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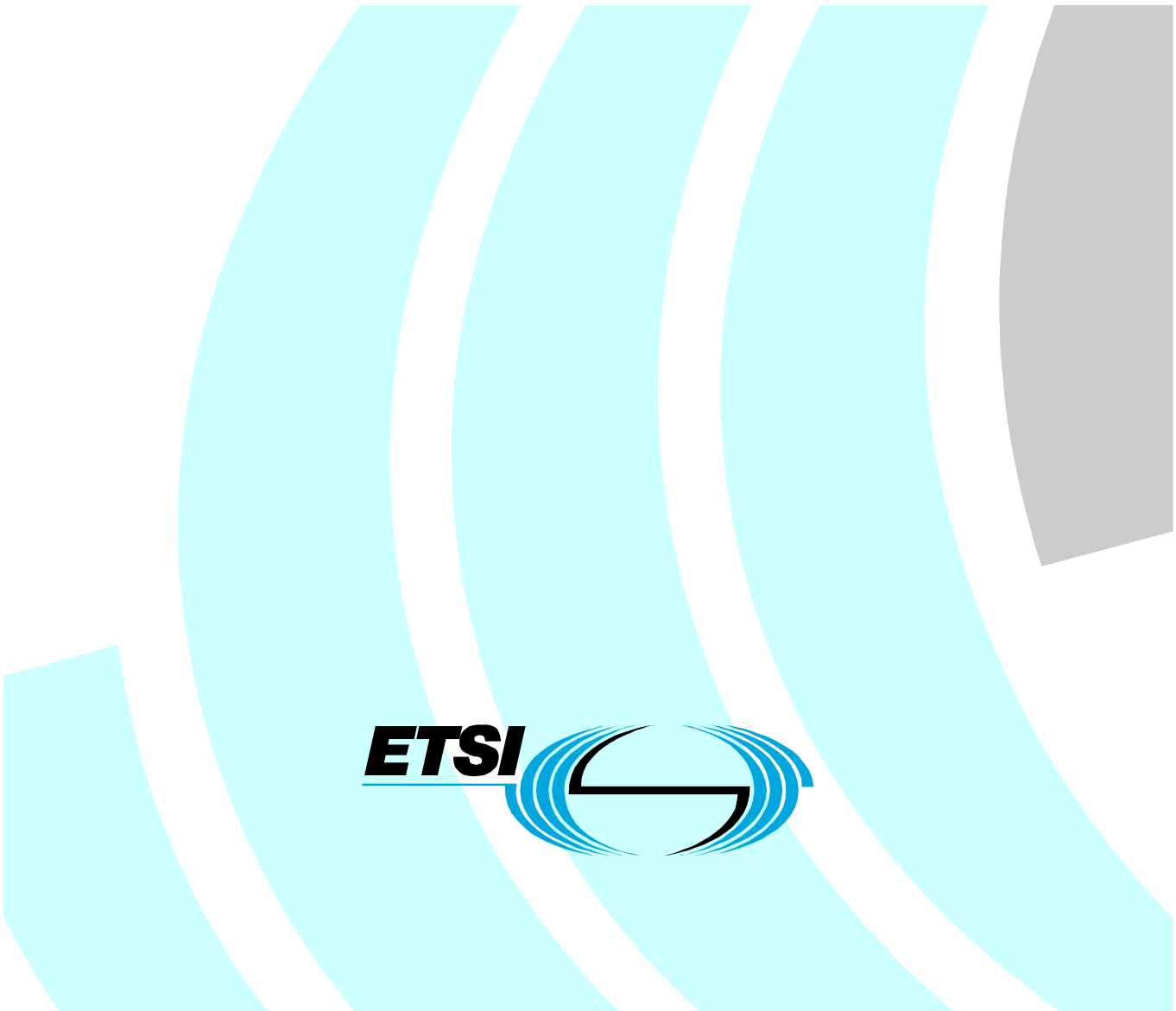
ETSI Guide

Human Factors (HF); Guidelines for the design and deployment of ICT products and services used by children



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Contents

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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Human Factors (HF), and is now submitted for the ETSI standards Membership Approval Procedure.

The stakeholders identified who have an interest in the present document include standards developers, manufacturers, designers, service providers, policy developers, parents/carers, educators and groups working with children.

The intended users of the present document include implementers and providers of ICT solutions for children, designers, interaction designers, developers of terminals, services and applications, standards and regulation bodies and those deploying ICT for children (e.g. education authorities).

Introduction

Children (12 years and younger) are rapidly becoming a significant consumer group for advanced computing and communications services. In some cases, children as young as four or five are using and are becoming increasingly familiar with ICT products and services. A new range of products designed specifically for this age group are about to be launched. TR 102 133 [7] identified the need to develop detailed guidelines for taking account of children's needs in the design and deployment of ICT products and services.

The purpose of the present document is:

- to contribute to the design of safer and more accessible ICT products and services for children;
- to advance the implementation of the *e*Europe 2005 Action Plan in the area of e-inclusion;
- to promote a common approach with respect to the development followed by network providers and equipment manufacturers in developing products and services that respond to the specific needs of children;
- to address the risks of negative side effects for children, such as physical injury, threats to personal security, service abuse and social exclusion;
- to facilitate the revision of European and international standards, with the view to better respecting the specific needs of children using information and communication technologies and services.

In drafting this set of guidelines, a number of key assumptions were made. These assumptions are mainly about categories of end users of ICT products and services, and the actions of standards bodies in general to this market. These assumptions are described in the next few paragraphs.

The basic assumption is that mature adults are able to purchase ICT products and services for their own use. They can set-up and configure terminals, log-on to (and log-off from) one or more a networks, sign-up for services, and authorize transactions. They are aware of, and as mature adults willing to accept, the consequences of these actions. In general, the ICT industry sector operates to provide products and services to mature adult users. ETSI standards and guidelines, as well as those from other standards bodies, are designed mainly to address products and services for such users. This includes, among other aspects design for all principles. In effect, mature adults are the default (or generic) set of users for most ICT products and services.

There are, however, a number of sectors of the market for ICT products and services for which some special provisions are made. These provisions include guidelines, generic standards, and regulations for situations where users may be naïve, or are not fully informed, or have misunderstood the information provided. In addition, there are cases where there is a need for specialized adaptation, for example to deal with the case of users with special needs. Actions by standards bodies and other regulatory authorities (including national administrations) create and implement policies and guidelines in order to assist as far as is practicable users who find ICT terminals and services more difficult to use, or where there is an increased risk of some type. Sometimes this means using specific adaptive technology.

One of the market sectors for which special provision needs to be made are young people, of different ages, and at different stages of development, who now have access to terminals, networks and services, sometimes when fully supervised by a responsible adult and sometimes when alone. The needs of this type of user have not as yet been adequately considered by standards bodies. The broad range of issues raised by young people's access to ICT products and services which are mainly targeted at mature adults also needs to be addressed.

These issues have a high political profile at present. It is essential, to the development of children that they experience the power and usefulness of ICT products and services, and that they receive appropriate training. However, it is also the case that children, as users of ICT products and services which are primarily targeted at adults, are more vulnerable to misuse of such products and services, either their own misuse, or, more critically, misuse by others. The needs of children for ICT products and services are very different from those of mature adults. Unrestricted and unsupervised access by immature children to products and services designed mainly for mature adults can, and does, lead to unintended, and undesirable consequences for the children. In this respect it is particularly important to understand that ICT products and services are an interactive medium of communication between end users. It is this interactive functionality which poses the greatest risks of misuse.

