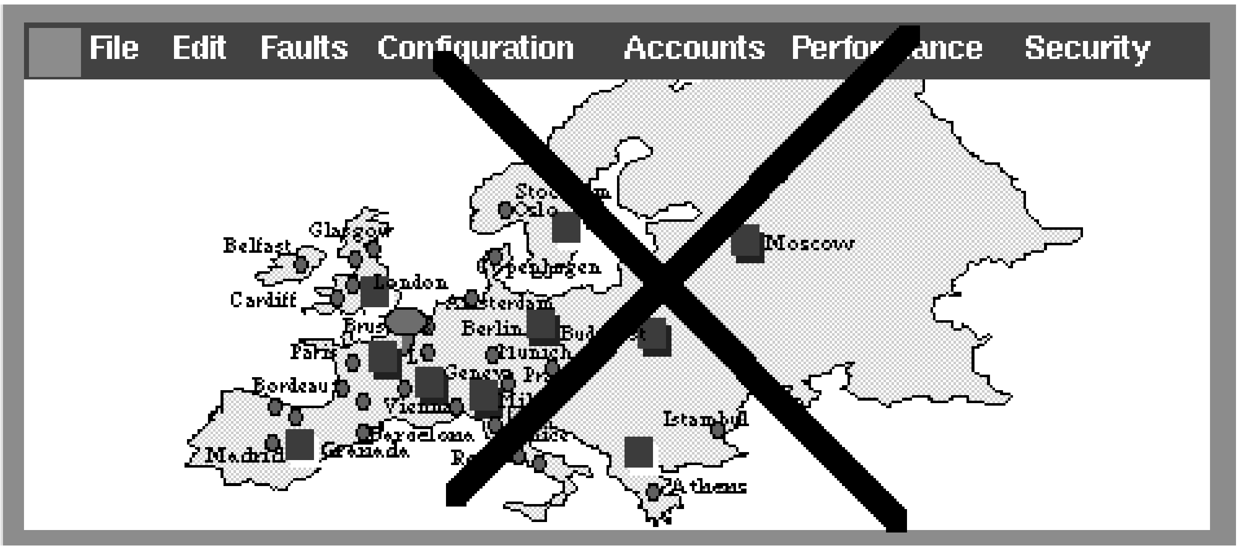


Figure 2: An example of information overload

5.2.1 Telescoping in place

The task of network management can be further assisted by minimizing the amount of user navigation required to access relevant information. Where it is clear from the task context in which the user is currently operating, then wherever possible, key information that would assist the user, should be brought automatically to the user level. An example is shown in figure 3 where a nodal alarm is automatically highlighted without requiring user action to locate it. The action of presenting key related information at the user level , without the need for user action is known as "telescoping in place". In this example, the "balloon icon" attachment to the original icon outline could be further elaborated to include details of the critical nature of the alarm.

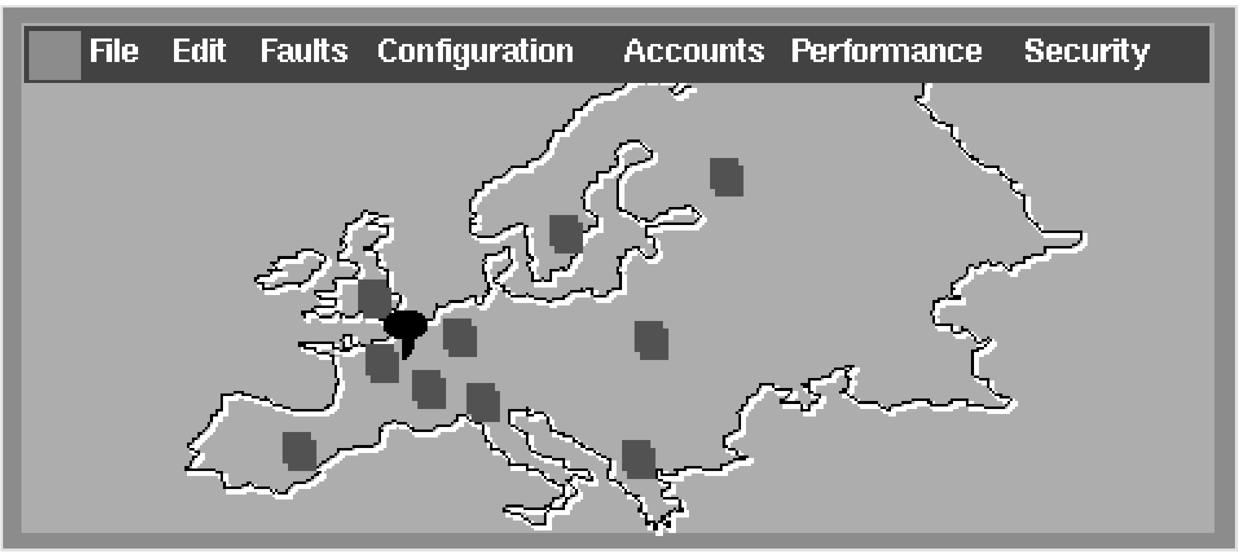


Figure 3: An example of the use of telescoping to reduce overload

5.2.2 Flattening the hierarchy

In the example shown in figure 4, the user has to chase alarm indicators through a number of logical windows, equipment views and alarm lists in order to obtain important information. In figure 5, the key information relating to, in this case fault information, but equally applicable to other network management functions, has been combined and located within a single window. The principle of combining relevant information and presenting it within a single window as shown in figure 5 is an example of flattening the hierarchy.

