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Contents

Foreword

ETSI Technical Reports (ETRs) are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature or is not yet suitable for formal adoption as an ETS or I-ETS.

This ETR has been produced by the Human Factors (HF) Technical Committee of the European Telecommunications Standards Institute (ETSI). It is based on "Use of Telecommunications: The needs of people with disabilities" [1], a report from the European Co-operation in the field of Scientific and Technical Research (COST), Project No. 219, "Future telecommunication and teleinformatics facilities for disabled people" [2], Working Group 2, "Practical needs of disabled people" [3].

Introduction

The proportion of elderly people in the population is growing rapidly. According to the OECD Demographic Data File, the medium fertility variant projections for Europe of people aged 65 years plus will increase, from 12 % of the population in 1980 to 16 % in the year 2010 and 22 % in the year 2040. Within this grouping, the proportion of those aged 80 years and over will increase from 17 % in 1980 to 25 % by the year 2040. In some individual countries these figures will be even higher.

With continually improving health standards, elderly people now tend to live longer and, with the universal lowering of the retirement age, lead much longer active lives. The future elderly, who also tend to live more independent lives and are, generally, economically better off than previous generations, will constitute an important group of new users of telecommunication services.

Due to age related impairments and disabilities, special considerations need to be given to the design of telecommunication equipment and services so as not to exclude them from using the new telecommunication services now being developed.

With the world-wide and accelerating growth in industrialisation and urbanisation, an increasing segregation between working and living areas and increased mobility for large population groups, more and more people of all ages will be dependent on telecommunications. In certain, previously rural populations with little or no formal education, who are now increasingly urbanised, they shall have to learn to cope with modern technology, including telecommunications. Special considerations in the design of user-friendly equipment and services is needed.

A more recent trend, currently gaining momentum, is the increased recognition of the need to integrate disabled people into society rather than caring for them in specialised institutions. These people will be much more dependent on telecommunications to allow them to lead independent lives.

These people will also have more diverse and special needs in relation to telecommunications than the other above-mentioned groups but, taken together, all of these users will be a challenge to designers and providers of existing and new teleservices.

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1 Scope

The scope of this ETR is both to identify some of the main factors that can inhibit the access to and use of telecommunication services for people with special needs, and to propose recommendations for improvements and changes in terminals and services to make basic telecommunication services accessible to as many people as possible.

The term "people with special needs" denotes people who for any reason such as: advanced age, temporary illness or injury, permanent physical or intellectual impairment or disability, belonging to an ethnic, cultural or linguistic minority group, having little or no relevant education, etc., will encounter barriers in accessing, and difficulties in using, the telephone and other telecommunication equipment and services.

This ETR is not a comprehensive treatment of all impairments and disabilities that can occur, nor of all possible problems that people with special needs may encounter in using and accessing telecommunications, or the recommendations for solutions to overcome these problems.

The factors that have been identified in this ETR are intended as a basis for new ETSI telecommunications standards taking account of people with special needs and for national legislation.

It is important that the requirements of people with special needs are seriously taken into consideration when new teleservices are designed and when new ETSs are made, first and foremost to make basic teleservices accessible to as many people as possible, and secondly, to reduce the need for having to provide special terminals and services to other people than the most seriously disabled people (e.g. deaf-blind people) who cannot be helped in any other way.

Since this ETR cannot cover the very extensive field of user interactions and people with special needs, interested readers are encouraged to consult further literature on these topics as well as the ETSI experts in this field within STC-HF2.

2 References

For the purposes of this ETR the following references apply.

[1] European Co-operation in the field of Scientific and Technical Research (COST): "Use of Telecommunication: The needs of people with disabilities".

[2] COST Project No.219: "Future telecommunication and teleinformatics facilities for disabled people".

[3] COST, Working Group 2: "Practical needs of disabled people".

[4] CCITT Recommendation E.161 (1988): "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

[5] ISO/DIS 9999: "Technical aids for disabled persons - Classification".

3 Impairments and disabilities

3.1 Visual impairment

Visually impaired people can be divided into three categories:

- people who are blind or seriously visually impaired;

- people who are partially sighted and who cannot read;

- people with reduced vision but who can read with aid.

With regard to telecommunications, the first two groups often have similar problems, while people with reduced vision but can read usually encounter fewer problems.

3.1.1 Physical access: private subscribers

Blind and partially sighted people have relatively few problems in getting access to the telephone in well known surroundings, e.g. in their home, at their work place or in the houses of family and friends, but they may have great difficulties in locating a telephone in unfamiliar surroundings.

A blind person may often be able to locate a ringing telephone by auditory localisation, but in some surroundings it is not always possible to pin-point the position of a ringing telephone due to bad acoustics. Some modern telephones' ringing signals can also have very poor directivity for auditory localisation.