This set of guidelines addresses the needs of young children, and in particular, those less than 12 years of age (or who have not yet reached the developmental stage which would normally be associated with those aged 12 years or above). The aim of these guidelines is to encourage careful, planned use of ICT products and services by young children, while at the same time encouraging the industry to provide tools and techniques to enable appropriate control of such use. In addition, the guidelines address the problem of deliberate misuse of the technologies by those in society who would seek to exploit an extremely vulnerable and naïve group users.

It should also be noted that the main target of these guidelines is the design and deployment of new ICT products and services, where the principle user will be young children. Some of these guidelines are of generic use to designers of products and services for other users, such as mature adults. However, it should also be clear that if the parents and guardians of young children consent to the child's use of other ICT products and services, such as those principally designed for adult users, then any difficulties experienced by the child are the responsibility of the parents/carers.

Although the guidelines in the present document aim to be technology independent, this is not always possible, whilst at the same time not being too general. The body of knowledge that these guidelines draw upon refers to existing or near future technology, although there are areas of some new technologies where there is no body of knowledge with regard to children's use. Whilst every effort has been made in producing the guidelines to take account of the developments in ICT technology, it should be noted that there will be developments in the future which could not be predicted. For some aspects of new technologies, further work to develop guidelines will be needed. The general advice with respect to new technologies is to take account of stakeholders vies and test with target child user groups.

Information on the following topics can be found in the annexes:

- Annex A: Rationale for the Guidelines.
- Annex B: Children as Users of ICT Products and Services.
- Annex C: Usability Testing with Children.

1 Scope

The present document provides guidelines for standards developers and ICT designers on how to take account of the needs of children (12 years and younger) in the design and deployment of ICT products and services.

The guidelines are presented in a form that will assist the different stakeholders to identify and access those parts of the guidelines appropriate to their needs.

The present document is applicable to ICT products and services characterized by a capability to offer interaction between children and other users or services, including:

- fixed and mobile telephones, PDAs, and services which use these devices;
- computers connected to the Internet;
- networked services and applications;
- interactive games.

Stand-alone, non-networked applications or toys are outside the scope of the present document but might be considered in cases where clear separation is not obvious.

Wherever possible the requirements of children with special needs, i.e. children with sensory, motor, cognitive and communication impairments have been considered. It is acknowledged, however, that some children with very extensive and complex disabilities may have requirements beyond the level addressed in the guide.

The annexes to the present document describe the characteristics and requirements of children relevant to their interaction with ICT and the issues encountered by children using ICT, along with usability testing with children.

Medical safety issues are beyond the scope of the present document.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

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3 Definitions and abbreviations

3.1 Definitions

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

bluetooth: short-range radio technology aimed at simplifying communications among Internet devices and between devices and the Internet

browsing: moving from place to place on the Internet searching for topics of interest

chat room: virtual room on the Internet where real-time communication between two or more users takes place via computer

child development: process that turns infants into adults, including changes in size and shape, in knowledge and reasoning ability, in physical and social skills, etc.

comprehension: according to the communication theory, process that involves not only decoding messages, but also making additional inferences about meaning

context of use: the users, tasks, equipment (hardware, software and materials), and the physical and social environments in which a product is used (ISO/DIS 20282-1 [38])

design for all: design of products to be usable by all people, to the greatest extent possible, without the need for specialized adoption

ease of operation: the usability of the user interface of an everyday product when first used by the intended users to achieve the main goals supported by the product (ISO/DIS 20282-1 [38])

emergency call: call from a user to an emergency control centre

emergency call number: special short code(s) or number(s), used to contact the Public Safety Answering Point (PSAP) to provide emergency services

NOTE: The emergency number issued by the emergency caller to request assistance from the emergency services. There exist two different types of emergency numbers in Europe:

- **European emergency number, 112:** unique emergency number for pan-European and GSM emergency services and used, for example, in EU member states and other countries.
- **National emergency numbers:** each country may also have a specific set of emergency numbers.

emergency service: legally recognized service that provides immediate and rapid assistance in situations where there is a direct risk to life or limb, individual or public health or safety, to private or public property, or the environment but not necessarily limited to these situations

end user: See user.

filter: technical way of reducing the likelihood of unwanted material being accessed via the Internet

function: abstract concept of a particular piece of functionality in a device or service

generic: generalized set or general purpose set, often in the sense of basic or ordinary

icon: small picture displayed on the screen that depicts a task that can be invoked by clicking with the mouse

impairment: any reduction or loss of psychological, physiological or anatomical function or structure of a user (environmental included)

Internet: global network of computers

mobility: See personal (user) mobility, service mobility and terminal mobility.

multimedia: combination of media types including text, graphics, animation, audio and video

passive location services: services where a mobile phone user consents to be located by another user (which initiates the action)

primary end user: hereafter called *end users* for the purpose of the present document, are children under 12 years of age, with or without motor, sensory, cognitive, communication or other impairment(s)

software: series of computer instructions or data that can be stored electronically

surfing: See browsing.

terminal: physical device which interfaces with a telecommunications network, and hence to a service provider, to enable access to a telecommunications service

NOTE: A terminal also provides an interface to the user to enable the interchange of control actions and information between the user and the terminal, network or service provider.

usability: effectiveness, efficiency and satisfaction with which specified users can achieve specified goals (tasks) in a specified context and particular environments (see ETR 095 [1] and ISO/IEC 9241-11 [10])

NOTE: In telecommunications, usability should also include the concepts of learn ability and flexibility; and reference to the interaction of more than one user (the A and B parties) with each other and with the terminals and the telecommunications system, see ETR 116 [2].

user: person who uses a telecommunications terminal to gain access to and control of a telecommunications service or application

NOTE: The user may or may not be the person who has subscribed to the provision of the service or owns the terminal. Also, the user may or may not be a person with impairments.

User Interface (UI): physical and logical interface through which a user communicates with a telecommunications terminal or via a terminal to a telecommunications service (also called man-machine interface, MMI)

NOTE: The communication is bi-directional in real time and the interface includes control, display, audio, haptic or other elements, in software or hardware.

user requirements: requirements made by users, based on their needs and capabilities, on a telecommunication service and any of its supporting components, terminals and interfaces, in order to make use of this service in the easiest, safest, most efficient and most secure way

World Wide Web (WWW): system of Internet servers that support specially formatted documents

NOTE: The documents are formatted in a markup language called HTML (HyperTest Markup Language) that supports links to other documents, as well as graphics, audio, and video files.

