INTERNATIONAL TELECOMMUNICATION UNION

ITU-T E.135

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(10/95)

TELEPHONE NETWORK AND ISDN

OPERATION, NUMBERING, ROUTING AND MOBILE SERVICE

HUMAN FACTORS ASPECTS OF PUBLIC TELECOMMUNICATION TERMINALS FOR PEOPLE WITH DISABILITIES

ITU-T Recommendation E.135

(Previously "CCITT Recommendation")

FOREWORD

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

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

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation E.135 was prepared by ITU-T Study Group 1 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 3rd of October 1995.

NOTE

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

CONTENTS

SUMMARY

The intention of this Recommendation is to address telecommunication issues that are encountered by people with disabilities. Telecommunications providers will be challenged with the opportunity of addressing the service requirements of this growing population. This initiative might also contribute to the requirements of the percentage of the population, ranging from 4-12%, that has some form of severe physical impairment.

Recommendation E.135

HUMAN FACTORS ASPECTS OF PUBLIC TELECOMMUNICATION TERMINALS FOR PEOPLE WITH DISABILITIES

(Geneva, 1995)

1 General

1.1 Introduction

The intention of this Recommendation is to address telecommunication issues that are encountered by people with disabilities. Telecommunications providers will be challenged with the opportunity of addressing the service requirements of this growing population. This initiative might also contribute to the requirements of the percentage of the population, ranging from 4-12%, that has some form of severe physical impairment.

The International Standard ISO 9999 "Technical aids for disabled persons – Classification" contains the following definitions:

- **impairment**: Any loss or abnormality of psychological, physiological, or anatomical structure or function.

- **disability**: Any restriction or lack, resulting from an impairment, of ability to perform an activity in the manner or within the range considered normal for a human being.

- **handicap**: Disadvantage for a given individual, resulting from an impairment or disability, that limits or prevents the fulfilment of a role that is normal (depending on age, sex, and social and cultural factors) for that individual.

In principle, impairments represent disturbances at the organ level, disabilities represent disturbances at the level of the individual, and handicaps result from the interaction with and adaptation to the individual's surroundings. Thus, a physical disturbance may or may not result in an impairment. This impairment may or may not result in a disability and a disability may or may not result in a handicap. Whether an impairment becomes a disability or a handicap is an effect of the environment of the individual and provision made within it to cater to his or her needs.

2 Scope

This Recommendation includes services for people with vision, hearing, and motion impairments. Preferably, this Recommendation applies to all public terminals. Practically, however, this Recommendation may cover a subset of public terminals, as determined by particular service provider's circumstances and/or national laws. The information that is contained in this Recommendation should be used at the various steps of user interaction that are addressed in Recommendation E.134, "Human factors aspects of public terminals: Generic operating procedures". This Recommendation is organized to correspond to the steps outlined in Recommendation E.134. Figure 1/E.134 has been added to provide visual representation of the various stages of user interaction for public terminals.

Although the elderly are frequently associated with the disabled in literature dealing with human factors and telecommunications, this Recommendation focuses on people with disabilities. The gerontological perspective, which focuses on the elderly, should be treated separately.

The intent of Recommendation E.134 is to provide a sequence for the basic user actions that should be supported in the design of all public telecommunications terminals. Customers will benefit by being able to use procedures in Recommendation E.134 when using an unfamiliar terminal or a new type of terminal. See Figure 1.