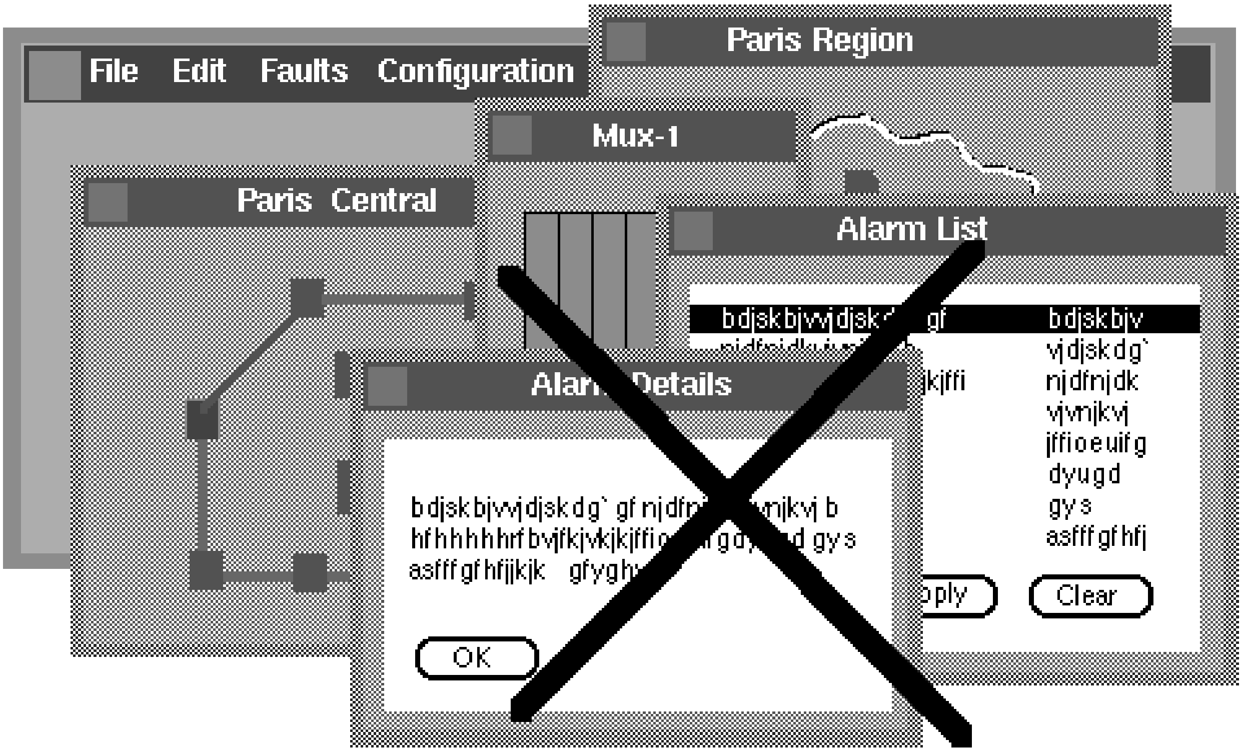


Figure 4: An example of a too deep hierarchy

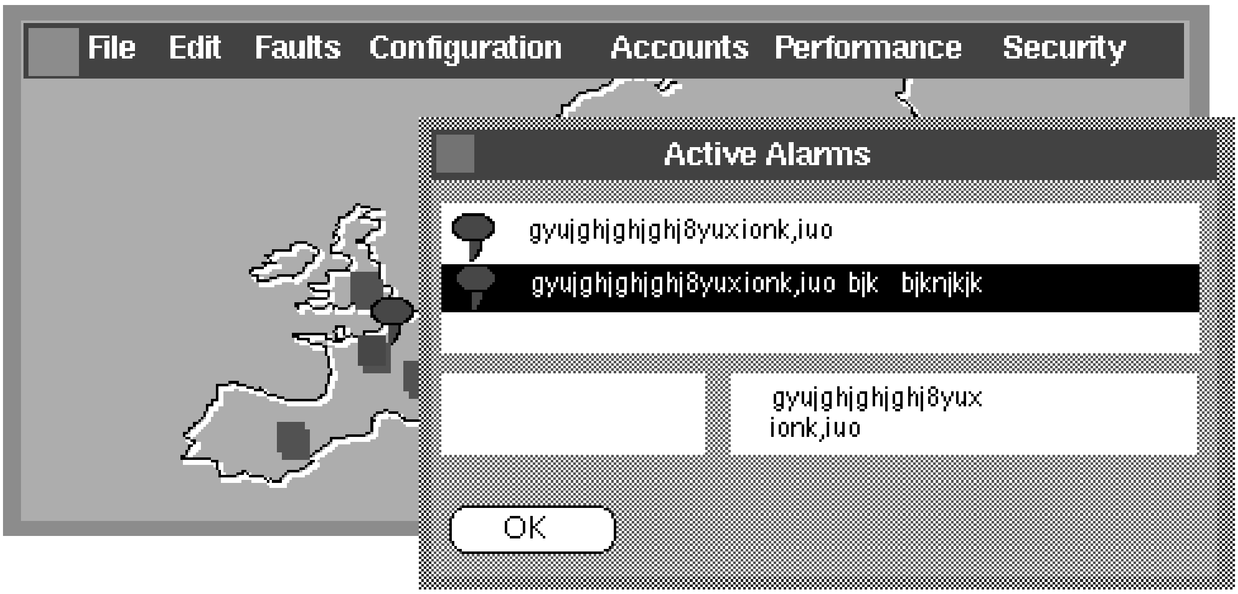


Figure 5: An example of a flatter hierarchy

5.3 Redundant coding

When important information needs to be brought quickly to the user's attention then the principle of changing multiple coding dimensions (often termed redundant coding) may be applied. Changing the graphical representation of an element in more than one dimension, e.g. colour, shape, location, size will make the element attract the users attention more easily than if only one dimension is altered (see figure 6). Adopting this strategy will also help cater for users with colour vision deficiencies and for changes in ambient lighting conditions.

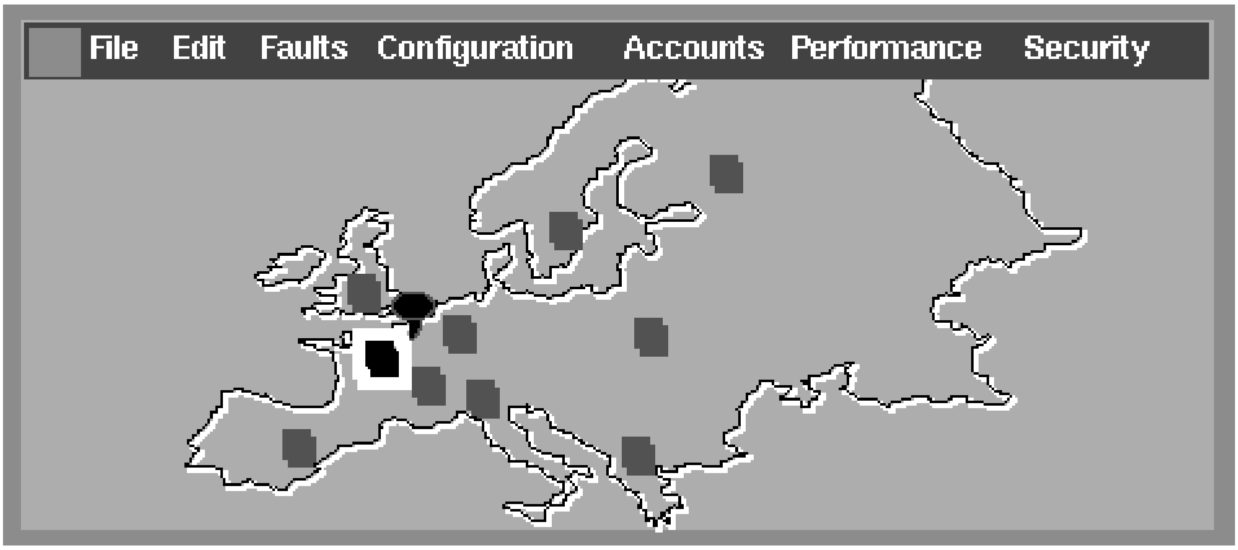


Figure 6: An example of redundant coding

5.4 Allow users to customize the interface

It should be recognized that the ETSI area of influence is not only limited to the European Union but extends to many countries in the world, with their own languages and culture and hence there can be a need to customize the interface design to suit the local requirements. To accommodate the requirements of the national perspectives as well as the "global" perspective consideration should be given to the issues mentioned below:

- communicate in the native language;
- support the natural writing symbols, punctuation's etc.;
- support native formats for date, currency, weights, scales, numbers and addresses;
- support natural work habits and the environment;
- communicate in a natural and inoffensive manner;
- sensitivity to the target culture.

NOTE: This is by no means a complete list, its aim is to raise awareness of some likely issues, see "Global Interface Design" [5].

An example of how user preferences can be accommodated within predefined limits for colour, text style, font size and sound, is shown in figure 7.

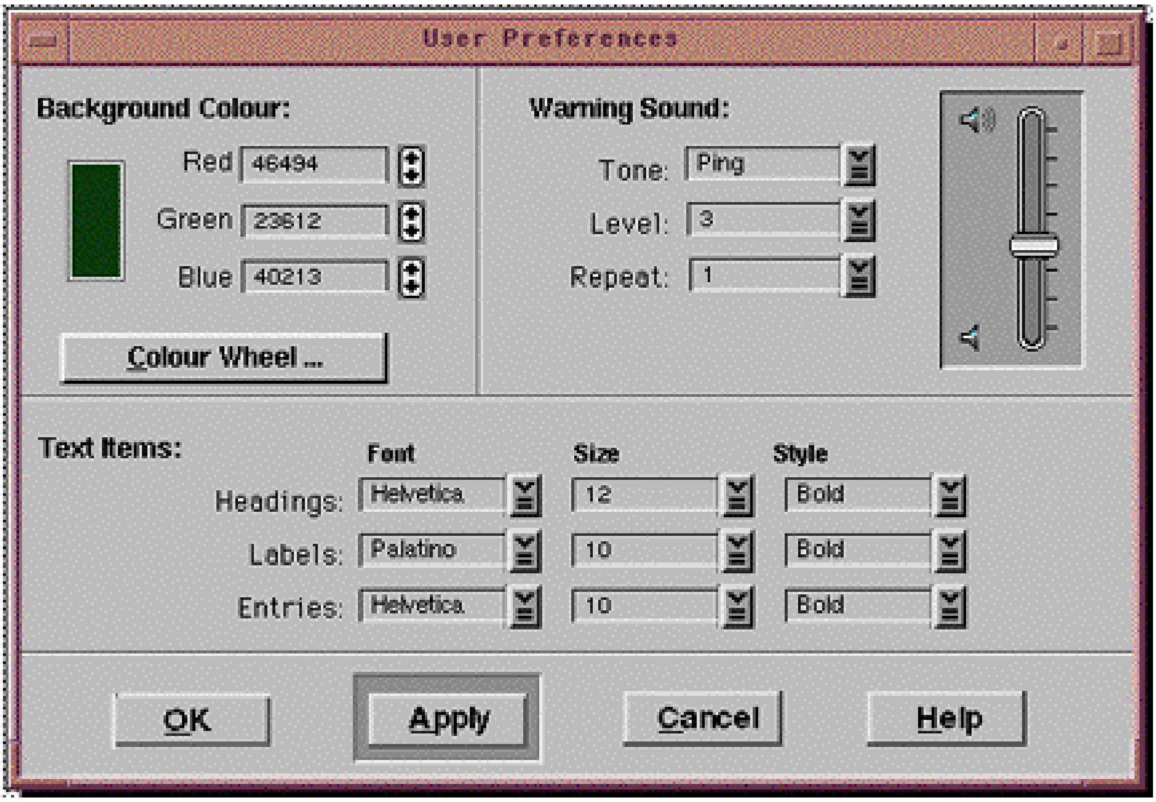


Figure 7: An example of interface customization

5.5 Colour

Sensitivity to the colour association of different cultures, can be important. Table 2 lists a set of symbolic associations with colour that apply in Western culture. However, it should be noted that even within a culture a given colour may have various interpretations e.g. red may signify, fault, take priority action, or "danger power on" depending upon the application context, hence, rather than use the table as a definitive statement it is far better to use the colours consistently, thereby enabling users to learn associations with colour (see "Effective colour displays, theory and practice" [6]).

Table 2: Colour associations in Western cultures

Concept	Colour	Percentage Association
stop	red	100
go	green	99
cold	blue	96
hot	red	95
danger	red	90
caution	yellow	81
safe	green	61
on	red	50
off	blue	32

5.5.1 Colour usage

Colour is useful for attracting a user's attention; it can increase the salience of an object. Colour is also useful for conveying information (i.e. coding) because it is effortlessly processed by people:

- in surveillance tasks, muted colours shall be used for steady state displays. Objects in this state should appear to blend into the background, while remaining visible to the user;
- objects which contain task relevant information or new critical information should be displayed using redundant coding techniques;
- displays should limit the of colours that are presented in the foreground. As a rule of thumb, four different hues can be displayed simultaneously without overloading the display;
- the background for a graphical display of information that is important to a users task and that contains coloured objects, such as the area within the outline of a network map, should facilitate distinguishing objects and their colours in the foreground;
- in the selection of colours for backgrounds and for the middle and foreground elements, the maximum contrast ratios should be reserved for those elements in the foreground. For example, black text on white ground provides a high contrast ratio and in general optimizes visual processing. Actual contrast is dependent on the display device being used;
- the backgrounds for windows of an application should be the same hue (but may vary in saturation) to facilitate user recognition of their relationship.

5.5.2 Colour coding

When colour coding is used the designer should consider the following points, see also "Effective colour displays, theory and practice" [6]:

- discrimination;
- detectability;
- perceptual equality of coding steps;
- meaningfulness;
- consistency;
- aesthetics.