3.2 Abbreviations

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

AAC	Augmentive or Assistive Communication
AHL	Average Hearing Loss
API	Application Programme Interface
BMI	Body Mass Index
CE	Community European
ChiCI	Children's Computer Interaction
COPPA	Children's Online Privacy Protection Act
ECDL	European Computer Driving Licence
EMF	Electro Motive Force
EU	European Union
GSM	Global System for Mobile telecommunication
HCI	Human Computer Interaction
ICT	Information and Communication Technology
ISP	Internet Service Provider
ITU-T	International Telecommunications Union - Telecommunication standardization sector
IWA	International Working Agreement
MMI	Man-Machine Interface
MMS	Multimedia Messaging Services
PC	Personal Computer
PDA	Personal Digital Assistant
PIN	Personal Identity Number
PoC	Push-to-talk over Cellular
PSAP	Public Safety Answering Point
RSI	Repetitive Strain Injury
RTTE	Radio and Telecommunications Terminal Equipment
SIM	Subscriber Identity Module
SMS	Short Message System
TV	TeleVision
UCI	Universal Communications Identifier
UI	User Interface
USB	Universal Serial Bus
WCAG	Web Content Accessibility Guidelines
WWW	World Wide Web

4 Guidelines for the design and use of ICT by children

The intended users of the present document include implementers and providers of ICT solutions for children, designers, interaction designers, developers of terminals, services and applications, standards and regulation bodies and those deploying ICT for children (e.g. education authorities).

The above listed users of the present document have a number of overall, specific or common, objectives or goals, including the creation and provision of:

- a safe and secure ICT environment for children;
- a reliable and affordable ICT infrastructure;
- easy-and fun-to-use, accessible devices, services and applications;
- high sales volume products, with a viable business case;
- interoperable standards and systems, based on and making use of the public infrastructure.

Although the emphasis of the guidelines is for children under 12, many of the recommendations are applicable to older children.

The structure and format has been defined based on literature on guideline application [24], [25], [26], [27] and requirements from the stakeholders and guideline users. The format is as follows:

Reference number:

The reference number is a unique number within the present document, derived from the section number of the clause it appears in, and with letters to achieve a unique number, e.g. guideline 4.2.4.a. This uniquely identifies a guideline within the present document, making it easier to find and to cross-reference specific guidelines.

Guideline title:

The guideline title is a short descriptive title containing the salient points of the recommendation in the guideline and where it applies, and if possible, some reference to the rationale for the guideline. The title facilitates rapid scanning of the contents in order to find relevant guidelines.

Guideline and rationale:

The guideline and rationale gives the detailed recommendations on how to design ICT for children, and a rationale for the guideline. The rationale includes information about the context in which the guideline applies, why it is important that the guidelines is adhered to and source(s) of the guideline contents (e.g. theories, supporting evidence, heuristics), etc. The citation of supporting evidence to give a rationale for the guideline facilitates further research into particular issues, where needed, and enables the guideline users to evaluate the validity and importance of a particular recommendation.

EXAMPLE: The guideline may contain example(s) of solutions to illustrate a particular issue in the guideline. The example may include graphics. The examples make it easier for guideline users to understand how to use the guideline.

In clause 5, table 1 provides classifications of guidelines (reference number and title) with respect to the following parameters:

- Age group of children for which the guideline is relevant (babies, toddlers, infants, pre-teens, all).
- Document usage (design, deployment, standardization and regulation, all)

The present document focuses specifically on information in relation to designing and deploying products and services for children (under 12 years old). ETSI has produced a number of recommendations for general human factors, accessibility and usability testing, and the readers of the present document are advised to consult these documents for guidelines that are not child-specific (but might still be relevant). Of particular relevance are EG 202 116 [4] and EG 201 472 [16].

This part of the document, clause 4, contains the guidelines. The guidelines are grouped under the following headings:

4.1 Physical Interaction with ICT.

4.2 Operational issues of terminals and services.

4.3 Services.

4.4 Content.

4.1 Physical Interaction with ICT

4.1.1 General guidelines

Guideline 4.1.1.a: Design ICT to take into account that children are smaller, weaker, less dextrous and less careful than adults

Children are not little adults, and when designing or deploying ICT, the differences from adults in children's physical characteristics (e.g. size, strength, dexterity, co-ordination), behaviour (e.g. less careful than adults) and contexts of ICT use (e.g. play, school) should be taken into account. This is particularly important if they are the primary user of the device, if they are required to use the device for extended periods or if they are required to use the device for critical tasks such as requesting emergency assistance.

Guideline 4.1.1.b: Consider whether ICT device use by toddlers and babies is appropriate and beneficial

There is a long-standing debate about introducing children to computers at a very early age. However, there does not seem to be very strong evidence of potential benefits or of harm [34]. Some researchers do not recommend that children younger than 3 years of age use computers [33], because up to this age computers do not help in developing the skills that children develop at this stage (e.g. crawling, walking, talking and making friends). However, for some children (e.g. disabled children), computers may be beneficial to their development. Consider in each case whether computer use by the children in question is appropriate and beneficial.

Guideline 4.1.1.c: Use standardized hardware and software interfaces on ICT terminals for connection of assistive devices

If a design-for-all approach is not readily achievable, assistive devices offer the possibility to get an optimized user interface device while not compromising the user interface solutions developed for mainstream users. With harmonized interfaces supporting the connectivity of assistive devices, children can properly be supported in their efforts to use them, often involving social activities (such as attending school).

ETSI has dealt with these issues previously, in detail and stated a set of requirements for these interfaces, found in TR 102 068 [5]. Europe-wide standardization of assistive technology device interfaces across all ICT devices is becoming an urgent topic.

As accessibility requirements vary widely between and within different categories of children with disabilities, access via assistive devices often provides better solutions than access directly via the terminal device.

ICT users with disabilities may have their own assistive devices that they can connect to systems that they share with other users, such as computers at school or in a public library, a shared mobile phone or a public address system, These assistive technology devices and software are being designed to interface to ICT systems using standardized interfaces. For this reason, ICT systems should have the means to either mechanically or wirelessly couple to an assistive device, or to interact with assistive software through standard software APIs and interface technologies.

EXAMPLE: A standard physical couplings such as USB, IEEE 1394 [47] or audio and video connectors should be provided in addition to the set of ports normally provided. Where such interfaces are impractical (e.g. in the case of a mobile phone or handheld games console), a wireless couple such as Bluetooth should be provided. In this way, additional earpieces for children with severe hearing loss can be accommodated.

Guideline 4.1.1.d: Specify and design public access and service terminals to be accessible by children

Specify and design public access and service terminals to be accessible by children.

4.1.2 Physical characteristics of devices

Guideline 4.1.2.a: Limit the weight addition to children's backpacks when deploying portable computer devices

When deploying portable computer devices (e.g. laptop computers) intended to be carried by children in their backpacks (e.g. to and from school), the weight addition that this introduces to children's backpacks, and the total backpack weight (children also carry schoolbooks) should be considered. In studies of the impact of backpack carrying on children [48], [49] and [50], children report discomfort from carrying heavy backpacks. The guidance for how heavy a backpack can be for a child varies from between 10 % to 15 % of the child's bodyweight. The American State of California has passed a bill [51] on textbook weight where they recommend that children's backpacks should not exceed 15 % of the child's body weight. An additional concern is that children who carry visibly heavy objects in their backpacks may be more susceptible to muggings.

Guideline 4.1.2.b: Design devices intended for children with "wear and tear" in mind

Children are not as careful as adults when using ICT devices, and will use the devices in different contexts of use than adults (e.g. play, school). Therefore, ICT devices intended for children should be designed with "wear and tear" in mind. Consider water proofing the device, as children may not understand what damp and wet conditions may do to electronics. Use lettering and symbols on keys that do not wear off easily. Devices intended for children should be shock proof.

