

# THE AT&T USER-INTERFACE ARCHITECTURE

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The user-interface architecture is a framework for defining the components of the user interfaces to AT&T products and services and for developing standards and software tools to ensure that those interfaces are consistent, attractive, and flexible. This paper describes the user-interface architecture, its purpose, and some examples of user-interface standards that compose it.

## Introduction

The variety and breadth of AT&T's products and services pose a challenge to user-interface design. They span the range from basic telephony to workstation applications, from stand-alone products to network services, and they serve casual users and experts, general users and administrators. Every product or service has a user interface; no one user interface or user-interface style can meet the diverse needs of all of them. At the same time, there is a recognized need for some level of consistency and coordination in the design and development of AT&T user interfaces. Arbitrary differences in user interfaces increase development costs, impede product interworking, and frustrate users. The goal of the AT&T user-interface architecture is to provide a basis for coherence and coordination in user interfaces, while recognizing the distinct needs of different products and services. The AT&T user-interface architecture provides a framework for defining the components of the user interfaces to AT&T products and services, and for developing standards and software tools to ensure that those interfaces are consistent, attractive, and flexible.

A common user-interface architecture provides a number of important benefits to users, customers, and developers.

- It makes products and services easier to use by ensuring that similar products and services have similar interfaces. A user who is familiar with one application within a set that shares a common user-interface architecture can easily learn to use other members of that set. For example, a common user interface to different network management systems makes the task of a network manager much easier. With one user interface, the same user can manage several different network elements without having to learn and remember different and perhaps conflicting rules for interacting with each. Similarly, a standard way to enter basic commands from a touch-

tone keypad enables users to send and retrieve messages on different systems without confusion.

- It simplifies and improves the development process. User interface design standards and common software tools that implement them can be reused to quickly and efficiently develop new applications. In addition to the obvious benefits of reusing common user-interface software, user-interface standards promote savings in development through reuse of user interface design and human factors decisions. The use of a model that separates the major elements of the user interface from other application components can also help to insulate the user interface from other parts of the application.
- It helps to improve the general quality of AT&T user interfaces by providing a focus for the definition, testing, and implementation of important user-interface components and by allowing new user-interface technologies and concepts to be introduced quickly across different products. Concentrating design and development efforts on a relatively small number of basic standard elements makes it possible to make more effective use of design and development expertise. It avoids the need to constantly rediscover user-interface principles for each new application.

#### Overview

The AT&T user-interface architecture defines user-interface standards and tools to implement them for classes of AT&T applications. It includes standards specific to AT&T as well as externally defined standards. It is organized around two basic concepts: the model of the user interface as a set of “layers” that mediate between user and application, and the idea of user-interface “domains”—natural classes of applications that share common user-interface standards.

**User Interface Layer Model.** Figure 1 represents the user interface as a set of functional layers that mediate the user/system dialogue. It can be thought of as analogous to the familiar layer model for data communica-

tions. Just as that model provides a rational framework for organizing the flow of information between applications through standards and protocols, the user-interface model provides a framework for organizing the flow of information between user and system. Within this model, the AT&T user-interface architecture defines common functional standards for the input and display of information, and for the structure of the dialogue between user and system.