3.1.2 Physical access: public telephones

Blind and partially sighted people are unable to locate telephones in open and unfamiliar surroundings, e.g. public telephones and phone booths, if the telephone is silent or if the site is not marked in a way that is easy to perceive by blind or partially sighted people, e.g. sound signals or specially patterned pavement/floor surfacing.

Proposed solutions: it is important that telephones are identified so that blind and partially sighted people are able to locate them, e.g. by showing their positions on direction boards or floor plans, or to mark them acoustically or by specially patterned pavement or floor surfacing which can be easily perceived by blind people.

3.1.3 Payment: coins, cards

Blind and partially sighted people normally have few problems in identifying and handling coins of different denominations in their own currency, but coins of foreign currencies may constitute great obstacles. Magnetic cards are also easy to handle, but need to be identified for correct insertion, e.g. by a notch or cut corner.

Locating and identifying the coin/card insertion slot (or slots when different denominations have to be inserted in different slots) can be a major problem. Visual displays, showing either the amount that has been inserted or the amount remaining, and providing prompts to insert more coins are impossible for use by blind people.

Proposed solutions:

a) slot(s) for inserting coins must be fashioned in a tactile manner for easy identification of where the coins have to be inserted and the type of denomination the terminal will accept;

b) terminals that accept magnetic cards, should have the insertion slot marked in a similar way to show where to insert the card and how the card must be inserted or moved through a card reader. Cards must be tactilely identified for the correct way to insert;

c) there should be some form of acoustic feedback to advise the user about the amount that has to be inserted, the amount that has been accepted by the terminal and, during a call, of prompts to warn the user if more coins need to be inserted.

3.1.4 Reading telephone directories

Blind and partially sighted people who cannot read ordinary print cannot use telephone directories or printed signs displaying telephone numbers and directions for making calls. Directories printed in Braille are too bulky, expensive and impractical to provide blind people with telephone numbers and other information. Also, relatively few blind people can read Braille.

People with reduced vision, who can read with aid, may have problems with the small print and poor contrast in many directories (a situation which is not improved by the usually low level of lighting in public telephone booths where the directories may have to be read).

Proposed solutions: a service with prerecorded or synthetic speech, or manned by operators, to give verbal information about telephone numbers and call set-up procedures, should be provided to help blind and partially sighted people and other people who cannot read. Telephone directories should be printed in larger typeface and have better print to paper contrast.

3.1.5 Lifting handset: going "off-hook"

Once the handset has been located, blind and partially sighted people have no problems in lifting the telephone handset off-hook to initiate call set-up or to answer a call. For hands free mode and other services that require different procedures for initiating the terminal (e.g. off-hook or en-bloc dialling), blind and partially sighted people may have problems in identifying and operating an unorthodox "off-hook function" correctly.

Proposed solutions: terminals that require other procedures for initiating a call(s) than lifting the handset off-hook to dial, must have an easily recognisable control, with standardised markings for both tactile and visual identification and simple acoustic prompts.

3.1.6 Dialling the number: reading the keys

Blind and partially sighted people can normally use a standard telephone for dialling ordinary calls, but it is absolutely essential that the number dialling keys, or the digits on the dial, are laid out in a standardised way on all telecommunication terminals.

To assist blind and partially sighted people, the "5"-key should be identified by a "dimple" or other tactile marking. Unfortunately, both CCITT and ISO number keypad layouts are currently in use on telephones and other teleinformatics equipment. It is impossible for blind and partially sighted people to determine the actual layout of the numbers on a keypad (or dial), even when the "5"-key is tactilely identified, since this key is located in the same position in both key layouts. ISO number key layouts should not be used.

Non-standard dialling key layouts and function keys marked only with text, abbreviations, icons, pictograms, symbols etc., are not accessible to blind people. Keys should be tactilely marked and grouped according to their functions for easy tactile localisation.

If standard and non-standard keypad and dial layouts are mixed (e.g. as in Denmark and Norway), blind and partially sighted people will have problems. They have no way to figure out the layout of a particular keypad or dial by themselves. It is, therefore, imperative that only standardised keypad and dial layouts are used.

Proposed solutions: the layout of the number dialling keys on all telephones and teleterminals where telephone numbers have to be dialled must conform to CCITT Recommendation E.161 [4].

"2 x 6" or "6 x 2" key layouts are best avoided. If they must be used they should also follow CCITT Recommendation E.161 [4]. Novel and unorthodox key layouts should never be used since they will only confuse blind and partially sighted people. Turning dials must also conform to CCITT Recommendation E.161 [4].