Guideline 4.1.2.c: Style devices appropriately for child's age and intended use

The style of the ICT device will influence children's use of the device. According to [34], young children may be more likely to successfully use devices that have the appearance that is similar to the other toys and objects that they own. A "child-appealing product" is in [59] defined to be a product that is constructed such that it induces or encourages handling by a child. [59] identify child-appealing aspects of products as including the representation of a model, person, animal, buildings or vehicles; having bright and contrasting colours, and a function, noise or texture consistent with a child's desire to experiment. The study in [59] also highlighted that children may mistake the identity of child-appealing products, believing them to be harmless and thereby are unaware of the potential hazards or correct handling.

Guideline 4.1.2.d: Provide personalization of physical appearance for devices intended to be owned and used by older children

As children mature they tend to choose objects that reflect their personality and chosen peer group values (e.g. clothing tastes, watch designs, etc.). Devices that are intended to be 'owned' by these children and used by them should be available in a variety of styles or their appearance should be personalized to suit the preferences of these children. Older children aspire to own the same objects as adults, but appreciate styles that reflect their youth.

EXAMPLE: Snap on covers for mobile telephones.

Guideline 4.1.2.e: Make it obvious for children how to turn the device on and off

The on/off switch should be clearly labelled, and operating the switch should be easy for children. Also see guideline 4.2.1.4.b.

Guideline 4.1.2.f: Remind children to recharge devices, and make recharging easy

Children may forget to recharge batteries and may not understand the implications of running out of batteries. They may find themselves without a telephone connection or with loss of data on a computer. The child should be reminded to recharge the device, and the indications that charging is necessary should be designed to be more understandable by children. Recharging should be designed to be easy for children, and not requiring strength or fine motor control that young children do not possess. Also see guideline 4.2.1.5.e.

EXAMPLE: A phone may have a charging station where the phone is just dropped in a holder, and where the charging station may be designed to easily give the correct positioning of the phone for charging.

4.1.3 Input devices

4.1.3.1 Keyboards and buttons

Guideline 4.1.3.1.a: Test button and keyboard characteristics with target child user group

The buttons should not require more physical strength to use than the child has at the targeted age. There is data on e.g. finger push strength in [52] that can provide some guidance. However, the testing situations in which the data was collected were different from the use of buttons on the ICT device. It is recommended that the buttons (keyboards) are tested on a representative selection of the intended child users in order to determine that the button characteristics are appropriate. For information on testing techniques and usability testing with children, see annex C.

Guideline 4.1.3.1.b: Test size and spacing of keys and navigation controls with target child user group

Children have smaller hands than adults, and fine-motor control may not be well developed. Size and spacing of keys should be tested with a representative group of target child users to ensure that size and spacing is appropriate. For information on testing techniques and usability testing with children, see annex C.

Guideline 4.1.3.1.c: Use alternatives to multiple, simultaneous key presses for young children

It may be difficult for children to perform the physically co-ordinated operations of this kind, and particularly for young children. It may also be difficult for young children to understand the concept of multiple, simultaneous key presses in order to invoke or control a function, and this may lead to errors in operation. For young children, multiple simultaneous key presses should not be required, and other, single action alternatives should be made available.

EXAMPLE 1: Young children have problems using <SHIFT>-key in combination with other keys on computer keyboards.

EXAMPLE 2: Context-dependant single key presses (soft keys on mobile phones) or PC mouse clicks as controls.

Guideline 4.1.3.1.d: Use alternatives to toggle-functions for young children

Young children have problems understanding toggle functions (same button controls on and off function). Dedicated keys for on and off should be considered as an alternative for young children.

EXAMPLE: Young children have problems using the <Caps Lock> function on computer keyboards, and end up writing all caps.

Guideline 4.1.3.1.e: Characters and symbols printed on device should subtend 20 minutes of arc for optimal readability

The smallest object that a normal human eye (20/20 vision) can detect subtends 1 minute of arc on the retina of the viewer, and this is equivalent to lower case characters subtending 10 minutes of arc. ISO 9241-3 recommends that the height of lower case characters subtends at least 20 minutes of arc for optimal readability [60]. As a rough measure, character size should be approximately $1/200^{th}$ of the viewing distance. Readability is reduced for character or symbols sizes of 18 minutes of arc. For tasks where readability is secondary, smaller characters may be used. Also see guideline 4.2.1.1.f.

EXAMPLE: To calculate the character or symbol size for optimal readability, see [64].

4.1.3.2 Pointing and selection devices

Guideline 4.1.3.2.a: Test physical size and characteristics of pointing and selection devices requiring fine motor skills with target child user group

Fine motor skills are not well developed in babies and toddlers (up to 3 years of age). From around 3 years to 4 years of age, children can grip pencils and start developing rough writing skills, at 5 to 7 they can handle buttons and zippers, tie shoelaces etc. The fine motor skill level of the intended child user group should be taken into account when developing or deploying input devices, and input devices requiring such skills should be tested with the target child group. For information on testing techniques and usability testing with children, see annex C.

Guideline 4.1.3.2.b: Avoid rotary controls that rely on small angles of rotation for young children

Fine motor skills are not well developed in babies and toddlers (up to 3 years of age). From around 3 years to 4 years of age, children can grip pencils and start developing rough writing skills, at 5 to 7 they can handle buttons and zippers, tie shoelaces, etc. The fine motor skill level of the intended child user group should be taken into account when developing or deploying input devices.

4.1.3.3 Other input devices

Guideline 4.1.3.3.a: Make it easy for children to locate and use built-in input devices

Built-in input devices like e.g. microphones (e.g. on loud speaking telephones or laptop PCs) and cameras (e.g. on mobile phones) may be difficult for children to use because they are unable both to locate and to operate the device. This is particularly relevant on multifunction devices, as younger children are likely to focus on primary input devices (e.g. keyboards and clearly visible buttons). Label the input devices clearly and make operation appropriate and clear for children.

EXAMPLE: Label built/in microphone on laptops intended for children clearly so they know where to direct the sound they are recording, or the speech they are communicating. Label the camera on multimedia phones clearly, and use camera-style interaction to operate camera (e.g. separate button and camera "click" feedback to take picture).

Guideline 4.1.3.3.b: Provide connectors and support for child-specific assistive input devices

Disabled children may need assistive devices (e.g. speech recognizers, special keyboards, eye control devices) in order to input information to ICT devices, and children in general may need child-specific versions of standard input devices in order to interact with ICT (e.g. children's sized keyboards or mice). Providing the necessary connectors and support (i.e. software) to use such assistive devices can enhance the utility of general ICT products for children.

EXAMPLE: Examples of different types of computer aids for disabled children can be found at [65].

Guideline 4.1.3.3.c: Consider tactile or tangible input devices for young children

Young children are developing manual skills and fine motor control. Tactile and tangible interfaces may be more appropriate than button and keyboard based interfaces for young children [34].

Guideline 4.1.3.3.d: Consider using touch screen technology for young children

Young children will not have the literacy skills needed to interact via text keyboards, and direct manipulation can be beneficial [43]. Consider using touch screen technology for young children (2 to 7), which offers a form of direct manipulation and eliminates the need for keyboards (while not precluding the input of text). However, consider the particular ergonomics issues related to touch screen use, e.g. arm fatigue [75].