5.5.2.1 Discrimination

It is necessary that the colours can be discriminated from each other by the predicted group of users. This can best be achieved by aiming for a large luminance contrast between the foreground and the background, e.g. light green on a dark blue background. It is also advisable to use colours that are "pure" in their group for areas used to convey key information. For example, red should be a true red rather than slightly orange or brown.

5.5.2.2 Detectable

The chosen colours should be detectable by the predicted user group under the ambient illumination of the network management control room. Consideration should also be given to the possibility of some users being colour blind, e.g. around 8 % of males have red-green discrimination problems, see "Effective colour displays, theory and practice" [6].

5.5.2.3 Perceptually equal steps

The discrimination steps between the chosen colours should appear approximately the same. If a set of say five colours is chosen in a user interface representation, then if two or more of those colours are similar, those colours will be associated together, whether or not they are intended to represent the same functionality.

5.5.2.4 Meaningful

The code should have relevance to the user. For example, red may well represent a major failure condition within the network that requires immediate attention, whereas yellow may signify a less urgent situation that is not catastrophic and can be dealt with at a later date.

5.5.2.5 Consistency

If the "major fault" option for example is coded in red on one screen, then it should be coded in red for all screens. Moreover, the colour should be "reserved" once it has been claimed for an option i.e. used only in that context.

5.5.2.6 Aesthetics

To be aesthetically pleasing use as few colours as possible and ensure that the chosen colours do not clash, causing the display to look garish and unattractive. An aesthetically well designed display will help users perform their task and assist in their ability to use it for many hours at a time.

5.6 Dialogue considerations

It is good practice to ensure that dialogue boxes have space available to accommodate non English text, assuming of course that the initial development has taken place in English:

- check out appropriate font - standard fonts vary with locale;
- leave space for text expansion, due to different language usage - do not use abbreviations (see table 3 extrapolated from "Software internationalization and localization: An introduction" [7]);
- layout and orientation of screen objects may differ.

Table 3: Examples of space requirements for translations

Number of characters in English	Allocate an additional character space
1 - 10	200 %
11 - 20	100 %
21 - 30	80 %
31 - 50	40 %
71+	30 %

5.7 Symbols

Whilst it is recognized that some network operators may require variants of given graphical symbols or icons to accommodate specific local needs, in the interests of consistency to facilitate interoperability between different suppliers, it is recommended that use is made of the symbols as defined in ANSI T1.232 [1] to define the type or class of network elements being referenced, for example, switching, transport and transport add drop (see annex B). Examples of how these symbols could be used within given icons to maintain consistency and good user recognition are shown in figure 8. It is recommended that all icons should undergo a usability evaluation, such as that defined in ETR 070 [8], to determine suitability for task.

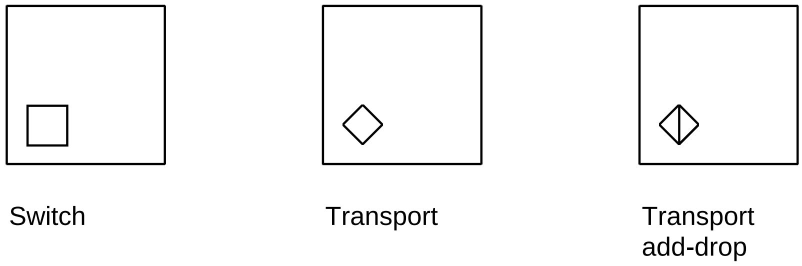


Figure 8: Examples of the use of symbol elements within a network element icon

5.8 Establish a consistent and complete visual language

A visual language is akin to a spoken one in that it empowers users to comprehend abstract events and objects through a clear and unambiguous taxonomy and lexicon.

5.8.1 Rationale

The visual language presented by the user interface is critical to the effectiveness and efficiency of the users. Language systems consist of two components:

- vocabulary; and
- grammar.

Vocabulary is the collection of elementary symbols, for example, letters and words.

Grammar is the collection of rules used to combine symbols.

People will respond to good visual design in specific and measurable ways. In particular the system and tasks will be easier to understand, easier to learn, and will be more engaging.

5.8.2 Design Implications

a) Contrast:

   - if elements are the same, make them look the same. If elements are different, make them look different.

b) Repetition:

   - create a series of common visual threads to tie the interface together by repeating one or more elements throughout.

c) Alignment:

   - every element should have a visual connection to another element. Do not position elements arbitrarily.

d) Proximity:

   - physically group related elements.

e) Apply the above - Contrast, Repetition, Alignment, Proximity, in a consistent way to the following visual attributes:

   - position, size, shape, colour, texture, composition, viewpoint, depth, and style.

In addition to the node classification shown in figure 8 the description of the states associated with a given network element should encompass the operational, usage or administration state as defined in IRU-T Recommendation X.731 | ISO/IEC 10164-2 [9].

5.9 Network views

The structure of network management systems varies from organization to organization according to such factors as their size and network coverage. Typically, however, such networks incorporate a centralized control centre linked to local regional centres. Staff within the centres are often responsible for specific tasks, e.g. performance monitoring and management, fault management and configuration. To support given tasks contextual information can be usefully provided by the use of geographic, logical and physical views of the network and network elements as follows:

- high level map;
- local detailed map;
- local view;
- racking system view;
- shelf view;
- concurrent views.

5.9.1 High level map view

At operational control centres it is often required to have a view of the network that can be used, for example, to monitor overall network status and includes the geographic location of the regional centres.

Again, applying the principle of avoiding information overload only sufficient information should be presented to the operator that is useful and informative. This could be as simple as indicating network management centres that are located locally, where the icons could also be used to indicate status e.g. operational, non operational, alarm, etc. A plethora of interconnection lines between the various management centres as seen in some designs is not to be recommended and should be used with care. An example is shown in figure 9.

Figure 9: An example of a high level geographic view

5.9.2 Local detailed map view

In situations such as fault management or configuration management it can often prove useful to present a detailed map of the local area network. Here again the emphasis should be to present key information that allows the task to be simply and easily accomplished. In the example in figure 10, the geographic location of network interconnections are shown in relation to roads and urban development. The user should be able to navigate the map freely and control the level of detail to be shown in a manner that is pertinent to their task.