Keys for auxiliary functions and supplementary features (e.g. redial, store/recall number, hold, etc.) should also be standardised and positioned in such a way that they will not be confused with the number dialling keys. They should be marked tactilely for easy identification. This is also good practice for non-impaired users.

3.1.7 Dialling the number: turning or pressing

For people who have to rely only on tactile and haptic information, it is important that the size, spacing and layout of keys and controls follow good ergonomic practice to facilitate the use of the terminal. This is also beneficial for non-impaired users. Small and crowded keypads are very difficult to use for people with visual (and motor) disabilities, and keys and controls located out of context, or in unexpected positions, may be impossible to find.

Using the traditional telephone turning dial is no problem for blind and partially sighted people, provided it follows the standard layout. They count off the finger holes on the dial until the correct digit is reached, then turn and release the dial in the usual way.

Proposed solutions: the size and spacing of keys should conform to accepted standards and well established ergonomic practice for keys. Grouping and positioning of keys should be logical and standardised to facilitate their localisation.

Keys should be marked for easy visual identification with large, high contrast numbers and legends for people with reduced vision who can read. Colour coding alone should be avoided because of colour blind people. If used, it should never be the only mode of coding, but be an addition to other information.

3.1.8 Visual alerting signals

Blind and partially sighted people cannot access visually displayed information, e.g. identify the active line in telephones with line light indicators, or the current status of multimode keys, where mode is indicated by lights, LEDs or LCD (Liquid Crystal Display).

Proposed solutions: essential, visually displayed information should also be given in parallel, either as acoustic signals or in a tactile form (e.g. buttons that pop up, vibrating buttons or displays, flags, etc.) to indicate active line or function mode.

3.1.9 Colours

Between 7 % and 10 % of all males in the normal population are colour blind or have deficient colour vision. Many visually disabled people also have reduced or no colour vision. It is, therefore, recommended that the use of colours as the only means of coding or identification should never be used. If colour coding cannot be avoided, it should always be in addition to other information, e.g. to icons, pictograms and symbols, text or abbreviations, inverse contrast, etc., for information redundancy.

If colours are used to identify different groups of keys (e.g. dialling keys versus function keys), clear, inverse colour contrasts (e.g. white keys with red legends versus red keys with white legends) can be acceptable, except to the blind and most seriously visually impaired people. All colours used should transform into clearly discernible grey-tones on the monochrome grey-scale.

Proposed solutions: colours should never be used alone to indicate vital functions and messages, but always in addition to other modes of information. If colours are used to identify or separate keys and information on displays, the colours should be chosen so that they are easy to separate into distinct grey-tones when transformed to the monochrome grey-scale.

3.2 Auditory impairment

People with impaired hearing can be divided into two main categories according to the seriousness of the hearing impairment in relation to telephone communication:

- people who are hard of hearing;

- people who are profoundly deaf.

Profoundly deaf people are traditionally divided into two categories:

- people who are pre-lingually deaf;

- people who are post-lingually deaf.

People who are born deaf, or have lost their hearing before they have learnt to speak, are called pre-lingually deaf. These people will typically have poor speech intelligibility, or no speech, and poor or no reading abilities. This is because for most of these people their first language will be the manual sign language of their country (i.e. French sign language in France, Norwegian sign language in Norway) and not the native tongue spoken in their environment.

People who lose their hearing later in life, after they have acquired a basic spoken language, are called post-lingually deaf. Depending on the time of the onset of deafness, these people may retain anything from intact and fully intelligible speech to very unintelligible or no speech at all. The reading abilities of post-lingually deaf people are normally also retained, but some post-lingually deaf people may not be able to read or be able to read very well. Reading impairments are treated further in subclause 3.4.

People with impaired hearing may thus be grouped according to their retained functions as follows:

- people who are profoundly deaf without intelligible speech but who can read;

- people who are profoundly deaf without intelligible speech but who cannot read;

- people who are profoundly deaf with intelligible speech but who can usually read;

- people who are hard of hearing.

These groups all have different problems with telecommunications and various solutions are needed.

3.2.1 Line signals

Profoundly deaf people with fully intelligible speech are potential users of ordinary telephony for giving one way spoken messages. However, they cannot hear telephone line signals, i.e. dialling tone, ringing tone, engaged tone, etc., and cannot know when to dial, if the other telephone is ringing, if the other party is engaged, etc.

Therefore, they must be advised about the status of the line signals by means of visual displays; preferably by displays that give the information in full text, icons or pictograms, or by simple lights, LEDs or LCDs that just mimic the line signals' time cadences. Noisy lines may interfere with the working of simple indicators.

Proposed solutions: visual displays, showing line status in text or symbols (ISDN), indicators that mimic line signal time cadences, should be provided on telephones to aid profoundly deaf people.