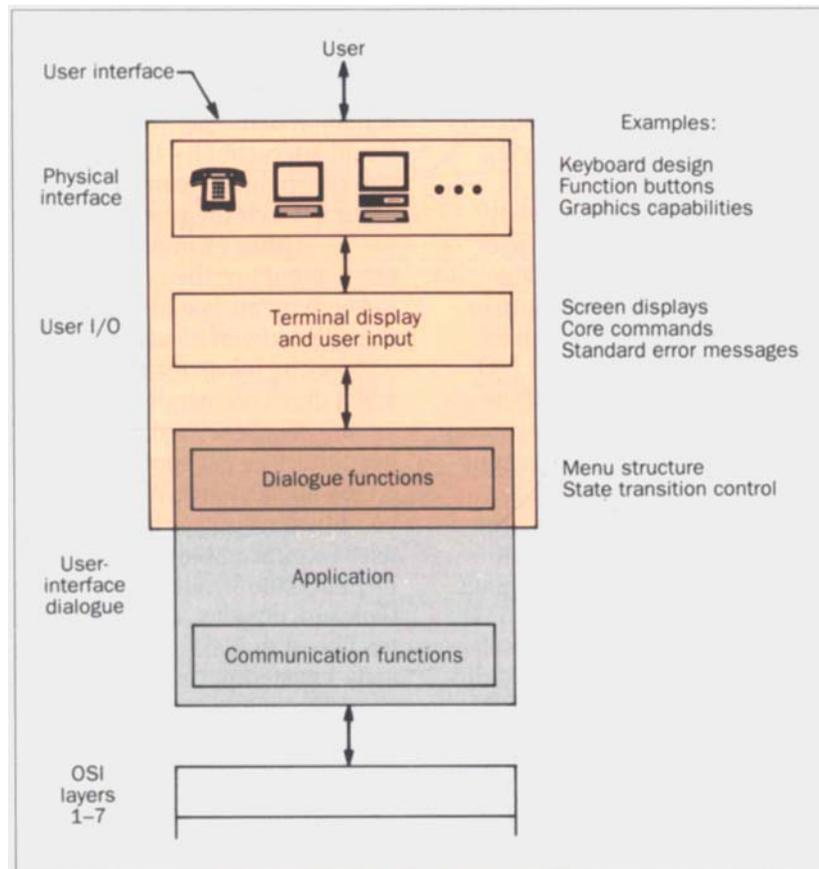
The three main components in this model are the *physical interface*, *user input/output*, and *user-interface dialogue*.

**Physical interface.** The physical interface refers to the hardware devices through which users and applications communicate. They include terminals, keyboards, touch-tone keypads, and cathode-ray tube (CRT) screens.

The common telephone terminal is a good example of the importance of user interface design at this level and of the value of common models and standards for the physical interface. Standard telephone terminal features include the layout of the touch-tone keypad, the use of feature buttons for the “big four” enhanced features in business telephony (conference, transfer, drop, and hold), and the use of light-emitting diodes (LEDs) to indicate information about call or line state. The existence of such standard terminal user-interface elements allows the user to place calls and manage enhanced features without having to learn about each new terminal.

**User I/O.** The input/output (I/O) component of the architecture is concerned with the way in which applications collect input from users and present output. User I/O elements include formats, protocols, and capabilities for collecting user input and for displaying information—including feedback, error messages, and data—to the user. The user I/O component involves both user-interface design standards and standard software tools.

User I/O standards deal with such things as how users enter commands; how forms and lists are used and represented; the design and use of graphical user-



**Figure 1. User interface architecture layer model.**

interface elements such as windows, icons, and menus; and how common types of information such as mail headers or directory entries are displayed. This layer of the user-interface architecture plays the major role in defining an application's "look and feel." Specific examples of user I/O standards in the AT&T user-interface architecture include the use of the touch-tone sequence \*H for requesting help in voice messaging applications, and the use of standard mouse operations *select*, *adjust*, and *menu* in the Open Look™ graphical user interface.

Where appropriate, user I/O standards are sup-

ported by common software tools, which are designed to make it easy to develop applications implementing those standards. Common user-interface software tools make it possible to provide consistent user interfaces to related applications in different products or distributed throughout a network.

Perhaps the best example of common user-interface software tools comes from the area of graphical user interfaces. Within the AT&T user-interface architecture, the X Windows™ system<sup>1</sup> and associated software standards and tools provide a common software base for

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developing graphical user interfaces. (X Windows is a trademark of the Massachusetts Institute of Technology.) The X Windows system provides a standard framework for basic graphical user-interface functions, such as collecting user input, displaying output, and managing windows.