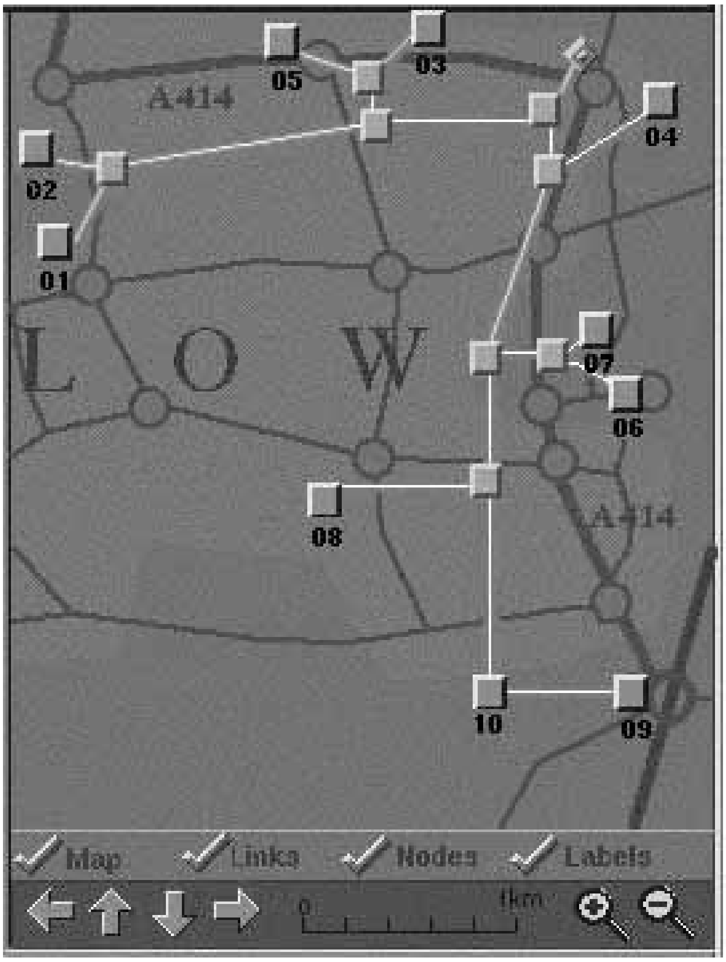


Figure 10: An example showing a detailed geographic view

5.9.3 Logical view

Alternative forms of presentation to the physical view in figure 10, can be provided such as the logical view of the local network as shown in figure 11. Logical views can show relationships between network elements with clarity in situations where a geographic view does not add value.

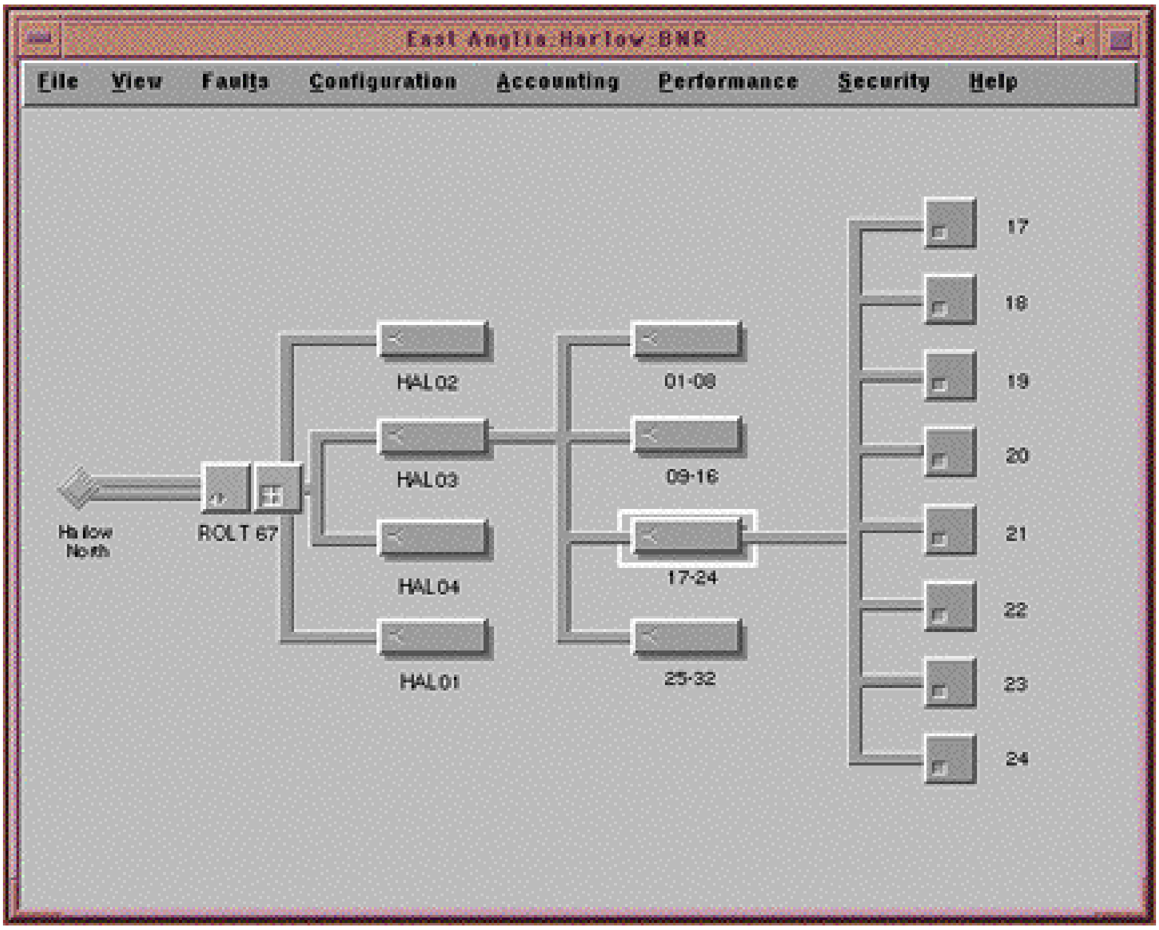


Figure 11: An example of a logical view

5.9.4 Racking systems representations

In situations such as configuration, or where network faults have occurred, it can be useful to enable the network management operator to focus down on the physical equipment utilized in the network. An example is shown in figure 12.