3.2.2 Acoustic alerting signals

Even a moderate hearing loss can make it difficult to hear a ringing telephone. Amplification of the ringing signal, combined with remote bells, and alerting lights, on the telephone or remote from it, will aid people with impaired hearing. Remote tactile vibrators, similar to vibrating pagers carried on the person, may be an interesting new aid.

Proposed solutions: all public telephones should also have some visual indication of the ringing signal. All telephones should have provisions for adding acoustic, visual or tactile signals, either local or remote, to aid hearing impaired people.

3.2.3 Vocal communication

Deaf people with no or unintelligible speech cannot communicate vocally. They can use the telephone for sending simple messages or alarms (the operator then tracing the call to locate the caller). For these people the text telephone for written communication or the video telephone for manual sign language communication and for lip reading should provide the best solutions.

It is important to stress that most post-lingual, profoundly deaf people retain intelligible speech and can use the telephone for vocal messages to hearing people, even though they cannot hear the replies and vocal interaction with other people is not possible. To aid profoundly deaf people, it is important that all operations to be performed and all signals to react on are also visually displayed.

People who are hard of hearing can use the ordinary telephone if some consideration is given to its design and to its surroundings.

The introduction of piezoelectric earphones in modern telephones has degraded the telephone service for people with impaired hearing who use hearing aids. Inductive coupling between the telephone handset and the hearing aid is the most beneficial feature to telephone communication for hearing aid users. Means must be found for obtaining good inductive coupling to hearing aids and a minimum electromagnetic field strength must be specified.

Acoustical amplification, with a loudness control, is of great help to people who are hard of hearing but do not use hearing aids and have no recruitment. To be of help, the amplification should have a gain of at least 20 dB (precautions may then be necessary to avoid acoustic feedback, which may lead to feed-back howling).

Reducing ambient noise at telephone sites will improve intelligibility for all users since noise is very destructive to vocal communication, especially when the hearing is impaired.

Proposed solutions: all telephones must provide for inductive coupling to hearing aids, e.g. by use of electrodynamic earphones, coils or other means. A standard for a minimum field strength is required. Adjustable, acoustical amplification should be provided for people who are hard of hearing, but do not use a hearing aid.

3.2.4 Operator controlled alarm services

Profoundly deaf people without intelligible speech may only be able to give simple error messages or alarms of errors in the system.

Profoundly deaf people with intelligible speech are usually able to give vocal error messages and alarms, but cannot interact with an operator or the recipient of the message.

People who are hard of hearing can normally communicate with an operator, although communication may be more difficult than for people with normal hearing.

Proposed solutions: operators of error and alarm telephones should be trained to deal with various communication disabilities to prepare them for situations where they must communicate with the deaf, the hard of hearing and people with speech impairments.

3.3 Impairment of speech production

People with speech impairments may be divided into three groups:

- people with no speech (or voice output);
- people with unintelligible speech;
- people with low volume intelligible speech.

These groups have different requirements for special services and equipment for telecommunication.

3.3.1 Vocal communication: no voice output

People with no voice output or have totally unintelligible speech cannot communicate vocally by telephone. For these people an optional keyboard or a text telephone for written communication may offer the best solution. The video telephone for lip reading support and manual sign language communication may soon offer good help.

The degree of intelligibility of the speech of people who speak with reduced intelligibility will vary greatly. This will influence vocal communication to different extents. Moderate levels of intelligibility may lead to some misunderstandings and the need for frequent repetitions. Some people with low intelligibility speech may not be able to conduct telephone conversations, although they may be able to communicate vocally in face-to-face situations.

3.3.2 Visual communication: lip reading

People with reduced speech intelligibility who cannot use the telephone, but who can communicate vocally in face-to-face situations, may find that the video telephone may enhance their vocal communication, e.g. by lip reading and gestures.

Some people with impaired speech production also lack control of lip movements (e.g. people with cerebral palsy). These people can neither use the video telephone for lip reading, nor can they lip-read.

3.3.3 Operator controlled alarm services

Reduced intelligibility may make communication with operators or personnel manning alarm telephones difficult, especially over poor quality lines.

Proposed solutions: operators of error and alarm telephones should be trained to deal with various communication disabilities to prepare them for situations where they must communicate with people with speech impairments.

3.4 Reading difficulties

People with reading difficulties can be divided into five groups:

- people with language impairments;
- pre-lingually deaf people (see subclause 3.2);
- people with insufficient reading education;
- foreigners and lingual minorities;
- visually impaired people (see subclause 3.1).

People with severe reading difficulties will normally be able use the telephone for making ordinary vocal calls.