By itself, the X Windows system does not define the detailed appearance or operation of the user interface—it does not specify a particular look and feel. It allows application developers a great deal of freedom in the design of graphical user-interface objects (such as windows and buttons) and in the definition of user I/O operations. User interface “toolkits” built on top of the X Windows system provide easy means for implementing specific user-interface designs. These toolkits both support and enforce specific user-interface standards.

In addition to the basic X Windows system, the user-interface architecture includes the Open Look graphical user-interface standard, which specifies details of appearance and operation (the look and feel) for AT&T UNIX® system-based graphical user interfaces and software tools that implement the Open Look standard. Additional, specialized toolkits are defined for other AT&T application domains, such as network management, described below.

**User-interface dialogue.** The dialogue component of the user interface deals with the overall structure of the interaction between a user and a product or service and with the sequencing and interrelations of the user-interface functions and components. The user-interface dialogue is analogous to the flow of conversation between two people.

For example, in a telemarketing application, if the task is to specify how incoming calls are to be handled, the overall model could be one of building a tree, with the nodes representing various decision factors, such as time of day or area code, and various call treatments such as playing an announcement, putting a call in a queue, or routing to an attendant. Structuring all call-routing tasks around tree building would provide part of

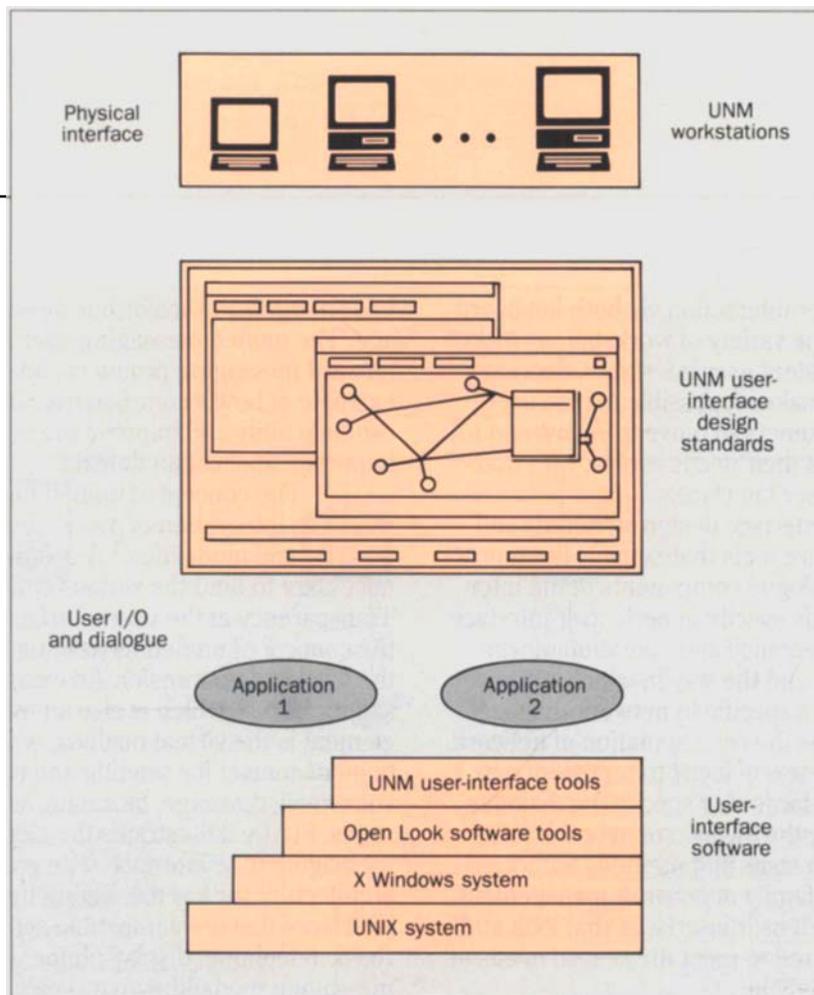
a common dialogue model for that class of applications.