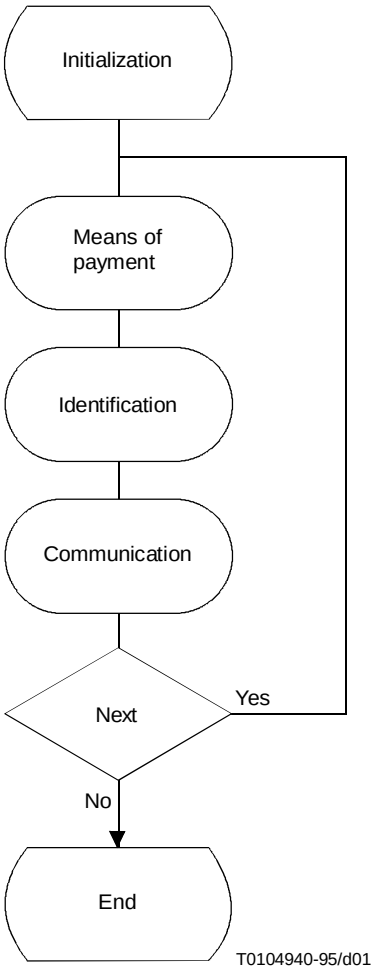

FIGURE 1/E.135

Generic operation procedures for public terminals

3 Initialization step

This step is the user action that activates the service being provided.

3.1 Initialization step – Visually impaired

The public terminal should be located so that there is no risk of collision by visually-impaired persons. The national guidelines to achieve this in the country concerned should be followed.

3.1.1 Signage

Signage to locate the public terminal from a distance may consist of a pictogram (see Recommendation E.121 for further information) or text.

Character height – The letters and numbers on these signs should be sized according to the distance from which they are to be read. For people with an average visual acuity, 1.0, the minimum height of upper case characters and numbers should be 1/125 of the reading distance – for people with a visual acuity of 0.25 this minimum height should be 2.5 times higher, i.e. 1/50 of the reading distance.

Character proportion – Letters and numbers on signs should have a width-to-height ratio between 3:5 and 1:1 and a stroke width-to-height ratio between 1:5 and 1:10.

Finish and contrast – The characters and background of signs should be eggshell, matte, or other non-glare finish. Either light characters on a dark background or dark characters on a light background may be used. The luminance contrast ratio between light and dark character details, within or between characters, should be at least 3:1.

3.1.2 Instructions

On presenting the instructions to the user, the size of characters, the contrast, the lighting conditions, and the colour codes should take into account the requirements of the user.

Instructions and information graphics should be understood by an international user group. Recommendation E.121 gives appropriate guidelines to this effect. They should be designed to convey the maximum amount of information to people with visual impairments. This requires, if at all possible, good, even lighting where the public terminal is located. Furthermore, large characters or symbols and high contrast between any text and its background should be provided. Basically, the same rules as for Signage apply – for instance, the lower-case x-height should be 4 mm for people with a visual acuity of at least 0.25, corresponding to an uppercase X-height of 6-6.4 mm. Still larger characters, however, do not further improve legibility for people with reduced visual acuity.

3.2 Initialization step – Hearing impaired

The public terminal should, if possible, be located in "low-noise-level" environment with good architectural acoustics. The telephone should be equipped with an adjustable volume control which can be identified and located visually and by touch.

3.3 Initialization step – Motion impaired

Public terminals should be accessible to individuals with motion impairments. The physical location should be such that motion-impaired users have free and unimpeded access. Furthermore, the public terminal should be located and designed in such a manner so that it can be easily operated by wheelchair users and other persons with functional disabilities.

There should be sufficient room under and around the public terminal for wheelchair access. A clear floor or ground space of at least 760 mm deep by 1220 mm wide that allows either forward or parallel approach by an individual in a wheelchair should be required. Knee space required for forward approach should also be taken into account when determining clear floor and ground space. The minimum knee clearance should be 685 mm.

The height of the highest operable part of the public terminal should be within reach of motion impaired individuals as well as walking users. If the clear floor space only allows for forward approach, the maximum high forward reach should be 1220 mm. If parallel approach is used, the maximum high forward reach allowed should be 1370 mm.

4 Means of payment step

Means of payment include coins, tokens, and all forms of card technologies. Some services may be provided without charge – in those cases this step could be bypassed. Recommendation E.133 describes the human interaction with a public terminal for card means of payment.