3.4.1 Instructions and guidelines

People with language impairments may encounter problems with tasks that involve reading user instructions and other printed directions. This may inhibit their use of many new services where long and complicated operating instructions and user procedures need to be read.

People with insufficient reading education, lingual minority groups, pre-lingually deaf people, refugees and people visiting a foreign country with a different language from their own and visually impaired people will all encounter great problems in dealing with written directions-for-use and telephone directories.

Proposed solutions: it is important that easy-to-understand directions-for-use are worked out using pictograms, miniatures, icons, symbols or simple abbreviations to help people with reading difficulties to use telephones. All pictograms, miniatures, icons, symbols and abbreviations used should be designed for easy recognition and understanding, and should be internationally standardised. Electronic coded dialling aids may benefit some of these people.

3.5 Reduced language comprehension

When referring to reduced language comprehension and intellectual impairment it is assumed that the impairment is not so serious that it precludes using a telephone or other form of telecommunication.

3.5.1 Payment

People with reduced language comprehension and intellectual impairment may have problems in following and understanding instructions on user procedures, such as the right order of activities in paying (e.g. to lift the handset off-hook before inserting coins). They may also have difficulties in understanding the use of money and to identify coins of different denominations (see subclause 3.9).

Proposed solutions: procedures for paying must be very simple and standardised; i.e. the order of actions should always be the same. Instructions should be graphic and extremely simple to comprehend and follow for people with intellectual impairment and impairment of language comprehension, but also for people with little education, people who only speak foreign tongues or people who belong to linguistic or ethnic minority groups.

3.5.2 Access to telephone directories: reading

People with reduced language comprehension and intellectual impairment will typically not have the necessary reading skills for using the ordinary telephone directory or reading other printed instructions for using telephones and other telecommunication equipment. They may, however, recognise simple icons and abbreviations and may comprehend and be able to follow graphic instructions. They should be trained in using the telephone.

Proposed solutions: basic user instructions should not demand reading skills or knowledge of the local language. Simple graphic instructions, with miniatures and pictograms showing sequences of procedures, should be standardised to make telephones accessible to people with reduced language comprehension.

3.6 Mobility impairment: legs and feet

People who are mobility impaired may be divided into three groups:

- people who are confined to bed;
- people who are dependent on wheelchairs;
- people who can walk with aids.

The main problem for mobility impaired people is actually getting to the telephone so that they can use it. For people who are confined to the bed, equipment must be designed in such a way that it can be used from the bed.

3.6.1 Physical access: private subscribers

Physical access to telephones in the homes of mobility impaired people can usually be arranged in such a way that it is no great problem to reach the telephone. In the houses of other people, e.g. family and friends, this can be more difficult. At places of work, in some offices, etc., there may sometimes be problems in placing telephones in such a way that mobility impaired people can have easy access to them. The cordless telephone, the "personal telephone" (e.g Telepoint), or even the mobile telephone, should be of great help to mobility impaired people.

A person walking with aids or using a wheelchair may need some time to get to and answer a ringing telephone. It may take so long that the other party gives up and hangs up. Some kind of remote control (e.g. an infra-red or radio device) to electronically take the telephone "off hook" when it rings and give a simple message e.g. "please wait, I will soon be with you", should be of great help to mobility impaired people.

Proposed solutions: provisions for using an electronic "off hook" remote control device, that gives a short "wait" message, should be standardised to aid "mobility impaired" people who need some time to answer a ringing telephone.

3.6.2 Physical access: public telephones

People who use wheelchairs or can only walk with aids can often have considerable difficulties in accessing public telephones, e.g. having to climb stairs to get to them. Also, the design of public telephone booths leaves much to be desired in accessibility for people who use wheelchairs or who can only walk with aids.

There are three major types of public telephone booths:

- closed telephone booths, where the width of the entrance, the operation of the doors, the height of the entrance step, insufficient space inside and, not least, the high placing of the telephone makes them impossible or very difficult to be accessed and used by people in wheelchairs or those who can only walk with aids;

- high open booths, where the high placing of the telephone makes them impossible or difficult to use from a wheelchair, and where the ambient noise level, due to lack of acoustic insulation at the level of the wheelchair users' ears, makes it difficult to carry on a conversation or to keep it private;

- open booths with telephones placed low, where they are easily reached and operated from a wheelchair, but where the background noise level, for lack of acoustic insulation at the level of the wheelchair users' ears, makes it difficult to carry on a conversation or to keep it private.

Proposed solutions: public telephones and telephone booths must be designed for full accessibility to people in wheelchairs and people who can only walk with aids; there must be no steps; the width of the booth and its door must allow entry of a standard wheelchair; doors must be easy to open and close by a seated wheelchair user and must not require any great strength to operate.

