



Graphic Information Requirements for Telecommunications Management Objects Technical Specification

TMF 046

Member Evaluation Version 4.5

February 2003

EXECUTIVE SUMMARY

This document provides information about the way in which telecommunications resources are displayed at end-user workstations. In particular it deals with graphical user interfaces and the information requirements for displaying telecommunications objects such as links and nodes.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT
OBJECTS TECHNICAL SPECIFICATION

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ABOUT THIS DOCUMENT

TM Forum Documents

The Graphic Information Requirements for Telecommunications Management Objects Specification is being issued as a Member Evaluation Version 4.5. It can be considered valid until June 2003, at which time the TM Forum expects to update it to reflect comments from implementation experience, as well as to reflect additional member comment.

The purpose of an Evaluation Version is to encourage input based on experience of members and the public as they begin to use the document. Following the Evaluation Period, documents that are seen to deliver value are candidates for formal approval by the TM Forum. All documents approved by the TM Forum undergo a formal review and approval process.

This document will continue under formal change control. Further work will be reflected in revisions to this document.

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This document is based on Version 1.5 of the TMF406 Technical Specification Template

ABOUT TELEMAGEMENT FORUM

TeleManagement Forum is an international consortium of communications service providers and their suppliers. Its mission is to help service providers and network operators automate their business processes in a cost- and time-effective way. Specifically, the work of the TM Forum includes:

- Establishing operational guidance on the shape of business processes.
- Agreeing on information that needs to flow from one process activity to another.
- Identifying a realistic systems environment to support the interconnection of operational support systems.
- Enabling the development of a market and real products for integrating and automating telecom operations processes.

The members of TM Forum include service providers, network operators and suppliers of equipment and software to the communications industry. With that combination of buyers and suppliers of operational support systems, TM Forum is able to achieve results in a pragmatic way that leads to product offerings (from member companies) as well as paper specifications.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
Notice	ii
Acknowledgments	iii
About this Document	iv
TM Forum Documents	iv
Revision History	iv
Document Template	iv
About TeleManagement Forum	v
Table of Contents	vi
List of Figures	ix
1 Introduction	1
1.1 Document Overview	1
2 User Interface Context Description	2
2.1 Scope of Document	2
2.2 Architecture of Human Computer Interfaces	2
2.2.1 Network and Service Management System	3
2.2.2 Generic User Interface Objects	3
2.2.3 Telecommunications Presentation Objects	3
2.3 Definitions	3
3 Telecom Presentation Views	5
3.1 Background	5
3.2 Generic Entry Forms	5
3.2.1 Graphic Representation of the Managed Objects:	6
3.2.2 Browsing the Objects:	6
3.2.3 Arranging the Objects:	7
3.2.4 Editing of the Objects:	7
3.2.5 Tree Browsers Behavior	7
3.3 Table-Based Views	7
3.3.1 Graphic Representation of the Managed Objects:	7
3.3.2 Browsing the Objects:	8
3.3.3 Arranging the Objects:	8
3.3.4 Editing of the Objects:	8
3.4 Tree-Based Views	8
3.4.1 Graphic Representation of the Managed Objects:	8
3.4.2 Browsing the Objects:	9

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT
OBJECTS TECHNICAL SPECIFICATION

3.4.3	Arranging the Objects:	9
3.4.4	Editing of the Objects:	9
3.5	Chart-Based Views	10
3.5.1	Graphic Representation of the Managed Objects:	10
3.5.2	Browsing the Objects:	11
3.5.3	Arranging the Objects:	11
3.5.4	Editing of the Objects:	11
3.6	Geographical or Logical Network Views	12
3.6.1	Graphic Representation of the Managed Objects:	13
3.6.2	Browsing the Objects:	14
3.6.3	Arranging the Objects:	14
3.6.4	Editing of the Objects:	14
3.7	Equipment Views	15
3.7.1	Graphic Representation of the Managed Objects:	15
3.7.2	Browsing the Objects	16
3.7.3	Arranging the Objects:	16
3.7.4	Editing of the Objects:	16
4	Telecom Presentation Objects	17
4.1	Container	18
4.1.1	Brief Description of the Object:	18
4.1.2	Graphic Object Attributes:	18
4.1.3	Generic Container Behavior:	18
4.2	Network Node	19
4.2.1	Brief Description of the Object:	19
4.2.2	Graphic Object Attributes:	19
4.2.3	Generic Object Behaviors:	20
4.3	Links	20
4.3.1	Brief Description of the Object:	20
4.3.2	Graphic Object Attributes:	20
4.3.3	Generic Object Behaviors:	21
4.4	Trail	21
4.4.1	Brief Description of the Object:	21
4.4.2	Graphic Object Attributes:	21
4.4.3	Generic Object Behaviors:	22
4.5	Equipment	22
4.5.1	Brief Description of the Class	22
4.6	Circuit Pack	22

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT
OBJECTS TECHNICAL SPECIFICATION

4.6.1	Brief Description of the Object:	22
4.6.2	Graphic Object Attributes:	23
4.6.3	Generic Object Behaviors:	23
4.7	Shelf	23
4.7.1	Brief Description of the Object:	23
4.7.2	Graphic Object Attributes:	24
4.7.3	Generic Object Behaviors:	24
4.8	Equipment Rack	24
4.8.1	Brief Description of the Object:	24
4.8.2	Graphic Object Attributes:	25
4.8.3	Generic Object Behaviors:	25
4.9	Off-page Connector	26
4.9.1	Brief Description of the Object:	26
4.9.2	Graphic Object Attributes:	26
4.9.3	Generic Object Behaviors:	26
5	References	27
6	Related Standards Documents	28
6.1	ITU-T Telecommunications Management Network Related Standards:	28
6.2	Communication and Management Standards:	28
6.3	Transmission Standards:	28
6.4	Human Factors:	28

LIST OF FIGURES

Figure 1: GUI Components Illustration	2
Figure 2: Illustration for a Form view, with an object tree browser	6
Figure 3: Illustration of a Table View	7
Figure 4: Tree View	10
Figure 5: Illustration of a Chart View	12
Figure 6: Illustration of a geographic network View.....	13
Figure 7: Illustration of a logical network view	15
Figure 8: Illustration of an Equipment View	17
Figure 9: Illustration showing Two Containers, East and West.....	18
Figure 10: Illustration of Managed Element.....	19
Figure 11: Illustration of Link	20
Figure 12: Illustration of Trail.....	21
Figure 13: Illustration of Circuit Pack	23
Figure 14: Illustration of Shelf.....	24
Figure 15: Illustration of Equipment Rack	25
Figure 18: Illustration of Operational Software outside the hardware	26

1 INTRODUCTION

1.1 Document Overview

Telecommunications networks operators manage their infrastructure and services via user interfaces (UIs) to operating systems (OSs) and management applications. In the ITU M.3000 series Recommendations this user interface is identified as the “G” interface. Work on standardizing various aspects of this vital interface has been undertaken by various standards bodies. Examples include T1.232 - ANSI (reference 2) and ISO 9241 (reference 3), and Z.361 from Question 13 in Study Group 10 (reference 1) of the ITU. The “G” interface is critically important in the management of modern telecommunications networks. It is the primary view of the system available to the operator and the organization. Improper or inadequate design at this interface can result in significant problems in the network in terms of reliability and operational efficiency. This interface is referred to as a Human Computer Interface (HCI).

As telecommunications network technology becomes increasingly diverse, management issues have become more complex. This complexity requires improved and standardized network management system interfaces to increase the quality of service and reduce response times to customers.

This document provides information about the way in which real telecommunications network management objects are represented to the user on workstation screens and the information that is made available to the operators.

2 USER INTERFACE CONTEXT DESCRIPTION

2.1 Scope of Document

This document describes requirements for the “G” interface of the telecom operations environment. This “G” interface, identified in the ITU M.3000 series of requirements, defines the interface between the user and the workstation often referred to as a Human Computer Interface (HCI). M.3100, the generic information model specifies the objects and object classes that are relevant to information exchanged across standard interfaces in the architecture. In the model, objects at the “F” interface are translated into user management objects, and it is this subset that is relevant at the “G” interface. The objects in this document are the subset of M.3100 objects that are likely to be presented graphically on operators work station screens.

While these requirements could be used to implement any OSS application, they will be focused on supporting the implementation of TMF NGOSS business aware components. The UI requirements are based on standard available information technology. They strive to maximize usability and interoperability of NGOSS components while being flexible enough not to restrict areas that are currently considered proprietary or add high value to product offerings.

This document details the requirements for presentation objects and view paradigms specific to the telecom industry. For an OSS component to be considered TMF NGOSS compliant or for any OSS application to be TMF046 compliant, the user interface must provide the minimum properties described when using any of the constructs defined in this document.