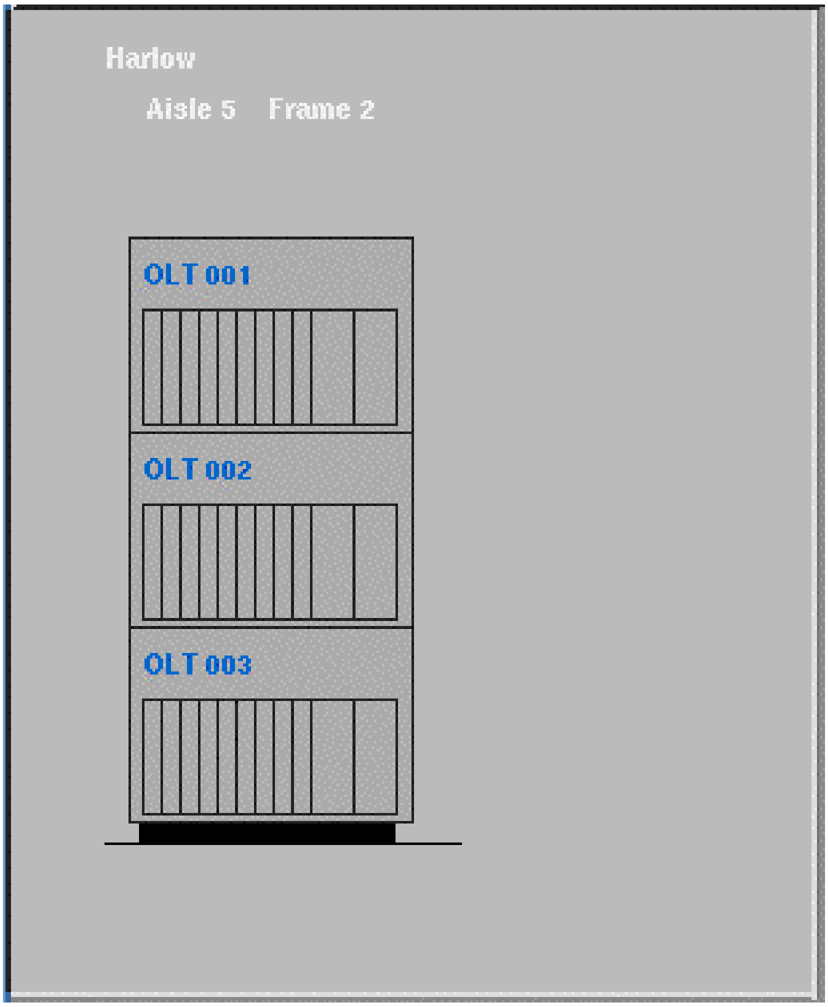


Figure 12: An example of a racking system representation

5.9.5 Shelf view

Again, when configuring the network or checking for a fault location, a physical view of the shelf housing circuit cards can be useful in providing on line information to the central network operator of the shelf status. In the example given, the dark grey shaded areas indicated unused positions for the location of circuit cards (see figure 13).

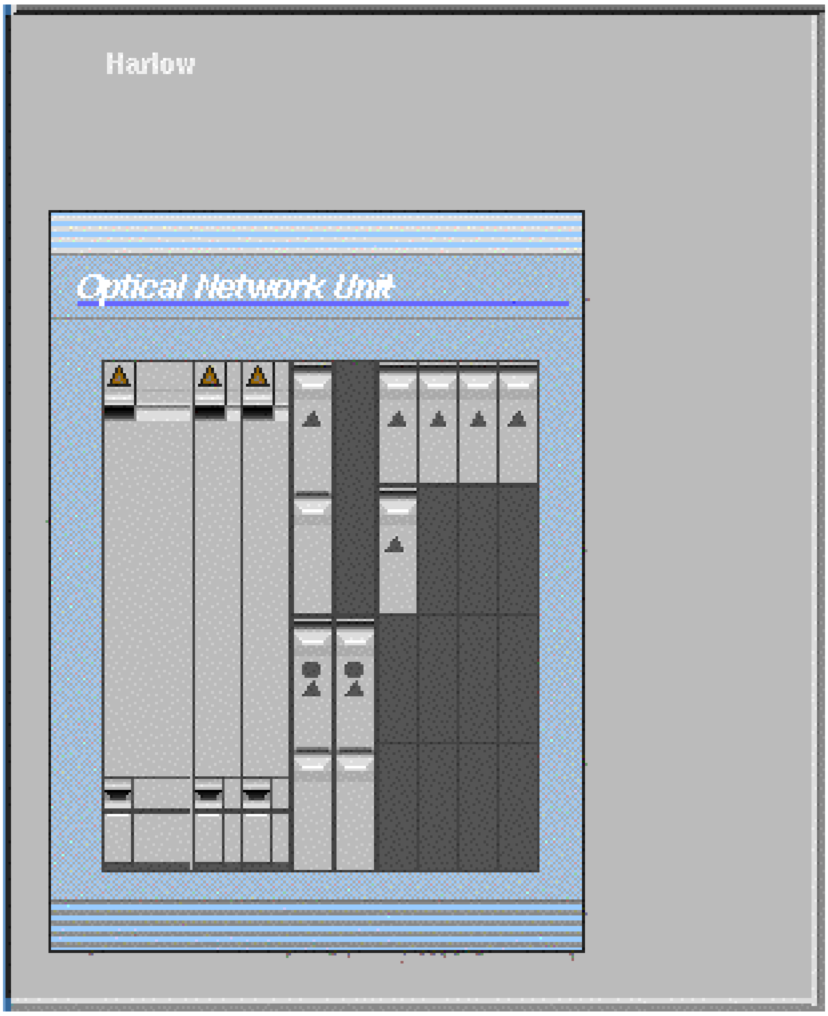


Figure 13: An example of a shelf view

5.9.6 Concurrent views

To ensure users can maintain a suitable context within complex tasks they should be allowed to generate multiple concurrent views of the network paths or elements. This is particularly useful for instance when the user is locating faults. In this case a user can benefit by having the ability to view details of several related network paths or elements at the same time, whilst maintaining an overall view of the network. The use of multiple views will minimize short term memory loading thereby reducing the possibility of errors. An example is shown in figure 14.

Some implications on the design of concurrent views are as follows:

- default parameters for window sizes and locations should be designed such that newly opened windows should not completely cover the previous frame;
- it should be possible to have open several different views of the network at the same time, however, care is needed to avoid screen overload.