Telephones must either be placed at a height where they can easily be operated by a person in a wheelchair or a standing, short person, or it must be height adjustable; the acoustic conditions in the booth must not adversely affect intelligibility or make it easy for other people to overhear conversations.

There should be some form of fold-away seat or body support for people with little strength in their lower limbs to sit on or to support themselves on while making calls. Telephones should be placed at a height where they can easily be used by seated people, children and people of short stature. There should be a shelf for people with little strength in their lower limbs for supporting themselves, for supporting directories and for writing.

Lighting must be sufficient and properly arranged for operating the telephone and for reading operating instructions and telephone directories by wheelchair users.

3.6.3 Payment

People with mobility impairments have few problems in handling coins and cards if they can reach the insertion slot. Even when the telephone is placed at a low position some parts may still be out of reach to

people in wheelchairs; e.g. if the slot for inserting coins or cards are placed on top of the terminal. It is important that all the telephone functions can easily be operated from a seated position or by children and people of short stature.

Proposed solutions: public telephones should have all controls, i.e. dialling and function keys, handset, coin/card insertion slots, etc., placed so that they can all be operated from the same seated or low position relative to the telephone terminal.

3.6.4 Telephone directories

Telephone directories are often fixed or hinged to the desk or the wall in public telephone booths and can be difficult to handle, or totally inaccessible, to people in wheelchairs or to people of short stature. Telephone directories may be very difficult or impossible to use by a person lying in bed.

Lighting is often insufficient where directories are fixed and must be read, and is often arranged in such a way that someone leaning over the directory to read it will put it in a shadow. Lighting should be arranged for good visibility in the booth for all functions and for reading operating instructions and directories without putting them in a shadow.

Proposed solutions: telephone directories must be positioned and secured in such a way that they are fully accessible to people in wheelchairs or people who have to get close to read small print. Lighting in telephone booths where directories are read should be sufficient, non-glaring and arranged so that near-sighted readers will not put the text in their shadow.

3.6.5 People who are confined to bed

People who are confined to bed constitute a diverse group. Some will have good motor control and strength, allowing them to use standard telephone equipment and directories in a normal way. Some people have little or no motor control and/or little strength, or they are restricted by medical equipment or confined to fixed postures (e.g. lying prone or supine). These people will require special solutions.

Proposed solutions: one-piece, compact or cordless telephones are very useful for most bed confined people. Electronic telephone directories (displayed on a screen), loudspeaking or hands-free telephones and remote answering devices should all be helpful to people who have little strength, are restricted in their movements or are in fixed postures. Telephones on trolleys, like the pay-phones used in hospitals, may be used in the home.

3.7 Motor impairment in arms and hands, reduced strength

People who have lost one or both arms or hands, or have problems using one or both arms or hands due to upper limb motor impairments, are still able to communicate normally via the telephone, but they may encounter great problems in operating a standard telephone terminal.

3.7.1 Access: private subscribers

At home, people who cannot use their arms and hands can have special foot-operated devices to lift the handset off-hook and hold the handset in the right position for speaking. Many motor impaired people have become experts in dialling (push buttons and rotary dials) with e.g. mouth-held sticks or other similar devices.

3.7.2 Access: public and other telephones

When people who cannot use their arms and hands have to use telephones outside their homes they meet nearly unsurmountable physical obstacles. They may still be able to use a mouth stick or similar device for dialling, but opening the doors of some telephone booths, or lifting the handset off hook and holding it against the ear during the conversation, may be nearly impossible.

An automatic door opener/door closer, operated by a treadle or large touch panel, the hands free (i.e. non-handset) telephone mode and large dialling keys, that require little force to operate, can make it possible for some people who cannot use their arms and hands to access and use a telephone for making ordinary calls when away from their homes.

Proposed solutions: public telephones and telephone booths should be designed so that people who cannot use their arms and hands are able to make ordinary telephone calls without enlisting the help of other people.

If doors are fitted to telephone booths, they should be operated from e.g. a treadle or large touch panel or button that requires little force, to make access possible for people with little strength and for people who cannot use their arms and hands.

Telephones must be designed in such a way that they can be operated with e.g. a mouth stick (or similar device) by people who cannot use their arms and hands.

All push buttons and keys must be large enough to receive the end of a mouth stick; keys must require little operating force; keys must have a slightly concave and non-slipping surface, and keys must face the user at an angle that is appropriate for operation by a mouth stick, but they must also be visible to non-impaired users.

3.7.3 Payment

Handling and inserting coins and telephone-cards can be almost impossible for people who cannot use their arms and hands. There are mouth-operated pincers and other special devices that these people can use.