4.1 Means of payment step – Visually impaired

Public terminals can be accessed using a variety of transaction cards. These cards should conform with the International Organization for Standardization (ISO) 7810. The characteristics of these cards should be such that they identify to the user where/how to hold the card and facilitate proper orientation when inserting the card into a public terminal. Card-operated public terminals should give the user a clear tactile and visual indication of how and in which direction the card is to be inserted. If multiple card slots appear on a single phone, clear tactile and visual identifiers should be included to identify which slot to use for which card. Recommendation E.136[1)] describes the location, size, and shape of a notch used for card orientation.

Based on their physical characteristics, telecommunications cards fall into two categories: embossed and unembossed. Because embossed cards provide more information for card orientation by visually impaired users, such cards are preferred to unembossed cards.

---

1) Presenty at the stage of draft.

4.1.1 Embossed cards

ISO 7811-1 specifies requirements for embossed characters on identification cards. If these standards are used, a person with limited vision can sometimes orient these cards by touch.

4.1.2 Unembossed cards

These cards are typically used as a form of telephone payment (cash, debit, prepaid or change). A card should have a tactile marker (i.e. notch) so that it is easily identifiable as a phone card. Cards should also have a tactile marker to aid in the orientation of the card. Clearly perceivable auditory indications that the credit is about to expire should be given.

Currently, Recommendation E.136 addresses the specification of a tactile identifier for use with telecommunications cards.

4.2 Means of payment step – Hearing impaired

Messages such as "card rejected" or "remove card" should be apparent both on display and by speech or other audible indication. It should be possible, both by speech and on display, to be informed of the residual value on the card. This information can be displayed on the card and/or terminal. Clearly perceivable visual and auditory indication that the credit is about to expire should be given.

4.3 Means of payment step – Motion impaired

The coin insertion slot and the card insert slot should be located so that they are easily accessible by persons with motion impairments. The maximum high forward reach measurements are addressed in 3.3, paragraph 3.

5 Identification step

The identification step is the point in the service where the initiating party identifies the destination of the communication.

5.1 Identification step – Visually impaired

Button labelling should be clear with large, high-contrast lettering. There should be enough space between the buttons to prevent accidental operation of two at the same time. Buttons should be large enough to easily locate and operate. Buttons should also provide audible indication of key activation.

With regard to the keyboard layout and location of the keys ∗, 0, and #, the keyboard should comply with Recommendation E.161 concerning keyboard layout. If the telephone is equipped with function keys other than those prescribed in Recommendation E.161, clear tactile identification is desired.

There should be the highest possible contrast between key background and text. Black text on white key background is preferable. The colours red and green must not be used together. There should also be the highest contrast between key and terminal background colour. Highly reflective, engraved keys should be avoided.

If guidance is given to the user from a liquid crystal display, the lettering should be large and well lit. The telephone display should have the best possible contrast. Black writing on a white background is preferable. The display should be equipped with background lighting and the viewing angle should be designed in such a way so that it is readable from a wheelchair. The display text should have a minimum height of 8 mm. Voice guidance should be provided as an alternative for visually impaired users.

5.2 Identification step – Hearing impaired

5.2.1 Volume control

Public terminal devices that facilitate voice communications should include volume control capabilities. Volume controls, whether they be contained within the handset or integrated into the terminal, should be capable of increasing the volume within the range of 12 dB minimum and 18 dB maximum above the non-amplified state. The 18 dB maximum should not apply where an automatic reset (i.e. on-hook) to the non-amplified state is provided. But even in the case of an automatic reset capability, the level should never exceed 20 dB above the non-amplified state. However, care should be taken that under no circumstances should the maximum attainable amplification be great enough to cause

either hearing damage or acoustic feedback. It is preferable for the volume to be always reset to the non-amplified state when the handset is returned to the cradle, or after a short time-out. Such a time-out would allow users to make subsequent calls without resetting the volume control.

5.2.2 Hearing aid compatible

Public terminal devices that facilitate voice communications should be equipped with handsets that are hearing aid compatible through inductive coupling. These handsets generate a magnetic field to which hearing aids may couple. Requirements for magnetic field intensity for telephone compatibility with hearing aids can be found in a (draft) ETSI ETS (European Telecommunication Standard) on inductive coupling, Draft ETS 300-381: "Telephony for hearing-impaired people, inductive coupling of telephone earphones to hearing aids. Performance requirements and testing methods". Other, somewhat older Standards on such inductive coupling are Recommendation P.37 and the Electronic Industries Association (EIA) Standards RS-504.