TMF-046 deals primarily with the network layer. There may be other objects that would be presented graphically, for example from the service management layer. As industry identifies these, they can be added to later versions of this document.

2.2 Architecture of Human Computer Interfaces

The “G” interface software can be divided into the conceptual components shown in figure 1. This architectural description provides an improved means of specifying and understanding the complex relationship between the system and the user. Figure 1 shows three different classes of user interface presentation elements, namely, task managers, generic elements, and telecommunications elements.

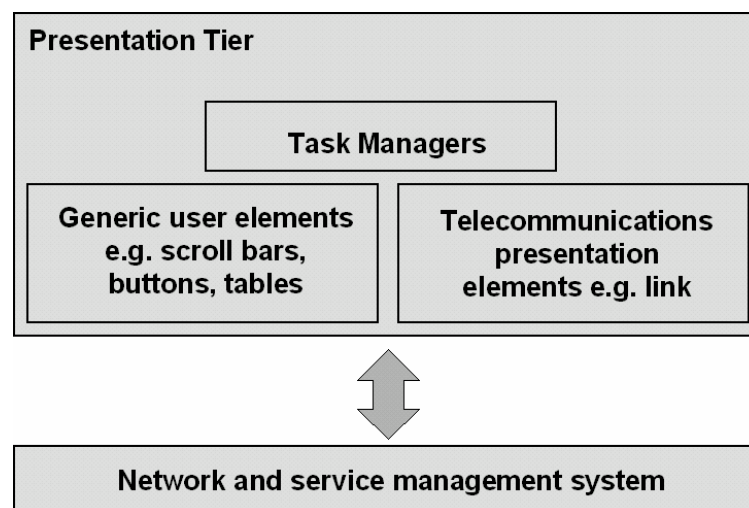


Figure 1: GUI Components Illustration

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

This document provides requirements for the telecommunications presentation elements in Fig. 2. Task managers are created when user interface designers and system developers assemble the various data displays and controls required for the management of a particular piece of technology such as a SONET ring. These are very specific to the technology and are where many companies see competitive advantage. However, the presentation of telecommunications objects should have a degree of standardization in order that operators quickly and accurately recognize the nature of the resource, its state or condition, and its relationship to other resources.

2.2.1 Network and Service Management System

The network and service management component represents the software that makes up the management system and also the data about the network elements and their interconnection. This data is typically specified in the underlying information models, for example, the ITU M.3000 series - Maintenance: Telecommunications Management Model.

2.2.2 Generic User Interface Objects

These are a set of elements such as buttons, windows, and scroll bars. These are defined by the specific user interface style or toolkit supported at the workstation (OSF Motif, Windows, JAVA Swing, etc.) and are aptly described in style guides provided by the manufacturer. These HCI elements are stable and common across the range of systems or products currently available in the market place. This document is not a style guide and provides no information about these generic elements.

2.2.3 Telecommunications Presentation Objects

These are the set of telecommunications specific objects such as network element symbols, link or connection graphics, and shelf level graphics. This document deals with the required information elements of these objects. There is a mapping between the system objects and the objects presented to the user. M.3300 describes these objects as User Management Objects (UMOs) which are created in the workstation and which are then represented to the user via the "G" interface.

It is the role of the Presentation object to change the management objects and models into user objects and models suited to the people who have to operate the network. Users will require access to the complete set of information available about a network object that may be made accessible via an operating system or application. There will be a relationship or binding between the graphic object which appears on the screen, the UMO, and the managed object.

This document deals with the minimum subset of the information that is generic. This subset should be displayed on the screen when any particular object is visible. For example, when an operator views a network with a number of regions with different vendors' equipment, the regions should have a standard set of attributes and behaviors. Further when the region is opened, the contained network elements should appear with a standard set of information. In human factors terms, the user benefits are:

- Easy to learn and remember
- Less likely to produce errors
- More efficient in accomplishing goals
- More pleasing to use

These are universal objectives for user interface designers and are at the root of the justification for this work.

2.3 Definitions

The following definitions include terms that may not be used in a standard way. They are presented for clarity and are not meant to be an exhaustive list of all the terms in the document.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

Link - An entity that defines a topological relationship including available transport capacity between two nodes in different subnetworks. In a graphic screen picture these links show up as the connections between nodes or network elements.

Domain - An administrative domain is a collection of managed entities grouped for administrative reasons.

Management System - An entity that manages a set of managed systems, which can be either NEs, subnetworks, or other management systems.

Network Element - A Network Element is a managed system, which is defined as a function of a user's scope. For example an NE may be a shelf containing a router for one user or a whole central office for another. It is a kind of container where network processing occurs. An NE may be realized as either a standalone device or geographically distributed system.

Trail - An entity that transfers information provided by a client layer network between access points in a service layer network. The transported information is monitored at the termination points.

Visual Presentation: Visual presentation includes the visual attributes: fill color, pattern, shape, font, border color and style, and drawing order.

Alarm collection: includes an indication of highest severity unacknowledged alarms and other alarms either acknowledged or of lesser severity. An alarm collection should be visible with no user action, or accessible by secondary mouse click and menu selection.

Zoom - The increase or decrees of a geographic or network view while maintaining the same data context. In a network view the user might be presented with a view of the network that was expanding to show more nodes across a larger area. Each step does not change the context of the data presented.

Drill-down (expand, collapse) - The change of levels of data and change in the data context. A graphical display changing from a province map, to a city view, to a building, a floor, an aisle, rack, and then the NE itself is an example of a drill down. Each step changed the context of the data presented. Double clicking an object is a form of drilling down.

Editing - This document uses the term editing in a number of cases. The operator as part of a task may be required to edit or change the parameters of an object. The application that controls this task would present the operator with a suitable screen for these changes to be made. Only after the application has determined the validity of the edits would the changes be made to the underlying data structures. These changes would then be reflected to the operator and would appear on the normal screens.

3 TELECOM PRESENTATION VIEWS

3.1 Background

All network management systems rely on some level of human intervention, whether for difficult fault isolation and repair, or for complex configuration tasks. The types of displays that are appropriate to bring the information to the network operator are of various sorts. For instance, regular entry forms and table-based displays are common, though they are not specific to the telecommunications industry. On the other hand, network management applications will require network representations, interactions and navigation paradigms that are very specific to the industry. The definitions of those displays, or views, as well as the various types of objects that populate those displays are the concern of the following sections.

A view is a rectangular space on a computer screen reserved for a coherent set of user interactions. In the old days, computer screens could only display a single, full screen view. However, with the advent of graphical user interfaces, the concept of an application window has been introduced, and one can generally conceive that a window contains a view. It is also possible to define several views coexisting inside a single window. For instance, one could imagine a window with an entry form to the left and a table to the right.

For the sake of clarity, we are hereby defining the various types of views that will be commonly found in the telecommunications industry. Namely, these are:

- Generic entry forms
- Table-based views
- Tree-browser views
- Chart-based views
- Geographical or logical network views
- Equipment views

Bringing the information to the network operator can be seen as a generic translation task depending on the view type. The real objects and data are provided by a network management system to a visualization layer that computes the appropriate graphic representation. In other words, the real business objects must be translated into graphic objects to give to the network operator the ability to understand and interact with the network. Various graphic objects according to the view type, user's preferences or role and application type, may represent a given real object.

The next sections will describe, according to each kind of view, how the managed object should be represented and will detail some interaction concepts that are common to every kind of view:

- Browsing the objects (like next, back, zoom, drill-down)
- Arranging the objects (like sorting, filtering, layout)
- Editing of the objects (creation, modification, copy, cut & paste, undo, redo)

Note: in the following sections describing views, (R) denotes a requirement whereas (O) denotes an option.

3.2 Generic Entry Forms

These are entry forms that are common to many data-driven applications, both inside and outside the telecommunications industry. These forms contain generic graphic objects, such as menus, buttons, text fields, combo boxes, drop-down boxes, etc. These objects are common to all GUI platforms used for network management applications, from UNIX to Microsoft to Java. Though we do not need to re-specify

these objects, it must be pointed out that these objects and their behavior are now an expected part of any application.

3.2.1 Graphic Representation of the Managed Objects:

One form generally represents one object from the network management system or a set of objects having common properties. A form consists of a panel including a set of graphic widgets on which the object's properties are mapped. The mapping depends on the property type. For example a Boolean property can be mapped to a checkbox or a combo box. A string property can be mapped to a text field.

3.2.2 Browsing the Objects:

When the represented object has a lot of properties, the form can be arranged as a set of tabbed panes to group the object properties by domain or semantic. Thus one way of browsing the properties of an object is to switch the visible pane. When creating user interfaces, care should be taken to not arrange properties in tabs reflecting the software architecture but in tabs corresponding to end-users' view of the structure of the managed objects or related to the user's task.