As another example, a network management application can be structured so that the graphical representation of the network map is the basic starting point for all interactions—the “main menu” in a sense. The network map then becomes the user-interface component around which the rest of the dialogue is structured.

Other examples of the user-interface dialogue component are the organization of and navigation through menu systems, when and how to provide *dial through* and *dial ahead* in voice information services, the way in which *help* features are provided, and rules for when user commands should be confirmed.

**Domains.** As noted in the introduction, no single user interface is appropriate for all users and for all AT&T applications. Whether two applications should provide similar user interfaces and adhere to the same user-interface standards depends on many factors, including the similarities in their user populations and their functionality, their interactions with each other, the likelihood that a user of one will also use the other, and—most importantly—the benefits of user-interface similarity to their users. When two-element management systems are likely to be used by the same person they should provide consistent user interfaces. It is less obvious that there is a need for great similarity between a management application and an electronic mail application. On the other hand, it seems desirable to make the user interfaces to electronic mail and voice mail as similar as possible.

On the basis of these considerations, the user-interface architecture currently addresses four domains: network management and system administration, store-and-forward messaging, interactive information services, and business telephony. In each of these domains, multiple products and services provide similar functions for similar user populations. Users, designers, and developers benefit when their user interfaces operate similarly, share common design features, and make use of common components.



**Figure 2. Unified network management user interface.**

The AT&T user-interface architecture has been used as a framework for defining user interfaces in several domains. The following sections illustrate the way in which the architecture supports unified user interfaces for two domains: network management and administration and store-and-forward messaging.

#### **The Unified Network Management User Interface**

The systems required to manage a communications network represent a clear domain in which a common user-interface architecture makes sense. Regardless of the particular products and services, there are strong similarities in their user populations and in the tasks that network managers perform—performance monitoring, trouble tracking, accounting management, network planning, etc. In addition, the work often requires the same

person to use several different network management systems. A common user interface can make the job easier and more effective.

The unified network management user interface is the part of the user-interface architecture that deals with network management applications. It provides the basic framework for user interfaces to AT&T network management products and services and is a major component of the overall AT&T unified network management (UNM) architecture.<sup>2</sup> Figure 2 illustrates the components of the unified network management user interface. They include workstations, a set of design standards and signature elements, and a set of software tools that implement the standards.

The UNM workstations are the physical interface component. They support high-resolution bit-

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mapped graphics and user interaction via both keyboard and mouse. Restricting the variety of workstations makes it easier to develop consistent user interfaces, decreases development costs, and makes it possible to plan user interfaces that allow customers to move from low-end to high-end workstations, as their needs evolve, with maximum continuity in the user interface.

The UNM user-interface design standards and the corresponding software tools that support them provide the user I/O and dialogue components of the interface. The design standards specify generic user-interface features, such as the appearance and operation of windows, menus, and forms, and the way in which a mouse is used, as well as features specific to network management applications, such as the representation of network maps and alarms and the use of icons to represent network elements. The standards also specify the dialogue component by describing the division of network management applications into tasks and methods for accessing tasks. The result is a family of network management products and services with user interfaces that look and act similarly and are tailored to meet the special needs of a particular application domain.

User interface software supports the design standards by providing common software tools for implementing the elements they define. For graphical user interfaces based on the UNIX system, there are two levels. The X Windows system is the generic base on which special software tools or toolkits are provided that implement the network management user-interface standards.

Like the design standards, these tools include both generic and network-management-specific elements. Generic elements include tools for common features such as windows, menus, buttons, scroll bars, and command lines. Network-management-specific tools provide standard icons for network elements and a standard network map.