5.3 Identification step – Motion impaired

The dialling and all function keys should be located so that they are easily accessible by persons with motion impairments. Subclause 3.3, paragraph 3 describes the physical dimensions recommended for easily accessible terminals.

6 Communications step

The communications step is the point in the service when communication takes place over the network.

6.1 Communications step – Visually impaired

As far as visual display is used for showing either control messages or (part of) the contents of the communication proper, the following visual characteristics of interfaces for normal and low-vision users apply. The content of this subclause is largely derived from (Van Nes and Bouma, 1990).

6.1.1 Intake of visually displayed information

Information presented on visual displays is either in graphical or text form. The information of immediate interest for performing a task should be searched for on the visual display. Searching is facilitated by not over-filling the visual display and, whenever possible, giving a sufficient amount of conspicuousness to the graphical or textual items to be found. This can be done by a proper use of layout, colour and typography (Van Nes, 1986). It also means that the area to be searched should be restricted as much as possible. Visual displays with superfluous, distracting "information", such as system or brand names and logos should be avoided. Such distractions unnecessarily make the task of searching for particular information more difficult and therefore should be discouraged.

Once the information sought is found, searching changes into interpreting the graphics concerned, according to criteria that now are partly known, or into reading. Roughly speaking, the same characteristics that aid search are also helpful for reading with sufficient visual comfort.

6.1.2 Adaptation to the visually impaired

Basically, the visual requirements for performing the (sub) tasks of reading textual or graphical material described in the previous subclause are similar for normal and low-vision users. However, for the latter category some adaptations must be made. This is of course only possible to a certain extent (i.e. to visual acuities that are not too low).

The following adaptations can be made:

Character size: This should be larger than for normal vision. Users with a visual acuity from 0.25 can read letters with an x-height of 4 mm without optical magnifiers. There are, however, upper limits to the size of characters in text that can be read without too much trouble, especially if the same text also may have to be read by people with a normal visual acuity. There is not a large amount of literature in this area (but see Aberson and Bouma, Acta Psychologica, in press). From the present data it can be concluded that the maximum useful x-height of characters is 7 or 8 mm.

Character shape: The discriminability of characters should be maximized, to cope with lowered visual acuity. Discriminability is more important than aesthetic concerns.

Contrast: The character-background contrast should be high, and in particular, specular reflections from the screen should be avoided.

In general this requirement leads to positive image polarity (i.e. dark letters on a lighter background, especially for high levels of ambient lighting). However, some pathological conditions such as cataracts lead to an increased glare sensitivity, calling for a minimum of display light, (i.e. light letters on a darker background). Therefore, the user should preferably be able to select the image polarity.

Wording of phrases: The larger character size means a reduced text capacity of the screen. This calls for a carefully considered, brief wording. If the screen is still too small to contain a complete message or paragraph, replacement of screen pages is better than scrolling because the latter destroys the reader's orientation in the pages read.

Orientation on the screen: Another way to cope with the problem of reduced screen capacity is windowing: different windows, clearly represented by sufficiently large icons when closed, could contain the messages needed in a concise form. The advantage of such a windowed set of messages may be an improved overview of the texts available to the users, because otherwise they may well experience orientation problems – especially when using magnifiers.

6.2 Communications step – Hearing impaired

Please refer to 5.2.1 and 5.2.2.

6.3 Communications step – Motion impaired

Please refer to 3.3.

6.4 Communications step – Speech impaired

A Telecommunications Device for the Deaf (TDD) or Text Terminal is a device that allows people who are hearing or speech impaired to use the existing voice network to communicate.

TDDs used with a public terminal should be permanently affixed within, or adjacent to the telephone enclosures. If an acoustic coupler is used, the cord length from the terminal to the handset should be a minimum of 813 mm (32 inches) to allow connection of the TDD and the telephone receiver.