Additionally, when the same kind of form can represent many objects, the first widget of the form could be a drop down list of objects that allows easy switching from one object to the other. If the objects are arranged as a hierarchy, the form view can be associated with a tree view presenting all the visible objects. Thus another way to browse objects is to select one/many objects in the tree view to display its/their properties in the form view.

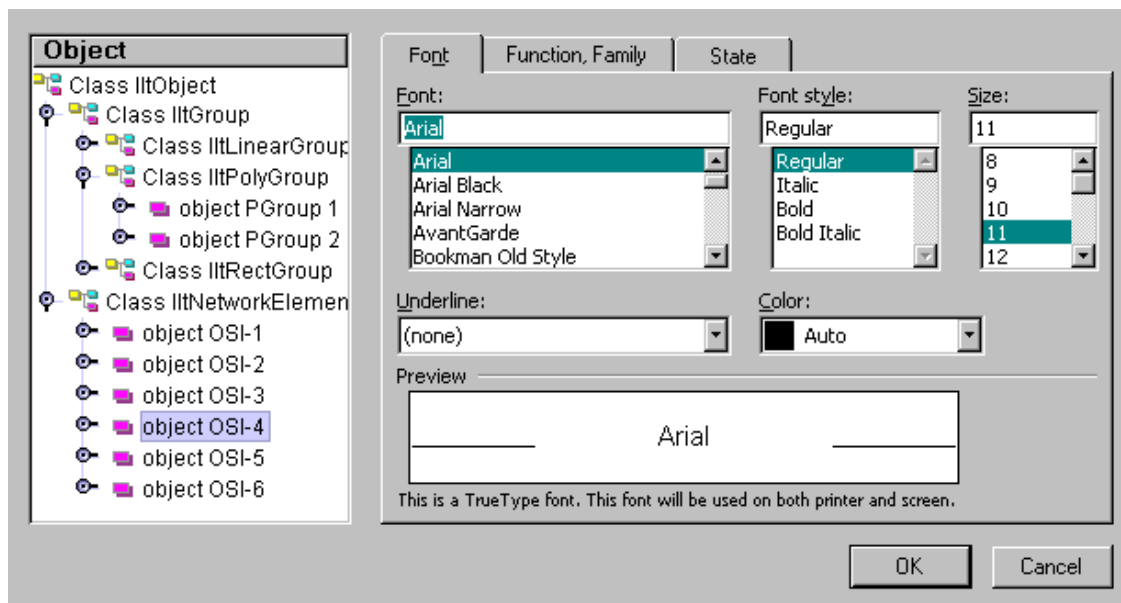


Figure 2: Illustration for a Form view, with an object tree browser
(This figure is not intended to imply any particular platform or toolkit)

3.2.3 Arranging the Objects:

Filtering can be used in form views, for example by showing only some of the object properties according to the operator's role/access rights, or by showing only some of the objects.

3.2.4 Editing of the Objects:

Form views can be used for inspection only or for editing the objects. According to the user's role, the task being performed and the property types, only some of the fields, or all of them can be made editable. Standard graphic gadgets used in forms like the text fields, choice lists or buttons can always be enabled or disabled so it is very easy to display editable or not editable properties.

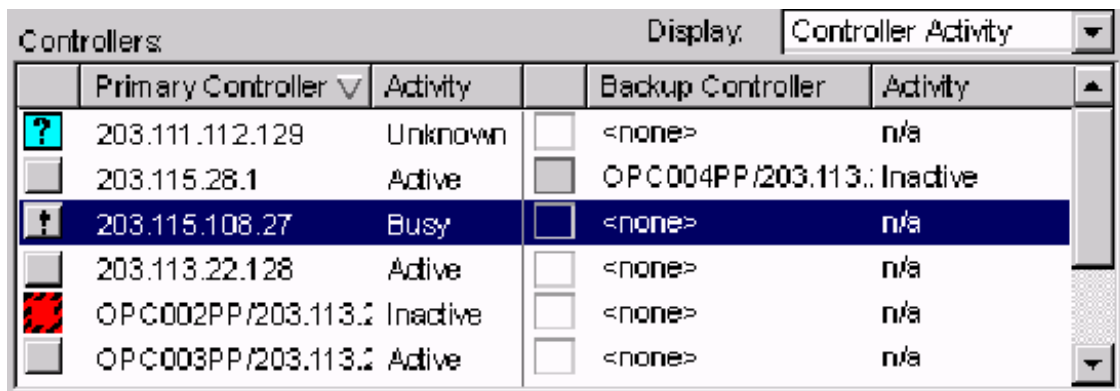
The form views are the most appropriate and most powerful views for editing the objects.

3.2.5 Tree Browsers Behavior

Tree browsers are generic widgets and have what is now standard behavior.

3.3 Table-Based Views

Table based views are spreadsheet like displays that are used to list large amounts of data. They are very useful in the network management area, for instance to display lists of network elements, alarms or events. In the field of network management applications, the table-based views must be presented to the user with the following capabilities. (The GUI builder typically provides these capabilities)



Controllers			Display:	Controller Activity
	Primary Controller ▾	Activity		Backup Controller
	203.111.112.129	Unknown	<input type="checkbox"/>	<none> n/a
	203.115.28.1	Active	<input type="checkbox"/>	OPC004PP/203.113.: Inactive
	203.115.108.27	Busy	<input type="checkbox"/>	<none> n/a
	203.113.22.128	Active	<input type="checkbox"/>	<none> n/a
	OPC002PP/203.113.2	Inactive	<input type="checkbox"/>	<none> n/a
	OPC003PP/203.113.2	Active	<input type="checkbox"/>	<none> n/a

Figure 3: Illustration of a Table View

(This figure is not intended to imply any particular platform or toolkit)

3.3.1 Graphic Representation of the Managed Objects:

A table is used to represent sets of objects.

(R) An object from the network management system is represented graphically as a row in the table

(R) The properties of the objects are represented at the columns of the table

(R) The table view maps graphically the value of a given property for a given object in each of its cell. The mapping depends on the property type. For example a Boolean property can be mapped to a checked cell, a state can be mapped to a cell containing an icon, an alarm severity can be mapped to the background color of the entire row.

3.3.2 Browsing the Objects:

(R) Browsing the objects presented by a table can be done using scroll bars

(R) Additionally, the columns and rows can be moved, resized, or hidden to show more or less information.

(O) When objects are organized as a hierarchy, table views can be associated with tree views where the tree represents categories of objects and the table represents the objects themselves (for example this is widely used in file browsers).

3.3.3 Arranging the Objects:

(R) The order of the table columns can be modified. The user can reorder the columns according to the property of the objects he wants to focus on.

(O) The rows of the tables can be sorted in ascending or descending order using the values in any column.

(O) Multiple column sorting should also be available. For instance, in a table presenting some network events, the events could be sorted both by date and then by severity.

(O) The visibility of the columns can be modified individually.

(O) A table can be filtered using patterns on the cell values. Filtering patterns may be user defined via a text field or predetermined and selected for example by a drop down list. The filtering pattern can be applied to a single column or to multiple columns. For instance, in a table presenting some network events, the events can be filtered by their source, displaying only those produced by a given object.

3.3.4 Editing of the Objects:

Table views can be used for inspection only or for editing the objects. According to the user's role, the task being performed and the property types, none, some or all of the cells may be editable.

(R) Cells are selected by a primary click

(O) In place cell editing is started using a double click

When the in place cell editing is not possible, an editable text field near the table generally represents the selected cell value.

3.4 Tree-Based Views

Tree-based views are widely used to represent hierarchies of objects in a very compact way. The main information directly visible to the user is the hierarchy. However some other information may be visible in a tree-based view. Generally, each tree node is represented with an icon that reflects the object type or class and a label, which is generally the name or ID of the object. Some graphic clues are also used to provide richer information to the user. For example, icon modifiers added to the object icons to represent the values of some useful properties.

3.4.1 Graphic Representation of the Managed Objects:

A tree is used to represent sets of objects. An object from the network management system is represented graphically as a tree node or as a tree leaf in the tree. The properties of the objects are not represented directly in the tree. However, some properties can be represented using graphic clues like font sizes, colors, icons, and icon modifiers.

(R) The tree view will map the name (or ID) of the object to the label of the tree node

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

(R) The view will map the type (or class) of the object to an icon

(R) The tree must also contain particular icons in the tree structure that allow the user to expand or collapse the containment hierarchy via one mouse click.

(O) The subtype or any other attribute can be represented using icon modifiers or by using foreground or background colors for the label.