In an emergency some people may have to use their lips and teeth to pick up and insert coins or cards, but most people will find this rather unattractive as a routine operation. It is important that slots for inserting coins and cards are positioned so that it is possible for people who cannot use their arms and hands to be able to insert coins and cards with a mouth operated tool.

Proposed solutions: all public telephones should be made accessible to people who cannot use their arms and hands for paying with coins or cards by arranging the positions of insertion slots in such a way that coins and cards may be inserted with a personal tool or, in an emergency, directly by mouth. The facility to pre-feed coins, would save the individual from having to do this during a call.

ISDN will, of course, also allow other services that are not possible in the analogue network, e.g. B-subscriber debiting, electronic directories and other services that may be beneficial for people with special needs.

3.8 Impairment of growth

People with growth impairments may be divided into two groups:

- people of shorter than average stature;

- people of taller than average stature.

Both people who are shorter and taller than average may encounter difficulties in accessing and using some phone booths and public telephones, but for different reasons.

3.8.1 Short stature

People of shorter than average stature and children, who have not yet reached their final height, may find it difficult or even impossible to use public telephones if these are placed at the normal height. Even when telephones are placed lower than usual, people of short stature may still not be able to access all the functions for successfully completing a call; i.e. they may be able to reach the dialling keys but not the coin insertion slot if this is placed on top of the terminal.

Proposed solutions: public telephones must be accessible to, and fully operable by, people of shorter than average stature and by children from about school age. Telephones can either be height adjustable or folding steps can be provided to suit users of various heights. All controls necessary to operate the telephone must be placed in such a way that they are all accessible from the same operating position.

3.8.2 Tall stature

People who are much taller than average may find it difficult to get inside some telephone booths with low ceilings or to find a position from which they can operate all controls. Displays should be visible and keys accessible also from a higher than average position.

Proposed solutions: public telephone booths must allow access to people who are taller than average by not having low ceilings. Telephones must also be fully accessible when operated by tall people.

3.9 Intellectual impairment

People with intellectual impairment constitute a very diverse group and are not easily categorised. One recurrent trait in many intellectually impaired people is that they tend to be slower than other people and thus require more time to complete some tasks. Their short-term memory is often impaired, i.e. they cannot remember long telephone numbers or long strings of consecutive operating instructions.

3.9.1 Telephony

Intellectual impairments range all the way from not being able to use any telecommunication services at all to being only marginally slower than non-impaired people, so that when given some extra time to complete the task at hand they may have no problems in using the traditional telephone. Some intellectually impaired people may also revert to various compensatory strategies.

Proposed solutions: operating instructions should be provided in a form that is easy to comprehend. Terminals should not require long sequences of operations that must be remembered. Time-outs should allow slow users to complete call set-up, or alternative procedures, e.g. off-hook en-bloc dialling, should be allowed.

3.9.2 Dialling

Many people with intellectual impairment do not have adequate comprehension of numbers and cannot understand their use in dialling. A simple automatic dialling device with pre-programmed numbers, using miniatures, pictures or pictograms to identify the numbers, may be a usable solution for some of these people.

People with intellectual impairment who comprehend and can use numbers may still find it difficult to remember and dial ordinary length telephone numbers (6 - 9 digits), even if they only have to remember and dial one digit at a time. It is important that time-outs in the dialling and call set-up procedures must allow enough time also for slow users to finish dialling a long telephone number.

Proposed solutions: time-outs should have sufficient duration to allow slow users to finish dialling long numbers and call set-up.

3.9.3 Line signals

People with intellectual impairments may not be able to understand or distinguish the acoustic line signals, i.e. dialling tone, ring tone, engaged tone, etc., or to understand if an error has been made.

A simple, visual representation of the current line status (similar to that proposed for deaf people above) may be of great help to many intellectually impaired people and to people from other countries where different line signals may be used.

Proposed solutions: acoustic line signals should also be displayed visually in a simple or graphic format to indicate the current status of the line; i.e. dialling tone, ringing tone, engaged tone, error signal, etc. The number of line signals should be kept to an absolute minimum.

4 Conclusions and further work

The impairments that have been covered here and the proposed solutions are meant to provide topics for recommendations that should lead to new standards and/or legislation. In the future, it is important that such new services are dealt with simultaneously at the planning stage.

Sometimes recommendations may be in conflict, e.g. the solutions for people of short and tall stature. It is important to arrive at non-conflicting standards. It may sometimes be necessary to provide more than one type of public telephone to allow users with different requirements to find a suitable terminal.

It is our hope that this ETR will provide the point of departure for compiling a fuller and more thorough list of actions that need to be taken and point out the most important aspects that should be dealt with in the future standardisation work in TC-HF and other ETSI Technical Committees. Telecommunication services must be accessible to as many people as possible - including people with special needs.