4.1.4 Output devices

Guideline 4.1.4.a: Test visual indicators for understanding with target child group

Lights and visual indicators are used to provide information to the user of the status of terminals, systems and networks. The advantage is that they are language independent, but they may not be recognized by children. Children may not have had much experience of different visual indicators, and may not have the experience and understanding of the underlying meaning of particular visual indicators. Ensure that the visual indicators used are well understood by the target child users, and test with the target child user group. For information on testing techniques and usability testing with children, see annex C.

Guideline 4.1.4.b: Test tones and earcons for understanding with target child group

Acoustic signals and auditory tones (sometimes called earcons) are used to provide information to the user of the status of terminals, systems and networks. The advantage is that they are language independent, but they may not be recognized by children. Children may not have had much experience of different acoustic symbols, and may not have the experience and understanding of the underlying meaning of particular tones or earcons. Ensure that the earcons used are well understood by the target child users, and test the earcons with the target child user group. For information on testing techniques and usability testing with children, see annex C.

Guideline 4.1.4.c: Provide connectors and support for child-specific assistive output devices

Disabled children may need assistive devices (e.g. screen readers, Braille printers, switches, hearing aids) in order to interact with ICT. Children in general may want or need child specific assistive output devices (e.g. tactile/tangible devices and speech output). Providing the necessary connectors and support (i.e. software) to use such assistive devices will enhance the utility of general ICT products for children.

Guideline 4.1.4.d: Consider tactile feedback and tangible output devices for young children

Young children are developing manual skills and fine motor control. Tactile feedback and tangible interfaces may be more appropriate than text and screen based interfaces for young children [34].

4.1.5 Child ergonomics

Guideline 4.1.5.a: Provide advice to children, parents/carers on good computer workplace design for children

Provide advice to both carers and children on good computer workplace design for children. However, the most important advice is to take breaks, and vary the working position, because even the best designed workplace can cause discomfort if the same position is used for a long time without breaks. Adjustable workstation set-ups can accommodation a variety of working positions, and should be promoted [61]. Children often use computers together [75], so consider arranging the physical space for social use, while still maintaining good workplace design.

EXAMPLE: Examples of guidance on good computer work place design for children: [36], [37], [53] and [54]. Note, however, that these sources assume stationary computers, with screen technology of date. The set-ups shown may not be appropriate for the use of other kinds of ICT devices (e.g. laptops, handhelds, mobiles).

Guideline 4.1.5.b: Encourage children to vary working positions and take frequent breaks from ICT use

All child ergonomics experts and sources (e.g. [36], [37], [53] and [54]) advocate frequent breaks from ICT use in order to minimize the risk of injury or other harmful effects. Children get more easily absorbed in activities, and may need reminding. It is very important to encourage children to vary their working positions, as fixed positions over a long time will cause discomfort. It has been shown that child users that use ICT intensively have a significantly higher BMI [29], probably because ICT activities displace more physical activity. Over use may also contribute towards eye strain and musculoskeletal problems.

Guideline 4.1.5.c: Provide advice to parents/carers on appropriate screen viewing distance to achieve good readability and avoid vision problems in children

Lueder [35] hypothesizes that working up close with computers may increase myopia, as has been shown for other activities involving too-close viewing. Wan [55] describes symptoms of eye strain due to too-close viewing distance such as eye redness, frequent rubbing of the eyes, complaints of blurriness and eye fatigue. Current advice on appropriate viewing distance from a stationary computer screen varies from e.g. 22 inches in [36] to 28 inches in [55]. However, the viewing distance given in this advice is appropriate only for the specific screen technology it refers to (the resolution, etc.). It is recommended that the height of lower case characters subtends at least 20 minutes of arc for optimal readability [60]. Based on this recommended visual angle and the character height on the screen, the appropriate screen viewing distance for good readability can be calculated.

EXAMPLE: To calculate viewing distance for good readability, see [64].

Guideline 4.1.5.d: Provide advice to parents/carers on adjustment of screen brightness to avoid vision problems in children

If the screen brightness is inappropriate, this may cause eye strain for children, resulting in symptoms like eye redness, frequent rubbing of the eyes, complaints of blurriness and eye fatigue [55]. The screen brightness should match the brightness of the environment. If the screen looks like a light source, the brightness is too high, and if the screen seems dull and grey it may be too low [56].

Guideline 4.1.5.e: Provide advice to parents/carers on proper lighting for ICT device use to avoid vision problems in children

Children adapt easily, and may accept vision distortions because they think everyone sees what they see. Neither children nor parents/carers may see the relationship between lighting conditions for computer use and vision problems that may occur.

EXAMPLE: See e.g. WAN [56] and [66] for advice on lighting as it relates to children's use of computers.

Guideline 4.1.5.f: Provide advice to children/parents/carers on how to avoid RSI injuries

There are concerns that children who spend too much time playing computer games or using text messaging with their thumbs may develop RSI (Repetitive Strain Injury) symptoms and other musculoskeletal problems ([30] and [31]). There is debate about the relationship between computer use and RSI injuries ([18] and [35]) and there is not enough data about long-term effects of extended game-playing or text messaging (e.g. repetitive thumb-action). However, the potential effects are taken seriously by industry players [32] and the general advice is to teach children the importance of taking frequent brakes from their game playing or text messaging and the use of tools like predictive-text tools in order to limit repetitive key presses. Provide advice to both carers and children on how children may avoid RSI injuries or other musculoskeletal problems from overuse of terminals or services, e.g. by advocating breaks, providing information on correct workstation set-up for children (child ergonomics) and suggesting exercises that may prevent RSI injuries [32].

4.1.6 Health and Safety issues

Health and safety issues are outside the scope of the present document. The present document does not deal with health and safety issues related to the physical interaction with ICT outside of general child ergonomics (e.g. guidelines to avoid musculoskeletal problems from poor workstation design).

However, since the introduction of the Radio & Telecommunications Terminal Equipment Directive the essential requirements of the Directive require all products covered by the directive to be checked for EMF and via the Low Power Directive for electrical safety prior to being placed upon the market with a CE mark. In the case of EMF, guidelines are scientifically-based and intended to be fully-protective of all members of the public including children.

All ICT equipment should as a minimum be compliant with ICNIRP/EU levels (via essential requirements of RTTE) and the current industry position is therefore that no special measures are required for children.

Further information may be found on the European Commission website [42].

4.1.7 Consumer regulation and public procurement issues

The present document does not deal with consumer regulation and public procurement issues. However, ICT products made for children will be required to fulfil the same consumer regulatory and public procurement requirements, as for other products intended for use by children. Please refer to the appropriate national and European frameworks for such guidelines.

4.2 Operational issues of terminals and services

The design of terminals (fixed and mobile) should follow good basic human factors design taking account of any specific requirements for children listed below. Where possible alternative modes of interaction should be available in order to accommodate the needs of children with different disabilities. Children do not have the range of "work-around" strategies for overcoming difficulties that adults have, consequently usability trials with children to quickly highlight any usability problems are needed. Terminals and services should be easy to use.

This clause covers issues in relation to children comprehending instructions; the configuration of the terminal and service; operation of the terminal and service and navigation around presented information.