As the tree view provides very compact representation for the objects, it is not supposed to display all the properties of an object. If representing all the properties of an object is mandatory, the tree may be associated with a table view or to a form view, which is more suited to represent a large number of objects properties.

3.4.2 Browsing the Objects:

(R) Browsing the objects presented by a tree can be done using scroll bars.

(R) Objects can be selected by a mouse click or using the arrow keys.

(R) As the tree represents a containment hierarchy, it is possible to drill down in the container with a primary click on the special expand/collapse icon in the tree structure or with a double click on the node itself or

(O) Pressing the enter key may also expand the container

3.4.3 Arranging the Objects:

In a tree view the ordering of the items mainly depends on their hierarchical relations.

(O) For each containment level, the items can be sorted alphabetically.

(O) A tree can be filtered using patterns on the tree nodes properties. Filtering patterns may be user defined via a text field or predetermined and selected for example by a drop down list.

3.4.4 Editing of the Objects:

As tree views are used to represent information or hierarchies in a very compact way, they should not be used to edit objects or objects properties directly.

(O) When editing is mandatory, a tree view may be associated to a table view or to a form view that is more suited to editing of objects properties.

However, in some cases it could be useful to edit the hierarchical structure of the tree.

(O) In such situation it may be possible to add, remove or move objects in the tree using drag and drop

See Figure 4 for an example of a tree view.

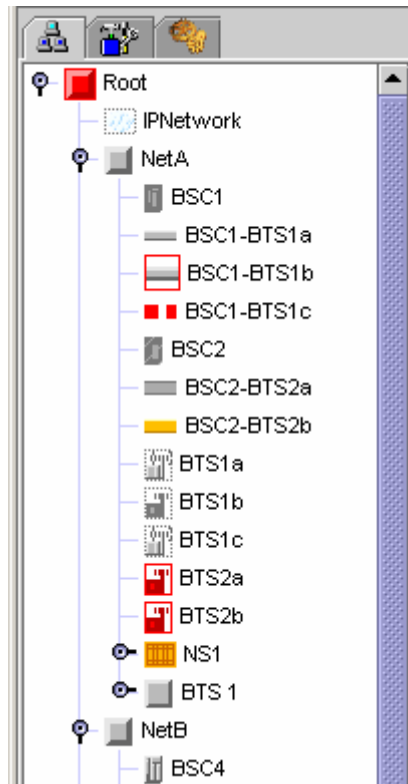


Figure 4: Tree View

(This figure is not intended to imply any particular platform or toolkit)

3.5 Chart-Based Views

Chart-based views are views that display information in the form of a chart or set of charts. These can be bar charts, pie charts, etc. Many network management applications will necessitate displaying information through charts, in particular all testing and performance monitoring applications. The chart widgets provided by the standard GUI platforms are considered sufficient to display all types of charts specific to the telecommunications industry.

3.5.1 Graphic Representation of the Managed Objects:

A chart view is used to represent either one object or a set of objects. When only one object is represented, the chart displays one or more of the numeric properties for this object. For example, a chart representing only one object may monitor a router by displaying its total bandwidth and the bandwidth for each of its ports. When a set of objects is represented, the chart displays the numeric value of a given property for each object. For example, a chart representing a set of objects may display a one-hour report of the bandwidth of a set of switches. Charts can display values over time either in real-time or in reporting mode. As the chart is mainly used to represent numeric values, the objects themselves are not directly represented. The properties are the actual data displayed.

Colors, pattern and line style are widely used when mapping numeric values to a chart. They can be used to differentiate properties or to emphasize some values. The color, pattern and line style of the chart may change when a numeric values reaches a threshold.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

(R) If 4 or more colors are used a legend must be provided

3.5.2 Browsing the Objects:

(R) If the chart is representing values in real time, it must be possible to temporarily freeze the chart to be able to print or read the values.

(O) Browsing the objects presented by a chart view can be done using scroll bars.

(O) If the chart is reporting values over time, it should be possible to zoom in and out to display different time scale and to use scroll bars to view the history of the values.

(O) A chart view can be associated with a tree view to select which objects or which object properties the chart represents.

3.5.3 Arranging the Objects:

Sorting features are not always applicable to chart views. However, it could sometimes be useful especially when the chart represents a set of objects.

(O) the bars in a chart may be sorted by value, alphabetically by name or by server location.

(O) Sorting criteria may be user defined via a text field or predetermined and selected for example by a drop down list.

(O) A chart view can be filtered using patterns on the object, on the properties or using thresholds on the property values.

(O) Filtering patterns or thresholds may be user defined via a text field or predetermined and selected for example by a drop down list.

3.5.4 Editing of the Objects:

As chart views are generally used to represent real numeric values editing is meaningless in most cases. For example, when a chart is used to report the bandwidth of a network element over a given period of time, modifying any numeric value of the chart is inappropriate.

However, in cases like network provisioning or simulation a chart may be used as a simulation tool. In such cases editing is useful. Selection should be available via a single click on a chart and editing via a double click. When in editing mode, graphic clues like anchors should be visible. The user can then move anchors with the mouse to modify the numeric values of the chart.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

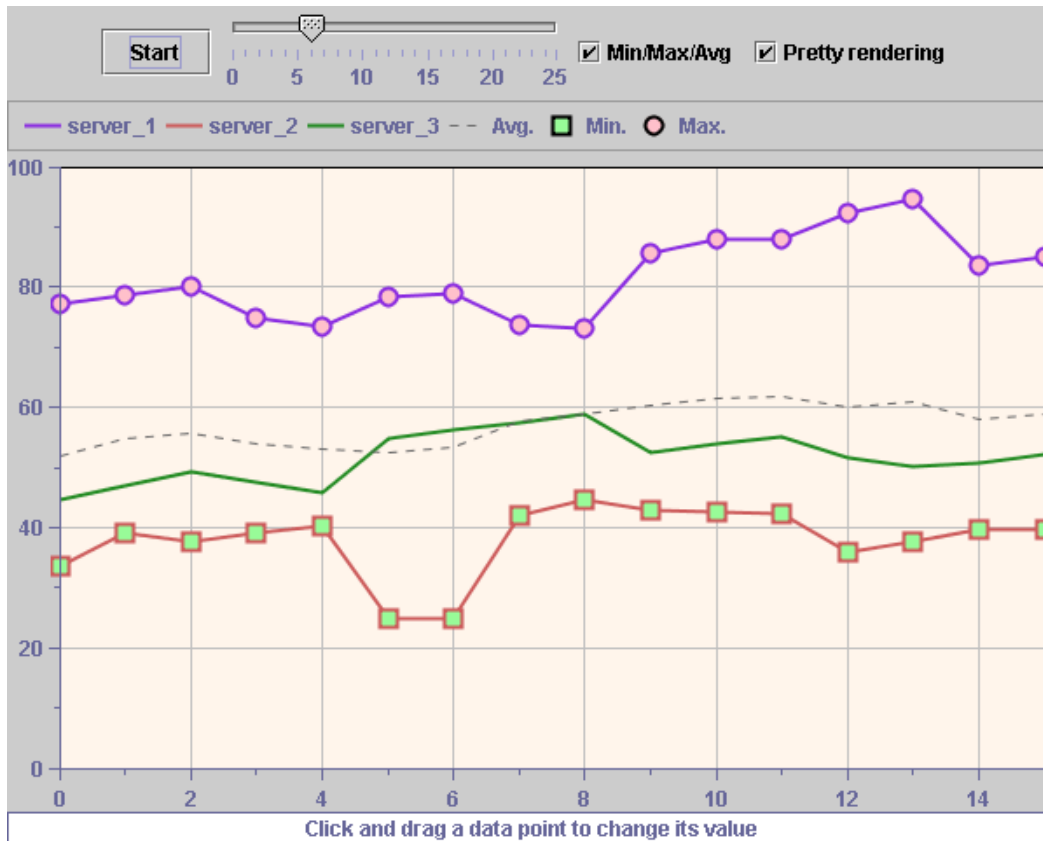


Figure 5: Illustration of a Chart View

(This figure is not intended to imply any particular platform or toolkit)

3.6 Geographical or Logical Network Views

These types of views are much more specific to the industry than the preceding ones. They provide the ability to monitor a network by visualizing a 2D or 3D image of the network, and by representing the devices that compose this network in an intuitive and informative way. This type of view forces us to define new types of graphical objects, which are specific to the industry and were not mentioned in the former types of views (see section 4). Examples include graphical representations of nodes, links, geographic maps, etc.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