#### **The Unified Messaging User Interface**

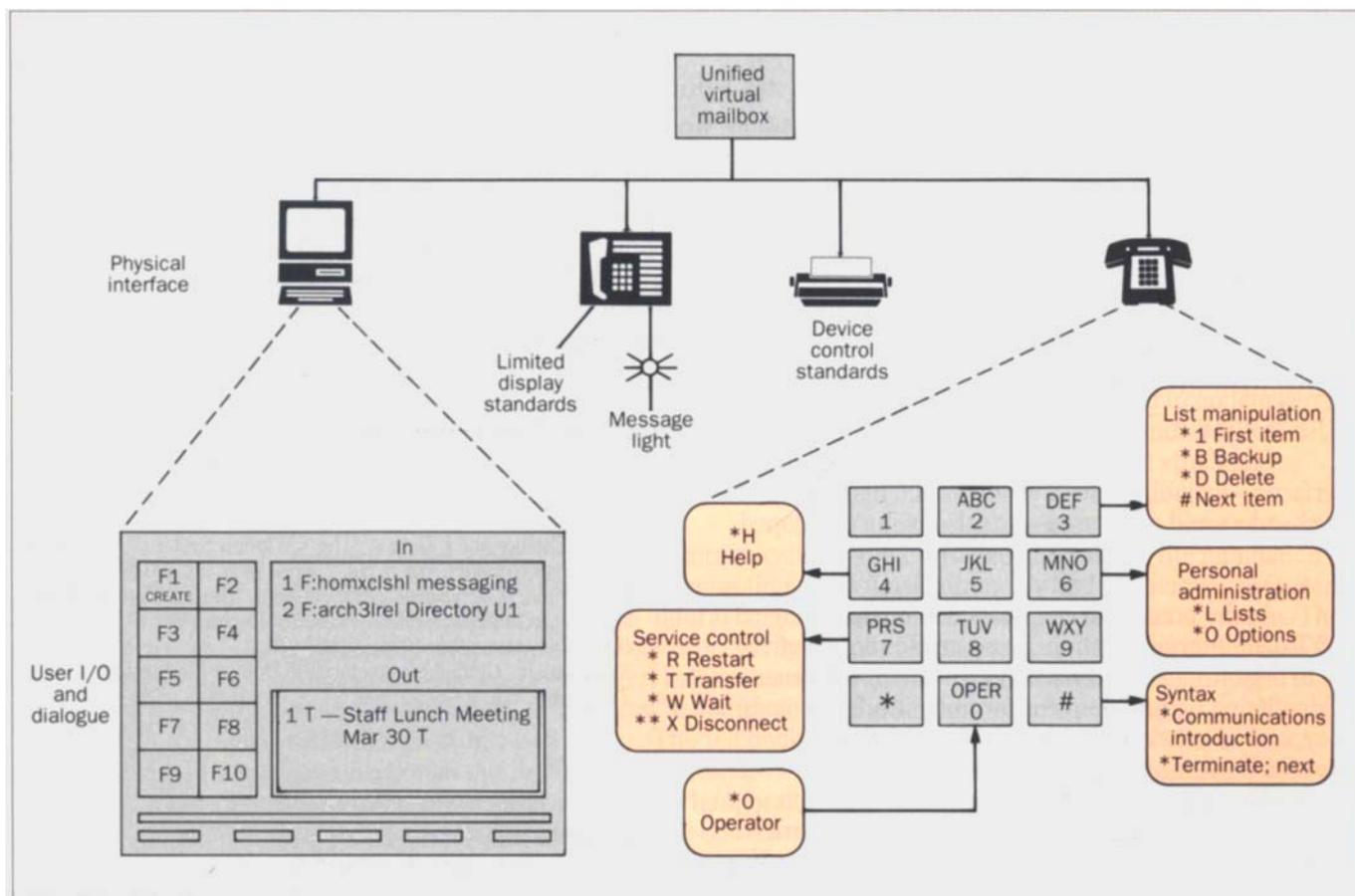
Electronic messaging, including electronic mail, voice mail, automated attendant services, and facsimile,

has emerged as a major business tool of the information age. The unified messaging user interface for store-and-forward messaging products and services is a second example of how a common user-interface architecture can help unify and improve the user interface for an important application domain.