4.2.1 Comprehending instructions

4.2.1.1 Style and format of language

Guideline 4.2.1.1.a: Use a style of language that is appropriate for the target age group to ensure understandability

Instructions should be designed in easily understandable and succinct text. Children faced by long instructions are likely to not read them and do something else. Provide the instructions in small steps, so as not to overload the child. Provide explicit directions on what to do. Direct commands are preferred to indirect commands. Girls are more likely to read instructions than boys [23]. Where possible use illustrations and graphics in order to overcome the understanding of language. Also see guideline 4.2.1.4.a.

EXAMPLE: Now press *.

Guideline 4.2.1.1.b: Present all information in the child's first language to ensure understandability

All instructions, prompts and labels should be presented in the child's first language (or that language in which they are proficient). It cannot be assumed that children under 12 are fluent in English. It should be noted that for deaf children sign language may be their first language and they may have difficulties with written language. The selection of language required could be part of the configuration of the terminal or service which is undertaken by the adult/carer. Also see guideline 4.2.2.a.

Guideline 4.2.1.1.c: Allow the selection of instructions in different media to cater for children with special needs

It should be possible during configuration of the device/service to select the media through which information is portrayed. It should be noted that for deaf children sign language may be their first language and they may have difficulties with written language and need video capabilities. Also blind children may require instructions to be spoken rather than written. Children prefer to listen to natural voices rather than artificial ones. The selection of media required could be part of the configuration of the terminal or service which is undertaken by the adult/carer. Also see guideline 4.2.2.a.

Guideline 4.2.1.1.d: Maintain a consistent readability level to ensure understandability

Instructions should be kept at the same level of readability. A child does not want to get part way through a process and then get to an instruction that cannot be understood. Also see guideline 4.4.1.1.a for details on comprehensibility to children.

Guideline 4.2.1.1.e: Provide instructions when they are needed by the child bearing in mind the context of the situation

Instructions should be provided when they are needed by the child. They should be context sensitive.

Guideline 4.2.1.1.f: Use simple, relatively large fonts with good contrast for instructions

To ensure good readability see guideline 4.1.3.1.e. Contrast is very important for beginner readers. Legibility of the font is an important design issue. Sassoon (2001) [14] has developed a family of typefaces for the screen, based on how children are taught handwriting and on what they find easiest to read for desktop computers with current screen technology. Bernard et al (2001) [17] found that a larger font size was easier and quicker to read on-line for a group of 9 years to 11 year olds. The Comic font was found to be more attractive. The sans serif font was preferred over serif fonts for displays. It needs to be established in each country whether children are taught in uppercase or lower case. Instructions should be adapted accordingly. It should be possible for the child to adjust the font size to suit their requirements, this may be of particular benefit to partially sighted children.

Many designers follow the rule of thumb that the younger the child the larger the font should be [12].

Guideline 4.2.1.1.g: Consider using shorter line lengths for children than for adults

Although there seems to be no significant difference in reading efficiency between full-screen length and narrower line lengths, Bernard et. Al, (2002) [62] found that children had a significant preference for the narrowest line length in the study (45 characters per line, 17" monitor, resolution 1 024 x 768 pixels, font 12-point Arial, 57 cm viewing distance).

Guideline 4.2.1.1.h: Consider using special fonts to increase accessibility of text

There are currently font styles available that increase the accessibility of text, e.g. for partially sighted people and for dyslexics. Consider such font styles to increase accessibility of text, and particularly for applications, terminals and services aimed at partially sighted children or dyslectic children.

EXAMPLE: Examples of special fonts are the "Tiresias" font [67] for partially sighted people, and the "Read Regular" font [68] for dyslexics.

Guideline 4.2.1.1.i: Avoid the use of text over pictures in order to keep the message readable

Avoid the use of text over pictures in order to keep the message readable. As contrast is very important, putting text over pictures can interfere with the clarity and readability. If text is to be put over pictures then provide a plain background for it.

Guideline 4.2.1.1.j: Avoid using moving or animated text for instructions in order to keep the message readable

Avoid using moving or animated text for instructions in order to keep the message readable. Although children like animation they can find moving text more difficult to read than still text.

4.2.1.2 Jargon

Guideline 4.2.1.2.a: Avoid the use of technical or metaphorical jargon so that children understand what is being stated

Younger children do not understand adult jargon or metaphors. The naming of a feature on a device or service is crucial to the understanding of that feature by the child. Children may not understand the concepts of click, drag, scroll, roll over etc. This was shown to be so with an online version of "joining the dots" game. [13] The mental model that children have for this game is to draw from one dot to the next. The online version required them to just click on the dots sequentially. The children were unable to complete the task.

Children may not understand the subtle differences of "cancel", "close" and "ok".

Check out the understandability of concepts with a selection of children (see annex C on usability testing with children).

EXAMPLE: State that a call is not possible rather than network unavailable.

Guideline 4.2.1.2.b: Create meaningful category names for options to make it obvious for children

Do not use fun names that do not give any indication of what the child can find in that category. In order to ensure that category names are meaningful to children, check out the understandability with a selection of children. (see annex C on usability testing with children).

EXAMPLE: From yahooligans [19].

4.2.1.3 Labels and abbreviations

Guideline 4.2.1.3.a: Avoid abbreviations which are not understandable by children

When designing labels the aim is not to confuse or mislead the child. One needs to avoid misunderstanding. When using labels, where possible use full words that accurately describe the control or display's function. Avoid abbreviations, unless usability testing confirms that they are acceptable. NB This may be a problem with certain languages using long words e.g. German, Norwegian.

4.2.1.4 Symbols and icons

Guideline 4.2.1.4.a: Use symbols and icons for overcoming literacy difficulties for children

Full word labels would not be appropriate for young children who do not have the literacy skills.

Interfaces using symbols, icons and pictograms would be useful for very small children who do not have well developed literacy skills.

Guideline 4.2.1.4.b: Use existing standards and stereotypes for symbols if they exist rather than creating new ones in order to avoid confusion by the child

Use existing standards and stereotypes for symbols if they exist, this reduces confusion for children. Children will have encountered icons in other media such as books, video games, TV, and there needs to be consistency and carry over from other media. Consider cultural differences for any symbols used.

EXAMPLE: Use  to indicate music and  for turning on a device.

Guideline 4.2.1.4.c: Use recognized sets of symbols for communication impaired children

A number of recognized symbol sets have been used for communication impaired children. Investigate which is appropriate for the target user group.

EXAMPLE: "Makaton" is a proprietary name for a language programme integrating speech, manual sign, and graphic symbols, developed to help people for whom communication is very difficult, especially those with learning difficulties.

Guideline 4.2.1.4.d: Design icons to be visually meaningful to children

Design icons that are easily recognizable and familiar to children and that represent items in their everyday world. New icons should be tested with a representative sample of users for meaning. (see annex C on usability testing with children). For a set of symbols to be successfully associated with the underlying functionality, the symbols have to be carefully designed, evaluated and selected see EG 201 379 [15].

EXAMPLE: Use doors for going "outside", use the **?** "question mark" for obtaining help.

4.2.1.5 Notification of status

Guideline 4.2.1.5.a: Present status information in more than one modality to provide redundancy

Status (e.g. the phone is ringing) can be indicated by spoken language, text, icons, earcons, etc. Presenting status information in more than one modality will make devices more accessible to children with disabilities.

Guideline 4.2.1.5.b: Make it clear to the child that a device is switched on so that they are aware of the status

Make it clear to the child that a device is switched on so that they are aware of the status. A light or LED that is obvious can be used to indicate that the phone is switched on.