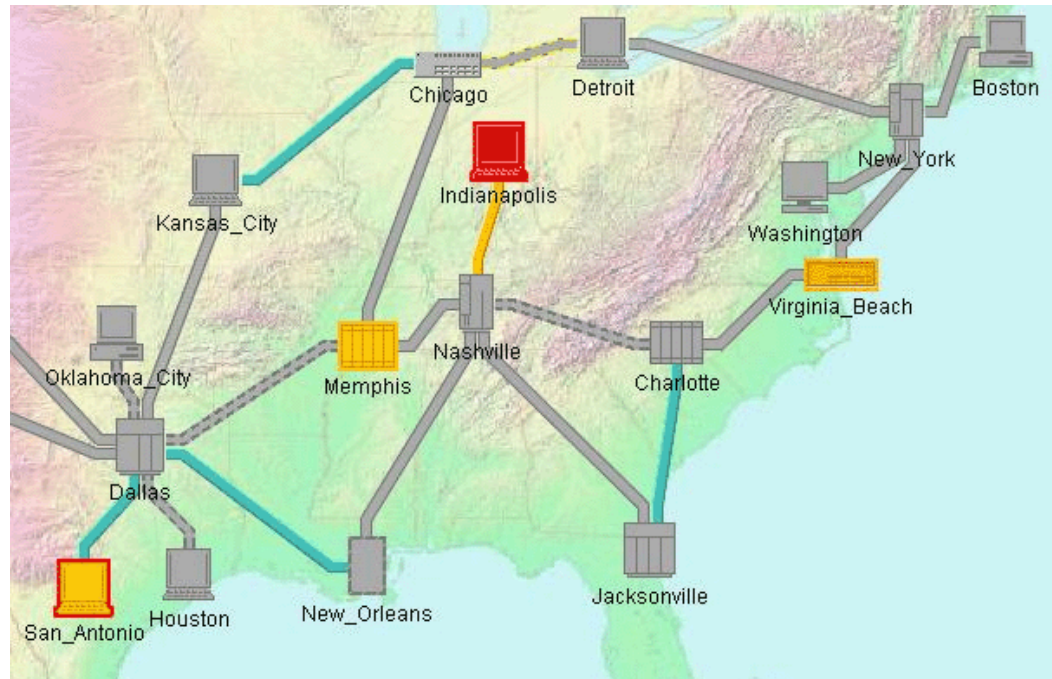


Figure 6: Illustration of a geographic network View
(This figure is not intended to imply any particular platform or toolkit)

3.6.1 Graphic Representation of the Managed Objects:

Geographical or logical network view is used to represent objects from the network management system. These objects can be either real managed objects from a network or logical objects (like virtual private networks or regions).

(R) Geographic network views must support background maps in formats such as bitmaps or vector-based.

(R) In geographical network views, managed objects are represented using icons located geographically relative to their actual physical position

(R) In logical network views, managed objects are represented using icons located to give the easiest understanding of the network topology (see the “Arranging the objects” section below).

(R) In both geographical and logical network view; colors, patterns or modifier icons represent the properties of these objects graphically.

(R) Network connections like electrical or fiber links are represented graphically as lines between nodes.

(R) Links can be straight, spline or polygonal lines

(R) The link properties are represented graphically using colors, line styles or modifier icons. (See section 4)

(O) When objects cover large areas, like regions, they may be represented by polygonal shapes approximating the geographic coverage of the objects.

3.6.2 Browsing the Objects:

- (R) Browsing the objects presented by a geographic or logical network view can be done using scroll bars
- (R) When objects are organized as a hierarchy, it must be possible to drill down
- (R) Containers can be opened either by expanding the objects (like regions or link bundles) either in the same view or in a new frame.
- (O) It should be possible to zoom in and out to focus on a set of objects
- (O) An overview should be available to allow the user to have the whole picture of the network in mind

3.6.3 Arranging the Objects:

- (R) In a geographical network view the objects must be located relative to their actual physical location.
- (O) In logical network views, objects are located using node layouts that allow an easier understanding of the network structure. The better node layout depends on the actual network structure. For example, when the network connections follow a tree structure, the network should be laid out as a tree. If the network is a ring, a circular layout should be used to set the nodes positions. The shape of the links can be calculated by a link layout. For example, orthogonal or straight links are better when representing tree structures, whereas spline links are better when representing rings.
- (O) A geographical or logical network view can be filtered using patterns on the object properties
- (O) Filtering patterns may be user defined via a text field or predetermined and selected for example by a drop down list.
- (O) The filtering can be either explicit by using a filtering pattern like a geographic location, an object type, the severity of the alarms or a property threshold or implicit using a visibility threshold associated to the zoom level.
- (O) Filtering objects according to the zoom level is very useful to avoid views cluttered by large amount of objects.

3.6.4 Editing of the Objects:

- Geographical or logical network views can be used for inspection only or for editing the objects. According to the user's role, the task being performed and the property types, none, some or all of the objects may be editable.
- (R) In a provisioning application it must be possible to create or remove, edit or move any object (nodes or links) graphically using the mouse.
 - (R) A primary click on an object should always select the given object
 - (R) Multiple selection is available either using a specific interaction or with a primary click and a keyboard modifier.
 - (O) As the double click is associated to the drill down action, editing should be available via either a global editing mode (vs. a view only mode) or via popup menus.

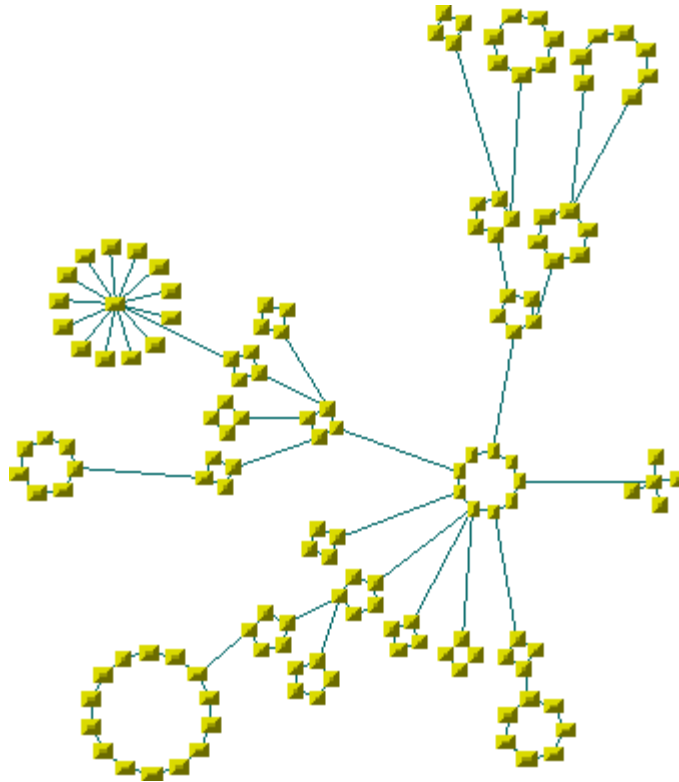


Figure 7: Illustration of a logical network view

(This figure is not intended to imply any particular platform or toolkit)

3.7 Equipment Views

The views that are used to describe the equipment are particular types of graphical views. They have the following properties:

- The ability to display vector-based or image-based backgrounds
- The ability to display equipment cards, shelves and equipment racks
- The ability to scroll, with the help of scrollbars or arrow keys.

The equipment views are important for the telecom industry. They provide the ability to monitor, configure or manage telecommunications equipment in a very generic way by visualizing a 2D or 3D image of the actual hardware equipment. Depending on the type of application the detail level of the equipment view can vary from the entire rack to the shelves and cards down to the ports and LEDs level. This type of view forces us to define new types of graphical objects, which are specific to the industry and were not mentioned in the former types of views. (See the graphical representations of equipment racks, shelves, circuit packs in section 4.)

3.7.1 Graphic Representation of the Managed Objects:

(R) The equipment views must support background images in various formats like bitmaps or vector based to represent the equipment itself or the rack. In equipment views, managed objects are represented using rectangles or icons located on a background image according to their actual position on the hardware piece of equipment.

(R) If the equipment graphic shows LEDs, then the correct state must be indicated

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

- (R) The correct placement and complement of cards must be shown
- (R) In equipment views, the properties of the objects are represented graphically by colors, patterns or modifier icons.
- (R) When state information is displayed it must be accurate with the current real object state
- (O) There is no need for the graphics to be photo-realistic but they should allow the user to recognize the look and positions of the real managed objects. In fact some degree of abstraction is preferred to photographs. This relates to the user interface principle of minimizing unnecessary or irrelevant information.