Annex A (Informative): List of proposed recommendations with references to disabilities

TC-HF agreed a set of recommendations and action points based on this ETR. These action points with reference to disabilities are listed below.

A.1 Access to terminals

A.1.1 Identification of public telephones

R1.1 Identification of location of public telephones for the blind and partially sighted (cf. subclauses 3.1 and 3.1.2; also ISO/TC173/SC4).

R1.2 Identification of the modus and facilities of the public telephone (cf. subclause 3.1).

A.1.2 Identification of payment facilities

R2.1 Tactile identification information of coin inserting slots (cf. subclauses 3.1 and 3.1.3; also ISO/TC173/SC4).

R2.2 Tactile identification information on accepted coin denominations (cf. subclauses 3.1 and 3.1.3; also ISO/TC173/SC4).

R2.3 Tactile identifiable information for the card slot (cf. subclauses 3.1 and 3.1.3; also ISO/TC173/SC4).

A.1.3 Design of public telephone booths

R3.1 Full accessibility for people in wheelchairs (cf. subclauses 3.6 and 3.6.2; cf. the American "Barrier-free" code and the Danish "roll-in/roll-out" system).

R3.2 Full accessibility for non-wheelchair-bound, mobility impaired people (cf. subclauses 3.6, 3.6.2, 3.7 and 3.7.2).

R3.3 All booth fittings should be accessible to seated people (cf. subclauses 3.6, 3.6.2, 3.6.3, 3.7, 3.7.2, 3.7.3, 3.7.4, 3.8, 3.8.1 and 3.8.2).

A.1.4 Accessibility and operability of interactive terminal elements

R4.1 Interactive parts of the telephone should be placed in such a way that they can all be operated from seated and standing positions (cf. subclauses 3.6, 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.7, 3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.8, 3.8.1, and 3.8.2).

R4.2 Interactive parts of the telephone should be placed in such a way that they can all be accessed by people who cannot use their arms and hands (cf. subclauses 3.7.1, 3.7.2, 3.7.3 and 3.7.4).

A.2 Terminal ergonomics: keys and displays

A.2.1 Implementation of keys

R5.1 Standardised layout of dialling keys (cf. subclauses 3.1, 3.1.6, 3.9; also cf. CCITT Recommendation. E.161 [4] "Dialling keys").

R5.2 Standardised layout of alpha-numeric keys other than 12-key dialling keypad (cf. subclauses 3.1, 3.1.6, 3.5 and 3.9; also cf. relevant ISO standards).

R5.3 Standardised layout of all other operating keys (cf. subclauses 3.1, 3.1.6, 3.5 and 3.9).

R5.4 Ergonomic standards for size, spacing grouping and positioning of keys (cf. subclauses 3.1, 3.1.6, 3.1.7, 3.7 and 3.7.2).

R5.5 Identification of standardised tactile indicators on keys (cf. subclauses 3.1, 3.1.6, 3.1.7 and 3.9).

R5.6 Identification of standardised visual indicators on keys, including size, fonts, colours, symbols, etc. (cf. subclauses 3.1, 3.1.9, 3.2, 3.4, 3.5 and 3.9).

A.2.2 Implementation of displays

R6.1 Visual displays should be accessible for people with colour perception impairments (cf. subclauses 3.1 and 3.1.9).

R6.2 Appropriate use of hues and contrasts for people with low vision and impairment of colour vision (cf. subclauses 3.1 and 3.1.9).

A.3 Operational procedures and alternative representation of relevant procedure information

A.3.1 Operational procedures

R7 Network considerations, such as time-outs, should not prevent slow users from setting-up and completing calls (cf. subclauses 3.5, 3.7 and 3.9).

R8 Mobility impaired people should be able to answer telephone calls remotely with a message (cf. subclauses 3.6, 3.6.1, 3.7 and 3.9).

R9 All people with special needs should be able to use and follow basic telecommunication procedures in a consistent manner (cf. subclauses 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8 and 3.9).

A.3.2 Alternative displays

R10 User instructions should be supported by non-verbal pictograms, icons and symbols (cf. subclauses 3.2, 3.3, 3.4, 3.4.1, 3.5 and 3.9).

R11 Acoustic and visual signals should always be used in parallel to indicate call progression and status (cf. subclauses 3.1, 3.1.3, 3.1.8, 3.2, 3.2.1, 3.2.2, 3.4, 3.5, 3.5.4, and 3.9).

R12 People who use technical aids should be able to use these with telecommunication terminals (cf. subclauses 3.2, 3.2.3, 3.3, 3.3.1, 3.5, 3.5.3, 3.7 and 3.7.2; cf. universal socket and plug for electronic interfacing and physical design).

History

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