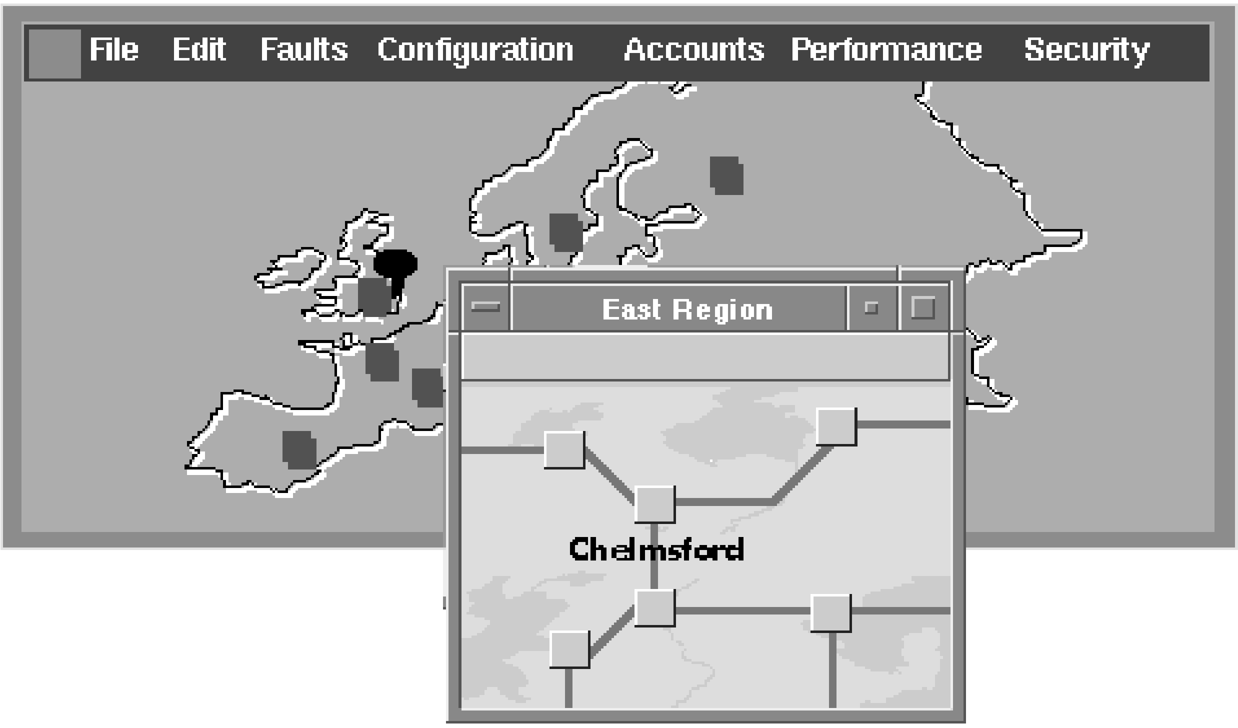


Figure 14: An example of a concurrent view

Annex A: The user centred design approach

A.1 Design approach

There are several documents which present a user centred design approach. These include ISO CD 13407 [10] and ETR 116 [11].

The recommended user centred design approach for the G interface of TMN systems is presented below. It is largely based on that given in ANSI T1.232 [1].

A.2 User-centred design

User-centred design is an approach to development that defines the interface based on a thorough understanding of the task, environment and specific users requirements. It involves designs that embody the way users think about performing their tasks. User-centred design enables the design of interfaces that:

- minimize the amount of learning required to use the interface syntax and semantics and allow users to focus on learning and performing network management tasks;
- maximize the correspondence between user interface semantics and efficient organizational methods and procedures;
- maximize the efficiency of the user-system dialogue; and
- minimize human error.

User-centred design requires a considerable amount of knowledge about the intended users, the tasks, and the task performance objectives and context. The best way to obtain this knowledge is through direct user contact. It is not possible to obtain this knowledge by imagining what users task structures might be and what the users might be like. Direct user contact may involve detailed task analysis and iterative prototype testing, both of which are important to the task of user centred system design.

A.3 Steps in performing user-centred design

A.3.1 Task definition

Within a user-centred design approach, OAM&P tasks are defined from the users perspective. This approach may lead to a user interface structure that differs from the underlying functional structure of a system.

In the absence of any existing standard on this topic, a process and procedure for user-centred design are identified here in order to assist users of the present document.

Firstly, task definitions (e.g. relieve traffic congestion) are derived from user interviews, or possibly job descriptions. The task definition includes:

1) initiation conditions for the task, e.g. the system parameters that require the task to be undertaken; and
2) termination conditions for the task, i.e. the goals of the task.

A.3.2 Task analysis

Secondly, a task analysis is performed. Task analyses are best performed by observing users perform a task, but may also be obtained from detailed user interviews. In general, a complete task analysis consists of the following data:

- a description of a typical users expertise both with the OAM&P system(s) and with the particular network management task;
- a list of all sub tasks, or steps, required to carry out the task;
- the user action(s) required to initiate each sub task;
- decisions the user shall make during the sub task;
- data necessary to make the decisions;
- identification of any sequential or temporal dependencies between sub tasks;
- feedback required to inform the user of the effect(s) of the users actions;
- potential sources of error and consequences;
- criteria for successful performance (including system parameters such as response time).

A.3.3 Task allocation

Thirdly, a task allocation takes place. This allows also for the possibility of changing and improving the task. In virtually every technically advanced network management system, many tasks will be automated. In deciding which tasks shall be automated and which will remain in the hands of the human user, one approach is to automate everything possible and leave what is left over for the human user. Unfortunately, this approach does not account for human performance effects like loss of vigilance and lack of practice that may result from boredom or inactivity. In addition, many event detection algorithms, in order to be conservative, generate so many false alarms that alarms lose their salience and are ignored or overlooked. A better task allocation process considers the possible effects of automation on the human performance parameters important to the overall goals of the task (see ISO 9241 Part 2 [12]).

A.3.4 Prototyping

This requires that a prototype(s) of the system be built to simulate system operation. At this stage, it is important that the prototype has an easily modifiable user interface. For example, an interface could be constructed using a throwaway software interface prototyping tool to provide a GUI "facade" that has no real network functionality, however to the user, it will appear real. The use of such a tool is particularly useful early on in the development cycle, where often issues are not clearly defined and changes can be expected. The prototype should simulate any known factors that affect human performance (e.g. ability to recognize major fault conditions without ambiguity, particularly when more than one occurs at a given time from different parts of the network, long response times, communication link failures, etc.). The prototype should be appropriate to the current stage of design process and may vary from a paper prototype to a full system user interface simulation.

A.3.5 Usability testing

Ideally using a prototype(s) iterative user testing can be undertaken. Prospective users who have not been involved in the design process, (or user surrogates matched in knowledge and experience) are allowed to use the prototypes to perform simulated tasks. During usage, these users are discreetly observed, but are allowed to commit errors. From an analysis of the error patterns among several users, inferences can be drawn about aspects of the user interface design that are likely to generate errors or inefficiencies in the final version of the interface. The testing process may be done only once if user performance matches the desired usability criteria on the first version, but it is far more likely that there will be several aspects of the interface that require redesign, and an iterative design approach will be necessary.

User-centred design, consisting of task definition, task analysis, task allocation and prototyping/testing, is the most effective procedure for user interface quality assurance.

A.4 TMN G interface design

Designing a specific G interface has two distinct aspects:

- the application domain; and
- the interaction elements.

The application domain is that aspect of the G interface that is specific to the network management application.