3.7.2 Browsing the Objects

- (R) Browsing the objects presented by an equipment view can be done using scroll bars
- (R) Where large numbers of objects are present, it must be possible to drill down to focus on a subset of objects
- (R). When focused on a given card or cards, its LEDs must be visible and must represent the current condition of the card
- (O) An overview should be available to allow the user to have the whole picture of the equipment in mind.
- (O) As objects are organized as a hierarchy (racks contain shelves which contain cards which contains ports and LEDs), a tree view may be associated with the equipment view to inform the user of the equipment structure
- (O). It may also be possible to hide or show some of the objects according to their containment level or to the zoom level. For example, when displaying an entire rack it may be useful to hide the LEDs,

3.7.3 Arranging the Objects:

The equipment views represents the objects arranged with a layout that is similar to their actual position on the hardware piece of equipment. There is no need for the graphics to be photo-realistic but the graphics must allow the user to recognize the look, controls, and positions of the real managed objects.

- (O) An equipment view can be filtered using patterns on the object properties
- (O) Filtering patterns may be user defined via a text field or predetermined and selected for example by a drop down list. The filtering can be either explicit by using a filtering pattern like an object type, the severity of the alarms or a property threshold or implicit using a visibility threshold associated to the zoom level.
- (O) Filtering objects according to the zoom level is very useful to avoid views cluttered by large amount of objects

3.7.4 Editing of the Objects:

Equipment views can be used for inspection only or for editing the objects. According to the user's role, the task being performed and the property types, none, some or all of the objects may be editable.

- (R) A primary click on an object should always select the given object
- (R) Multiple selection must be available either using a specific interaction or with a primary click and a keyboard modifier
- (O) In an inventory application it should be possible to create or remove, edit, move or resize any object (racks, shelves, cards, ports) graphically using the mouse.

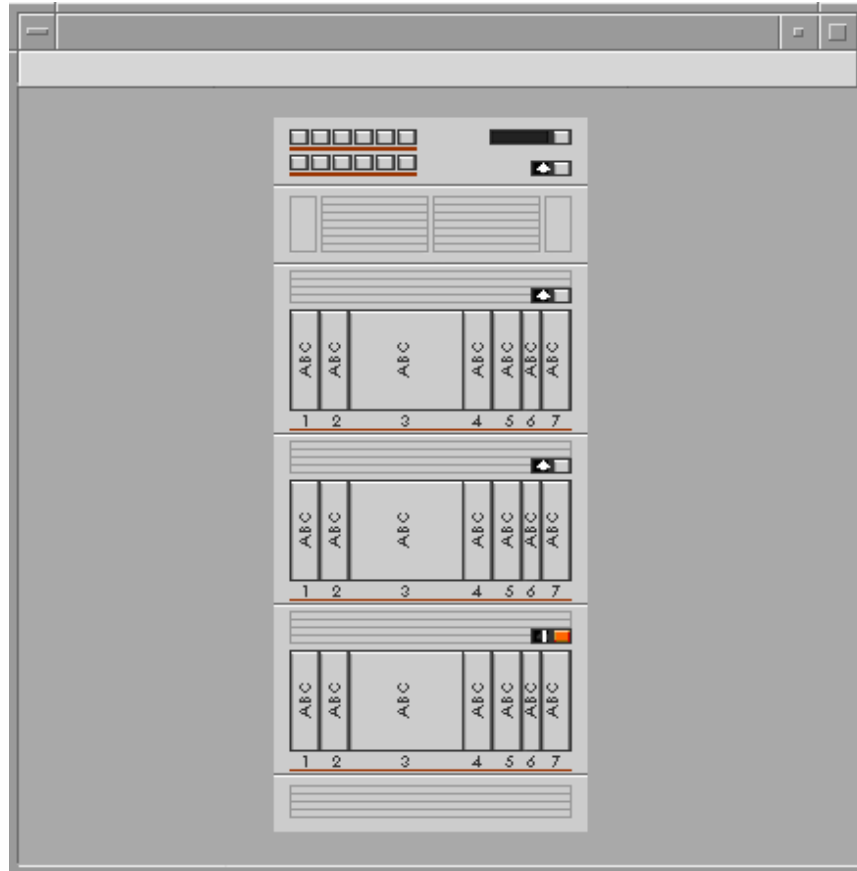


Figure 8: Illustration of an Equipment View

(This figure is not intended to imply any particular platform or toolkit)

4 TELECOM PRESENTATION OBJECTS

The real objects that are monitored by a network management system are often displayed on a network operator' workstation in order to permit management actions to be taken. The types of views described in section 3 will be sufficient to describe virtually all types of situations encountered in network management. The objects that are necessary to build Presentation views of the first three kinds (forms, tables and charts) are generic items that have already become de facto standards provided across the board within the various GUI platforms available on the market. The following chapter lists objects and the attributes that must be graphically represented in order to create an efficient and effective human-machine interface within the telecommunications domain. It is the intent of this document to state requirements for the graphic representation of these objects in order to stabilize and normalize the presentation of telecommunications network object to users.

The following graphical objects are described:

- **Containers:** examples are regions, sites, networks, customers...
- **Network Node:** examples are switches, ADMs, crossconnects, routers
- **Links:** examples are physical (Fiber, electrical...), logical (OCnn, PVC, SVC...)
- **Trails**

- **Equipment**
- **Off-page Connectors**

In the following sections the illustrations are not intended to suggest or recommend any particular toolkit or platform technology.

4.1 Container

4.1.1 Brief Description of the Object:

A container is a graphic object representing a number of other objects. It is used to reduce screen clutter and to organize regions of networks dependent on areas of work responsibility, geography, technology or for other administrative reasons.

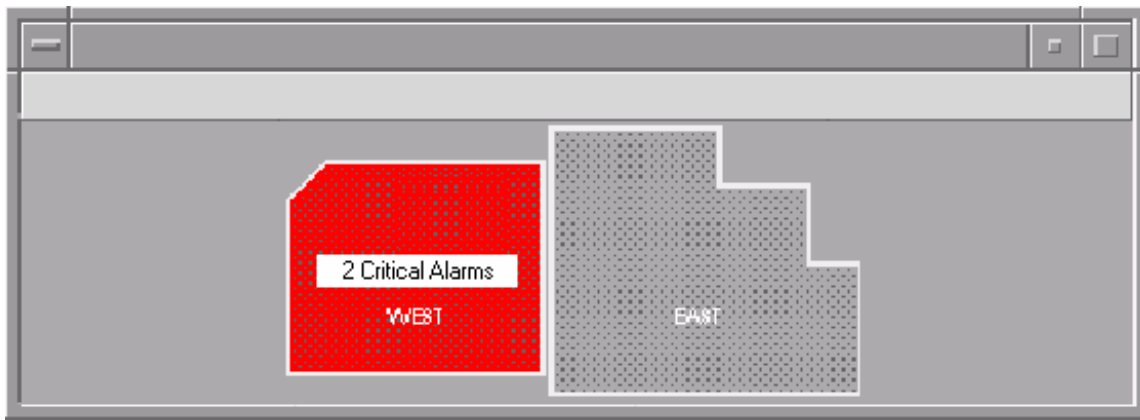


Figure 9: Illustration showing Two Containers, East and West
(This figure is not intended to imply any particular platform or toolkit)

4.1.2 Graphic Object Attributes:

- (R) Container ID: Text indicating the name of the container
- (R) Alarm Collection: Includes alarm propagation of contained objects
- (R) Visual Presentation: A graphic, which allows the user to double click to open the container
- (O) Information Box: Text providing additional information
- (O) Container Graphic: A graphic symbol, which indicates that this object is a container and can be opened.

4.1.3 Generic Container Behavior:

- (R) Containers can be opened with a double primary mouse click
- (R) Containers can be closed
- (R) Containers support the most critical alarm or indication propagated up from a managed object or objects in the container.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

- (O) Containers can be, moved, reshaped and resized.
- (O) Graphic Objects, including other containers, can be added to a container.
- (O) Graphic Objects, including other containers, can be removed from a container.
- (O) Containers can support secondary state information or summary information that is propagated up from a managed object or objects in the container.
- (O) Containers can have information boxes attached to them.
- (O) Containers can support menus, which are activated by a secondary mouse click

4.2 Network Node

4.2.1 Brief Description of the Object:

A network node is a graphic object that represents some network equipment or a network element. Examples include intelligent and non-intelligent devices, switches, transport add-drop multiplexers, routers, application servers, and repeaters.