The concept of unified messaging promises a seamless integration of messaging across products, devices, and modalities.<sup>3</sup> A common user interface is necessary to bind the various components together. Transparency at the user-interface level is as central to the concept of unified messaging as is transparency at the level of data transfer. An example of a unified messaging feature which is also an important user-interface element is the virtual mailbox, which provides a single point of contact for sending and receiving electronic mail, voice mail, coverage, facsimile, and other forms of messages. Figure 3 illustrates the elements of the unified messaging user interface. The goal of the user-interface architecture for the messaging domain is to create user interfaces that are compatible across terminal devices (basic telephone, display phone, PC, or workstation), messaging modalities (e.g., voice mail, facsimile, electronic mail), and different products and services.

Standards for touch-tone telephone-based user interfaces are a key component of the user-interface architecture for unified messaging. Touch-tone telephone-based user interfaces are important for messaging because of the ubiquity of the telephone, which provides universal access to messaging, and because of the role of the telephone terminal in the interfaces to voice messaging and facsimile.

Messaging applications that use a telephone for the user interface differ from screen-based human-computer interfaces in important ways because of the limited nature of the telephone as an input and output device. The touch-tone telephone constrains user input to the set of 12 dial-pad buttons and their associated dual-tone, multifrequency (DTMF) signals. Another constraint comes from the auditory presentation of information, which requires menus, lists, and dialogues to be



designed with special attention to the limitations of human information processing for sequentially presented information.

The AT&T touch-tone user interface helps integrate AT&T's messaging services by providing a common user interface to functions that are common across different messaging applications. Once learned, this common interface allows the user to concentrate on retrieving and managing messages, rather than on the special set of commands and procedures needed for each service. The touch-tone user-interface architecture includes

**Figure 3. Unified messaging user-interface components.**

standards for user input, system responses, and user/system dialogue. Specific guidelines in each of these areas are designed to help overcome the limitations of the touch-tone telephone as a terminal device.

A set of "core" commands for AT&T messaging products and services that employ a touch-tone dial pad for user input provides a common user interface to basic messaging functions, such as retrieving and manipulating messages and getting assistance. Each command has

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a unique touch-tone button sequence. Each command starts with the character \* followed by a character that represents the name of the command, for example, \*D (or \*3) for *delete* and \*H (or \*4) for *help*. The core commands allow users to request help, navigate through lists and menu structures, save and delete messages, etc. Their mnemonic design makes them easy to remember.

The touch-tone user interface also includes standards and guidelines for:

- Entering data (dates, yes/no responses, alphabetic information)
- User assistance (presentation of help messages)
- Presentation of prompts and menus
- Use of dial through and dial ahead.

Standards for workstation-based messaging interfaces—including use of windows and display of message headers and addresses—are also being developed.

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#### **Conclusion**

As the preceding examples demonstrate, the AT&T user-interface architecture provides an effective way to organize user-interface design and development by identifying natural domains for user-interface consistency, and by providing a framework for defining the essential elements of common interfaces.

The use of this model has already helped to create high-quality, consistent interfaces for network management and messaging products. In the future, the AT&T user-interface architecture will be extended by

adding domains and by taking advantage of new user-interface technologies. Other domains in which the same approach can be applied include user interfaces to enhanced features for business telephony and information services. Examples of new technologies include (1) higher-level tools to make the design of user interfaces easier and provide greater separation between the development of the user interface and other aspects of applications and (2) hypertext style technologies.

#### **Acknowledgments**

James P. Cunningham and Steven H. Lewis of AT&T Bell Laboratories, Holmdel, New Jersey, provided many valuable contributions to this paper, as well as to the AT&T user-interface architecture itself.

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(Manuscript received July 25, 1989)

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