Guideline 4.2.1.5.c: Make it clear to the child whether a device is connected or not connected to a network so that they are aware of the status

Make it clear to the child whether a device is connected or not connected to a network so that they are aware of the status. This could be done with a visual indication. When providing feedback do not use technical words. For example state that a call is not possible rather than network unavailable. Another example may be to state that "only emergency services can be called' rather than "112 only".

Guideline 4.2.1.5.d: Make it clear to the child that a device is keypad locked so that they know that they have to unlock it before use

Keypad-lock should be clearly and unambiguously indicated and the steps required to unlock a keypad should be clear. If a disabled child is unable to perform a two-handed operation the steps to unlock the device should be sequential. The timing of the sequential action should not be so fast that it is not possible for a child with slower reaction times to respond. It can also be difficult for younger children and dexterity impaired children to press multiple keys simultaneously. Also see guideline 4.1.3.1.c. Severe dexterity problems may be assisted by voice control of the device, although some difficulties such as tremor are often associated with speech difficulties.

EXAMPLE: Provide easy to understand guidance on the display or by voice commands.

Guideline 4.2.1.5.e: Make it clear to the child that the battery is low on the device so that they know that the device needs recharging

Information should be clearly provided to inform the child that the device needs to be recharged. Young children do not necessarily understand the implications that if the battery runs out on a mobile phone that they will not be able to make or receive calls. On laptop PCs a child may not realize that if the battery runs out that they can lose data. Also see guideline 4.1.2.f.

EXAMPLE: Provide easy to understand guidance on the display or by voice commands.

Guideline 4.2.1.5.f: Make it clear to the child that a device is ringing so that they can answer it

It should be obvious to a child that the device is ringing or vibrating. This needs to be set up and checked with the individual child. Some schools have banned mobile phones to be switched on during lessons. If the child leaves the phone in vibrating mode he/she should know what this means.

4.2.2 Configuration and set-up

Guideline 4.2.2.a: Make configuration as simple as possible for parents so that it is suitably set up for the child

Make configuration as simple as possible for parents/carers so that it is suitably set up for the child. Wherever possible a child should not have to configure a terminal. Such configuration actions could lead them into activities which are not appropriate for them. As much of the configuration as possible should be done by the parent/carer. In configuration, the parent/carer should be able to select for example, the language and media of the interaction for the child. Also see guidelines 4.2.1.1.b and 4.2.1.1.c.

Guideline 4.2.2.b: Make it clear to parents/carers what are the implications of the configuration options

Make it clear to parents/carers what are the implications of the configuration options.

EXAMPLE: If a carer is asked to input the child's age they need to know for what purpose this data will be used.

Guideline 4.2.2.c: Ensure only parents/carers have access to complex and critical configuration options

Complex and critical configuration aspects should only be visible to parents/carers, in order to simplify operation by children and avoid inappropriate configuration. The consequences of settings made in configuration should be clearly explained to the parents/carers.

Guideline 4.2.2.d: Provide default settings for children, which can be used by a parent/carer who may not be very ICT aware

Provide pre-defined settings for children or provide the facility for the parent/carer to easily configure the terminal. It may be necessary to provide different defaults for different age groups of children. Some devices may have several users, and could have different functionality/configuration for each user. User profiles can simplify the interface for the user. A user profile can be set up for a child user, see EG 202 325 [20]. A child should not be able to gain access to an "adult" profile setting of a terminal.

EXAMPLE: Depending on the child classification selected, a different style sheet could invoke a different font to be used.

Guideline 4.2.2.e: Provide additional features for children only with parental approval, so that the default is the safest setting for the child

In terminals/services targeted at young children, the default status should be "all features off" providing only the most basic functionality. This default setting should be the safest possible option for the child user. Turning on any additional features should require approval by the parent/carer/teacher. The consequences of this action should be clearly explained to the parents/carers.

Guideline 4.2.2.f: Make systems tolerant of different formats of input for date, etc.

A child should not have to conform to the system, it should be tolerant of all data formats (date, time, etc.).

Guideline 4.2.2.g: Provide longer timeouts for inputting data

Younger children may be slower at recalling numbers and inputting data. There should be provision to have longer timeouts set up in the configuration of the terminal.

Guideline 4.2.2.h: Ensure that devices owned by a 3rd party but used by children, can reflect ownership, to prevent devices from being stolen

Devices that are styled according to the brand style of a 3rd party (school, hospital etc) are less likely to be stolen and sold on than devices whose ownership is not readily apparent. This feature also reinforces the fact that these devices are to be used by children and are subsequently less attractive to adults or teenagers.

EXAMPLE: Case designs that can be cheaply modified to reflect the ownership brand.

Guideline 4.2.2.i: Ensure wireless connected devices used by children are not discoverable or visible to others on that network, to prevent inappropriate people being able to contact children

Children may not understand that they have connected to a network. The default should be that the device is not discoverable or visible by others on that network. This is to ensure that the child cannot be contacted by an inappropriate person or sent inappropriate material.

4.2.2.1 Control of outgoing calls

Guideline 4.2.2.1.a: Provide clear information to parents/carers about the need for barring calls and access

Parents/carers may not be aware of the dangers that children face when making calls and accessing the Internet. Service providers need to explain potential problems and why there is a need to restrict what a child is doing.

Guideline 4.2.2.1.b: Consider allowing parents/carers to restrict outgoing call numbers to avoid inappropriate calls

A parent may want to restrict the outgoing calls made by a child. This can be done as part of the configuration of the terminal. The parent/carer may want to provide a restricted set of numbers for a child to use on their own phone. Children can be easily tricked into making communications e.g. voting for pop idols. They do not understand the implications, either social or financial.

EXAMPLE 1: Some mobile phones provide a "child function" that only allows memory dialling from the 0 to 9 buttons on the keypad, when this mode is activated. The mode is password protected, so that parents/carers can control the feature. The consequences of this action should be clearly explained to the parents/carers.

EXAMPLE 2: In set up parents/carers can either list the only numbers to be called, or restrict access to premium rate numbers. The consequences of this action should be clearly explained to the parents/carers.

Guideline 4.2.2.1.c: Provide the ability for parents/carers to set up closed communication groups for children's use

It should be possible to set up closed communication groups for children e.g. to parents/school friends. Other adults should not be able to gain access to this group.

EXAMPLE: Some school chat groups can be set up with a restricted access allowed.
e.g. Cyber Patrol [69] that can block harmful websites, restrict chat, filter web based e-mail and manage time online.

4.2.2.2 Control of incoming calls

Guideline 4.2.2.2.a: Ensure that it is possible to restrict incoming calls and connections, except from callers personally known to the child and authorized by the parents/carers

As one does not want children to contact certain people, you also do not want certain people contacting children, for malicious or marketing purposes. Children cannot differentiate unsolicited communication for real communication. (N.B. spam or marketing). Security measures need to be in place to prevent bad people e.g. paedophiles getting in touch with young children.

If an incoming call does not come from a number registered in the device as being a legitimate number, then the call should be re-routed to the parent/carer.

Guideline 4.2.2.2.b: Provide feedback to parents/carers if the privacy preferences set for the child are being altered

A child or an unauthorized person may try to change the access settings for a child. If somebody attempts to do this the parent/carer should be informed that this has happened.