Figure 10: Illustration of Managed Element

(This figure is not intended to imply any particular platform or toolkit)

4.2.2 Graphic Object Attributes:

- (R) Node ID: Text indicating the ID of the network node
- (R) Node type: A graphic symbol that indicates to the user what type of network element is represented. Symbol shapes for several key equipment classes are provided in ANSI T1.232. Note: further work is contemplated by the TMF GUI team.
- (R) Visual Presentation
- (R) Alarm collection
- (O) Administrative, operational, and usage state
- (O) Information Box (Tool tip or dialog)

4.2.3 Generic Object Behaviors:

- (O) If the Network Node is also a container, it can be opened with a double primary mouse click.
- (O) Network Nodes can be moved when on geographical maps.
- (O) Network Nodes may have menus associated with them, which can be accessed by a secondary mouse click
- (O) Network Nodes can be indicated as selected by a left mouse click
- (R) Network Nodes support an alarm indication and will be propagated up from subclass objects of the managed element when it is a container.
- (O) Network Nodes can support secondary state information that is propagated up from subclass objects of the managed element when it is a container.

4.3 Links

4.3.1 Brief Description of the Object:

An entity that defines a topological relationship including available transport capacity between two nodes. Multiple links may exist between a pair of nodes or sub networks. A sub-network contains multiple links and nodes.

NOTE: A Link can be the same as the Pipe object class in M.3300



Figure 11: Illustration of Link

(This figure is not intended to imply any particular platform or toolkit)

4.3.2 Graphic Object Attributes:

- (R) Link ID: Text indicating the ID of the link
- (R) Status
- (O) Link Type: Symbol indicating transport media
- (O) Administrative, operational and usage state
- (O) Direction

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

- (O) Status of redundant or protection capacity
- (O) Alarm collection
- (O) Information box (Tool tips or dialogs)

4.3.3 Generic Object Behaviors:

- (R) If the network nodes can be moved, the ends of links remain connected to the nodes when those nodes are moved.
- (O) Links can be selected with a primary mouse click
- (O) If a link is a container it can be opened with a double primary mouse click
- (O) Links can support object menus that are activated by a secondary mouse click.
- (O) Links can support an alarm.
- (O) Links can support secondary state information.

4.4 Trail

4.4.1 Brief Description of the Object:

A trail is an entity that transfers information provided by a client layer network between access points in a service layer network. The transported information is monitored at the termination points.

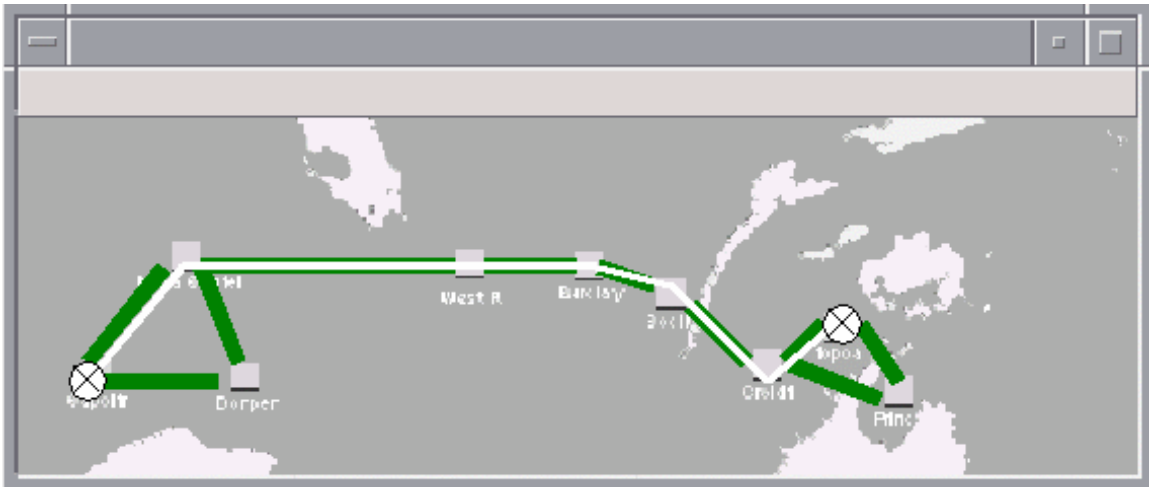


Figure 12: Illustration of Trail

(This figure is not intended to imply any particular platform or toolkit)

4.4.2 Graphic Object Attributes:

- (R) Trail ID: Text indicating the ID of the trail
- (R) Status
- (R) Termination end points
- (O) Customer Name

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

- (O) Layer / Capacity
- (O) Directionality
- (O) Priority
- (O) Channel
- (O) Utilization
- (O) Alarm collection
- (O) Administrative, operational and usage state

4.4.3 Generic Object Behaviors:

- (R) Trails can be added or deleted or modified.
- (R) Trails can be viewed.
- (R) Trail end points are shown.
- (O) Trails can support object menus.
- (O) Trails can support an alarm.
- (O) Trails can support secondary state information.

4.5 Equipment

4.5.1 Brief Description of the Class

Equipment is an example of a managed element. This object shares the same graphic attributes as the managed element. Equipment typically contains hardware such as Circuit pack, Shelf, Equipment Rack.

Note that the view of a pack, shelf, or rack must be accurate, representing the complement and condition or state of the object as it is in real time.

4.6 Circuit Pack

4.6.1 Brief Description of the Object:

A circuit pack is a managed component in the network and it may be a container if the pack has multiple ports. Examples include ports, line cards, memory modules, and processor cards.

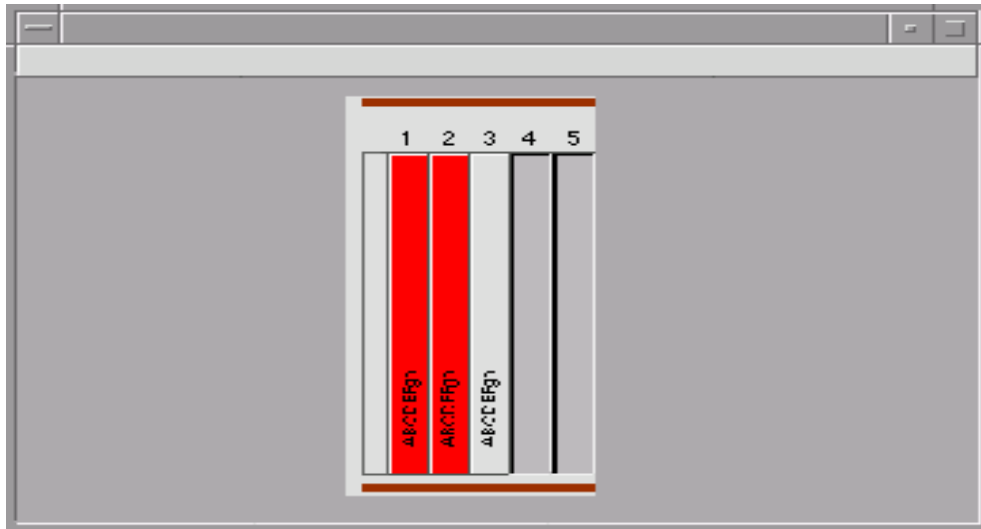


Figure 13: Illustration of Circuit Pack

(This figure is not intended to imply any particular platform or toolkit)

4.6.2 Graphic Object Attributes:

- (R) Pack ID: Text indicating the ID of the pack
- (R) Alarm collection
- (R) Visual Presentation
- (O) Administrative, operational, and usage state
- (O) Information Box

4.6.3 Generic Object Behaviors:

- (R) Circuit pack objects reflect the state and status of the real object, for example the condition of any alarm LEDs on the packs.
- (R) Circuit packs can support an alarm indication propagated up from a managed element it holds or from itself.
- (O) Circuit packs can have information boxes attached. Note that this assumes that a shelf graphic is being presented See below.

4.7 Shelf

4.7.1 Brief Description of the Object:

A shelf is a kind of container. It contains circuit packs and possibly other modules such as power supplies or fan units

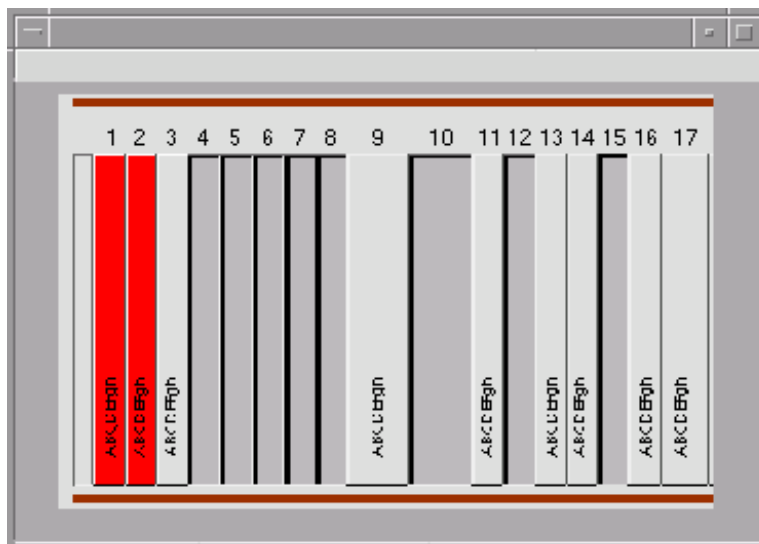


Figure 14: Illustration of Shelf

(This figure is not intended to imply any particular platform or toolkit)

4.7.2 Graphic Object Attributes:

- (R) Shelf ID: Text indicating the ID of the shelf
- (R) Alarm collection
- (R) Visual Presentation
- (O) Information Box

4.7.3 Generic Object Behaviors:

- (R) Shelves can be opened with a double primary mouse click
- (R) Shelves can be closed.
- (O) Shelf objects can support an alarm collection.