The interaction elements constitute that aspect of the G interface that specifies the workstation terminal features that help a user orchestrate the application functions.

Together, these aspects define the method of communication between the user and the system that supports user performance of OAM&P tasks.

The interaction-elements aspect and application domain aspect are interdependent, and should be combined within a user-centred design approach.

A.5 Application domain

The application domain aspect of the G interface involves the expansion of the TMN information model to support the user interface. This complex process includes the following steps:

a) evaluating the TMN information model and its object classes from the users perspective;

b) identifying the users mental model of the network and network functions;

c) determining the new object classes needed to bring congruence between the users mental model and the TMN information model.

The TMN information model and its object classes are defined in existing Operations System/Network Element (OS/NE) interface standards (such as the OAM&P messages in ANSI T1.215 [2]). These standards also specify the protocols required to communicate between an NE and its OS to support network operations. In order for a specific G interface to achieve the goals stated in this standard, the protocols for communicating between a user and the TMN will necessarily be different from those protocols specified in machine-to-machine standards. Additionally, while the TMN information model and the users view of the network may address similar information content, the information model shall be defined from a user perspective.

The second step requires a good understanding of the users expectations as well as knowledge of how the user views the network and the tasks defined in the OSI management categories (i.e. the users mental model of the network). This will indicate areas where the TMN information model shall be expanded to support the user interface in a manner consistent with the objectives of the present document.

The third step involves the use of object-oriented design methodologies to identify new object classes that will enable the smooth flow of information from within the users mental model to the TMN and back. This process is by nature iterative, and requires a thorough understanding of the issues addressed in steps a) and b) above. It is essential that this step be performed while keeping the user perspective in mind.

For example, the object classes shall be categorized in ways that reflect the users mental model. This includes understanding the user perception of the TMN OAM&P object domain and of the tasks that the user will have to perform on the objects. Important factors to recognize here include the frequency with which each task is performed, the phasing of performance of tasks, the types of users who perform the tasks, and other sequential and situation dependencies among the tasks. In general, the object classes will include the following five elements:

- a description of the object class;
- its relationship to other classes;
- restrictions on its usage;
- the specification of its attributes; and
- the specification of the actions that can be applied to its instances.

A process similar to that used to analyse object classes should be used to package the required functionality into appropriate tools and sets of tools. It is essential that:

a) the right set of tools be defined to allow users to efficiently manage telecommunications networks;

b) functionality is partitioned correctly among the tools;

c) the functionality to perform specific steps is available to users without unnecessary steps.

It is also important that specific tools may be flexibly assigned to applications as required by specific customer environments.

The final result of defining the application domain is that a new information model will be created that includes object classes from three areas:

- those already defined in the TMN;
- those defined specifically to support the user interface; and
- those which may be needed to represent new or unique elements not already included in the TMN.

The functional partitioning will also need to be optimized, within the task allocation phase. This process requires knowledge of the technical aspects of the object classes defined for the TMN as well as an understanding of the user task characteristics.

A.6 Interaction elements

The interaction-elements aspect of the G interface encompasses those elements which are not specific to the network management application, but which help a user manage the application and its functions. This aspect consists of the specification of three basic components: the presentation elements, the dialogue methods, and the administrative facilities.

The presentation elements are visual components of the user interface. Clause 6 in ANSI T1.210 [3] describes presentation elements that are specific to or especially important to the G interface; it also presents criteria for using these elements. Annex B of the present document describes a set of generic network element symbols recommended by ANSI T1.232 [1].

Dialogue methods constrain the manner by which a user communicates with the system. Presentation elements are used within the framework provided, by dialogue methods. ANSI T1.210 [3] clause 7 presents criteria for dialogue methods as used for network management applications.

Administrative facilities either administer the user interface or provide assistance in using the user interface. ANSI T1.210 [3] clause 8 defines a set of such administrative facilities.

Annex B: Network element symbols

B.1 Type and class of network element symbols

Figure B.1 shows examples of the symbols proposed to identify different network element classes, extrapolated from ANSI T1.232 [1].

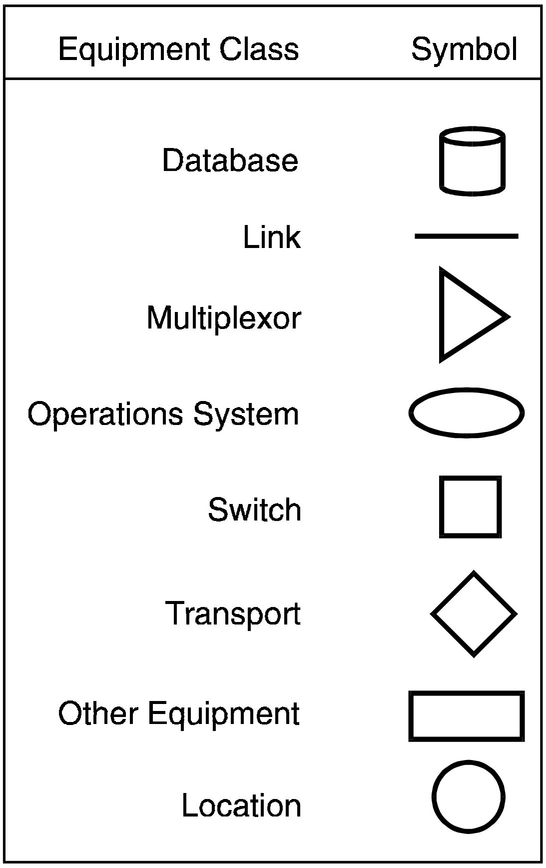


Figure B.1: Examples of the ANSI recommended network element symbols

Figure B.2 shows examples of how the proposed symbols may be enhanced to identify different equipment functionality, extrapolated from ANSI T1.232 [1].

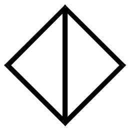
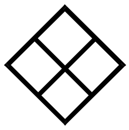
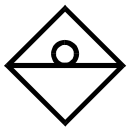
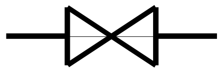
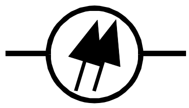
Class	Equipment	Symbol
Transport	Add-drop	
Transport	Cross Connect	
Transport	Loop Carrier	
Link	T Carrier	
Link	Fiber link	

Figure B.2: Examples of the ANSI recommended symbols enhanced to show different functionalities

History

Document history		
V1.1.1	March 1997	Membership Approval Procedure MAP 9719: 1997-03-11 to 1997-05-09
V1.1.1	May 1997	Publication

ISBN 2-7437-1555-3
Dépôt légal : Mai 1997