Some public terminals are designed to accommodate portable TDDs. Such terminals should be equipped with a shelf and an electrical outlet within or adjacent to the telephone enclosure. The telephone handset should be capable of being placed on the TDD so that it allows proper acoustic coupling. The shelf should be capable of accommodating a TDD and should have 150 mm minimum vertical clearance in the area where the TDD is to be placed.

7 Next step

The next step is the availability of next call or new option capabilities in public terminals.

7.1 Next step – Visually impaired

If the public terminal is equipped with function keys other than those prescribed in Recommendation E.161, clear tactile identification is desired.

7.2 Next step – Hearing impaired

Please see 5.2.1 and 5.2.2.

7.3 Next step – Motion impaired

The next call key when or if provided should be located so that it is easily accessible by persons who are motion impaired. Subclause 3.3, paragraph 3 describes the physical dimensions recommended for easily accessible terminals.

8 End step

At the conclusion of use of the public terminal, the end user notifies the public terminal in the form of an action indicating the service is complete.

8.1 End step – Visually impaired

The public terminal should provide an audible reminder to the end user to remove the means of payment, if appropriate.

8.2 End step – Hearing impaired

Please refer to 5.2.1 and 5.2.2.

8.3 End step – Motion impaired

Please refer to 3.3.

9 Additional information regarding people with disabilities

9.1 Hardware

The cord length from the terminal to the handset should be a minimum of 737 mm (29 inches) to allow the handset to reach:

- the ear and mouth of a tall person standing in an upright position;
- a TDD for acoustic coupling;
- the ear and mouth of a person in a wheelchair or a child.

The area to which the handset can reach is dictated by a combination of the cord length, the point where the cord leaves the case of the terminal, and the height of the terminal off of the ground.

9.2 User instructions

The user instructions should be provided in multi-mode (e.g. Braille, visual display, and possibly audio) to cope with the different requirements of people with disabilities.

The structure of the dialogues to operate the basic public terminal facility should be simple, straight forward and clearly indicated. The sequence of end user steps should be provided.

Symbols of accessibility – For symbols, references should be made to relevant internationally agreed to symbols for use with telecommunications equipment. Public terminals with volume control should be identified by a sign containing a wedge with appropriate nomenclature (for instance, “volume”) or a picture of a handset with concentric circles symbolizing radiating sound. Directional indication should also be included as part of the signage requirements. Additional information on symbols and pictograms can be found in Recommendation E.121.

9.2.1 Visually impaired

At a minimum, auditory step-by-step prompting on how to place calls should be given. The SOS/Emergency number should also be provided in Braille in a prominent standard location.

9.2.2 Hearing impaired

Information on the availability of inductive coupling (if any) and how to adjust volume should be provided. For inductive coupling, this might be done by the pictogram of Figure 5/E.121, an ear with a bar across. For volume control, it might be done by the “ramp” symbol of Figure 11/E.121.

9.2.3 Motion impaired

To accommodate the legibility requirements of persons who are wheelchair bound or have short stature, such as children, the instructions panel should be located no higher than 1200 mm from the floor for forward approach areas and 1350 mm for parallel approach areas.

10 References

ABERSON (D.), BOUMA (H.): *Acta Psychologica*, in press. The influence of age, visual acuity and character size on word recognition.

VAN NES (F.L.), BOUMA (H.): Telecommunication interfaces for the visually disable, *Proc. 13th Int. Symp. Human Factors in telecommunications*, pp. 227-234, Turin, Italy, 10-14 September 1990.

VAN NES (F.L.): Space, colour and typography on visual display terminals, *Behaviour and Information Technology*, Vol. 5, No. 2, pp. 99-118, 1986.

Americans with Disabilities Act Handbook, 1991.

EIA (Electronic Industries Association) Standard RS-504.

Draft ETSI ETS 300-381.

ISO Standards 7810, 7811-1, 9999.

ITU-T Recommendations E.121, E.134, E.136, E.161.