4.8 Equipment Rack

4.8.1 Brief Description of the Object:

An equipment rack is a type of container. It contains shelves.

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT OBJECTS TECHNICAL SPECIFICATION

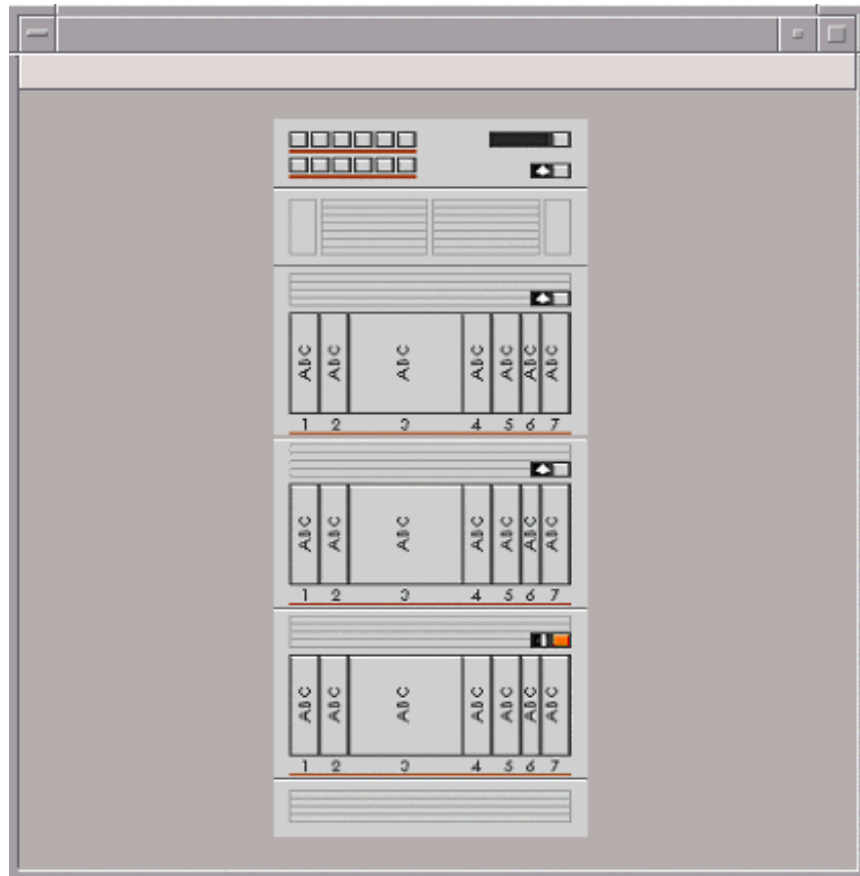


Figure 15: Illustration of Equipment Rack

(This figure is not intended to imply any particular platform or toolkit)

4.8.2 Graphic Object Attributes:

- (R) Rack ID" Text indicating the ID of the rack
- (R) Alarm collection
- (R) Visual Presentation
- (O) Information Box

4.8.3 Generic Object Behaviors:

- (R) Racks can be opened with a double primary mouse click
- (R) Racks can be closed.
- (O) Rack objects can support an alarm collection.

4.9 Off-page Connector

4.9.1 Brief Description of the Object:

Off page connectors allow users to navigate between managed elements, which are displayed in separate windows.

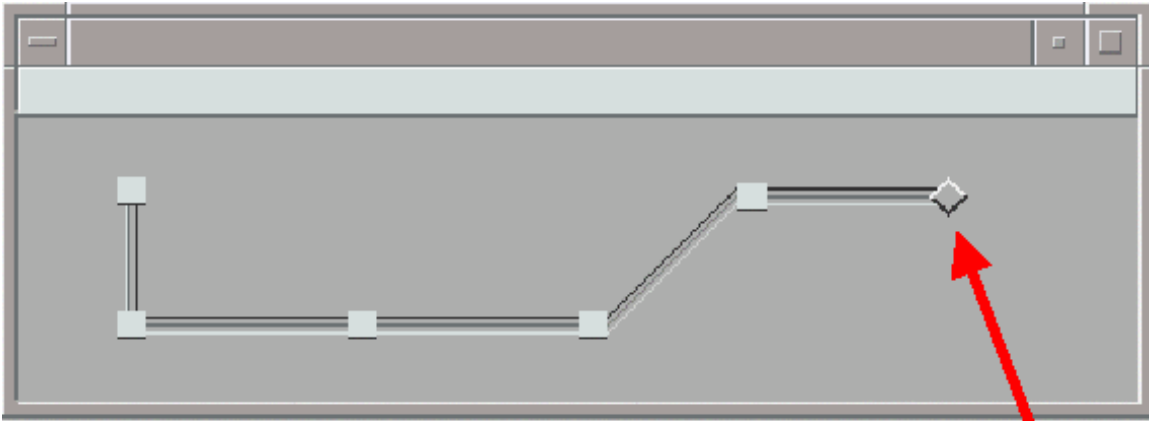


Figure 18: Illustration of Operational Software outside the hardware
(This figure is not intended to imply any particular platform or toolkit)

4.9.2 Graphic Object Attributes:

- (R) Off page connectors must indicate the destination element
- (R) After the transition to the new element view the entry point must be highlighted

4.9.3 Generic Object Behaviors:

- (R) Double primary mouse click will open a view containing the off-page connector.

5 REFERENCES

1. ITU-T Recommendation Z.361 - Design guidelines for Human Computer Interfaces (HCI) for the management of telecommunications networks
2. T1.232- Operations, Administration, Maintenance, and Provisioning (OAM&P) G Interface Specification for use with the Telecommunications Management Network (TMN)
3. ISO 9241-1: 1992, Ergonomic requirements for office work with visual display terminals (VDTs)
4. European Telecommunications Standards Institute, ETSI-EG201024V1.1.1, 1997, UI Design Principles for the Telecommunications Management Network
5. SONET Interoperability Forum, SIF-007-1996, Design Principles for the development of OAM Graphical User Interfaces
6. GB-909 (Part 1) Issue 1.92, February 1, 1999, Generic Requirements for Network Management Building Blocks

6 RELATED STANDARDS DOCUMENTS

6.1 ITU-T Telecommunications Management Network Related Standards:

M.3010 Principles of TMN
M.3020 TMN Interface Specification Methodology
M.3100 Generic Network Information Model
M.3200 TMN Management Service Overview
M.3300 Capabilities of F Interface
M.3400 TMN Management Functions
M.3201 TMN Management Service for Customer Controlled Services

6.2 Communication and Management Standards:

X.700 Series OSI Management Standards
Q.821 Alarm Surveillance (ex. X.721, X.733/4/5)
T1M1.5 T1.200 Series TMN Architecture, Models, Functions and Protocols

6.3 Transmission Standards:

I.751 Asynchronous transfer mode management of the network element view
G.774 Series SDH Network Element Information Models
G.774.02 Configuration
G.805 Generic functional architecture of transport networks
G.821 Error performance of an international digital connection operating at a bit rate below the primary rate and forming part of an integrated services digital network
G.826 Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate
G.851.1 Management of the transport network -Application of the RM-ODP framework
G.853.1 Common elements of the information viewpoint for the management of a transport network
G.853.2 Sub network connection management information viewpoint
G.854.1 Management of the transport network - Computational interfaces for basic transport network model

6.4 Human Factors:

E.134 Recommendation E.134 (03/93) - Human factors aspects of public terminals: Generic-operating procedures
E.135 Recommendation E.135 (10/95) - Human factors aspects of public telecommunication terminals for people with disabilities

GRAPHIC INFORMATION REQUIREMENTS FOR TELECOMMUNICATIONS MANAGEMENT
OBJECTS TECHNICAL SPECIFICATION

ANSI T1.232-1996, Operations, Administration, Maintenance and Provisioning (OAM&P) – G Interface
Specification for Use with the Telecommunications Management Network (TMN)