EXAMPLE: E-mail information to parents/carers.

4.2.2.3 Identification as legitimate user

Guideline 4.2.2.3.a: Provide a system for verification for both adults and children

Young children are naive, and therefore measures have to be taken to ensure their protection and privacy. Verification is needed to protect young children. Verification is needed to ensure that the communication is specifically authorized by the child's parent/carer. The legitimacy of the user needs to be checked to ensure that children do not access adult services. Also see guidelines 4.4.2 on safeguarding access to inappropriate content. And conversely needs to be checked to ensure that only legitimate people are contacting children (to avoid paedophiles contacting young children).

EXAMPLE: Use a user profile or something like a UCI described in EG 202 301 [9] with a trusted third party check of age.

Guideline 4.2.2.3.b: Consider the use of biometrics for verification

As children have problems in keeping PIN codes secret, other identification mechanisms rather than PIN codes, need to be considered. Many biometric techniques cannot be used for children, for example, a child's fingerprint is not stable. Iris recognition by be possible. There are likely to be developments in this area and current information should be consulted. It is important to educate children on the risks of sharing PIN codes.

Guideline 4.2.2.3.c: Provide information on whom the call is coming from

Children naturally trust adults and it is therefore difficult to get them to make decisions about who is calling them. Children should always be informed of who is calling them. The provision of a reliable means to identify a person who is attempting to communicate will make the provision of effective call screening and call management solutions possible.

Guideline 4.2.2.3.d: Ensure that national and EU legislation on data protection and privacy are adhered to

Rules and regulations exist for what data can be collected and hold on users to ensure privacy of data. This is of great importance for the data on children under 12. The EU Directive on Data Protection [40] and any national legislations should be consulted. Data protection issues are important when considering such services as location based services see clause 4.3.7.

In America many web sites comply with the Children's Online Privacy Protection Act (COPPA) if they are providing a web site targeted at under 13 year olds. The act spells out what a Web site operator should include in a privacy policy and what responsibilities an operator has to protect children's privacy and safety online [21].

Guideline 4.2.2.3.e: Provide easily accessible means for children to report unsafe situations that they are not happy about

Encourage children to report unsafe situations they are not happy about. Children should not be asked to provide unnecessary personal information. The EU is running the Safer Internet Programme which aims to promote a safer use of the Internet by children. Amongst its many activities are hotlines for reporting problems, research into filtering and awareness activities. Service providers should inform children on what is acceptable use of their services. Also see guideline 4.3.1.1.c.

EXAMPLE: The following information was provided on a children's web site for reporting unsafe situations. From Yahooligans [19].

4.2.3 Operation

Guideline 4.2.3.a: Provide detailed guidance for young children, to help them complete operations

Children should be guided through the basic level of call control using visual display, voice or on-product graphics. Very young children can hold a conversation on a telephone but they may not have necessarily initiated the call. In the same way young children may be able to use a computer but may not have initiated a communications connection on that computer. Any instructions on use should be very explicit (see clause 4.2.1 on comprehending instructions).

Guideline 4.2.3.b: Provide "shortcuts" for experienced (older) child users to allow speedy operation and to avoid frustration

Older children can be quick at understanding how to operate equipment, therefore short cuts should be provided for the more experienced child user. Always provide guidance for the novice user. Also see guideline 4.3.3.2.b.

Guideline 4.2.3.c: Provide clear expressions of functions to ensure easy operation

It may be appropriate to provide one function per device for very young children. However, older children can generally handle more functions per device. What is important is to provide clear expression of the functions of the terminal. Also see guideline 4.1.3.3.a.

4.2.3.1 Turning on a device

Guideline 4.2.3.1.a: Consider other means than a PIN-code/password to turn on devices, as children may reveal PIN-codes/passwords

Many devices when turned on require the input of a password/PIN number. Children can be bullied into revealing their PIN numbers/passwords. PIN codes to unlock mobile phones may be inappropriate for young children and may indeed pose a security risk as they may not then be able to turn on their phones to make a call to their parent or guardian.

EXAMPLE: Use other means of security rather than PIN codes.

4.2.3.2 Initiating a communication

Guideline 4.2.3.2.a: Provide a "call home" function, for ease of access to parents/carers

The primary aim for young children when using communications devices is to be able to communicate easily with home/carers. Provide an easily accessible key (possibly a dedicated key) on a communications device for a direct call to a specified number e.g. home.

EXAMPLE: In the configuration of the terminal the parent/carer programmes the device to call home from a specified key.

Guideline 4.2.3.2.b: Provide easy initiation of calls directly from phone lists for children

Children make mistakes when entering telephone numbers, they may have difficulty remembering the numbers to enter or difficulty entering them while reading the numbers off a paper based phone list. Provide an easily accessible phone list, and easy initiation of calls directly from the phone list, to make the task of making a call easier for children.

Guideline 4.2.3.2.c: Provide clear labels or symbols on the off-hook key, so that the child knows how to make a call

Provide clear labels or symbols on the off-hook key, so that the child knows how to make a call. Use language on keys that is obvious to children or use well recognized symbols.

EXAMPLE: Label the off-hook key "make call".

Guideline 4.2.3.2.d: Provide the means for parents/carers to control a child's connection to the Internet

Provide the means for parents/carers to control a child's connection to the Internet. The connection to the Internet should be managed by parents/carers allowing children access in their own restricted domain.

Guideline 4.2.3.2.e: Provide parents/carers with advice and mechanisms to avoid children accidentally invoking modem hijacking

With modem hijacking dial-up settings may be changed, and huge costs incurred due to unauthorized dialling of premium-rate services (in other countries) that are extremely overpriced. The modem hijacking may be invoked just by clicking "yes" to apparently innocent requests in pop-ups, or in the 'Terms and Conditions' of a web site. Children are known to like colourful pop-ups , and are likely to click on links. They will be unaware of consequences like modem hijacking. Advice on how to avoid and prevent modem hijacking, and mechanisms for avoiding dial-up of unauthorized numbers (e.g. safe diallers, filters) should be provided to parents/carers.

4.2.3.3 Receiving a communication

Guideline 4.2.3.3.a: Make call-waiting obvious and understandable to the child

It is very important for parents/carers to be able to easily communicate with a child, whilst they are not at home e.g. at school, at a friends house, in the park, etc. Provide a clear indication on the display or by voice that there is an incoming call from home/carers (call waiting). It should be possible to receive the call with one key press.

4.2.3.4 Ending a communication

Guideline 4.2.3.4.a: Provide automatic call ending, as young children may not successfully do this manually

Young children do not necessarily understand the implications of use e.g. not putting the receiver down or ending the call. They do not necessarily understand that calls can cost money. Children should be taught to end calls. It may be possible to provide automatic call ending based on a set time period, configurable by parents/carers. This would be useful from a health and safety viewpoint as well as the costs incurred. However, notification should be given that the call is due to end. Currently if both ends leave the line open there is not necessarily a check for voice traffic. If one end disconnects the other will get a "howler"/be disconnected after a period of time. However, this should not happen if the call is to the emergency services and/or the parents/carer, again this could be set up in the configuration of the device.

Guideline 4.2.3.4.b: Provide automatic log-off from the Internet, for dial-up services, if there has been a period of inactivation

Children are likely not to log-off. Provide automatic log-off from the Internet, for dial-up services, if there has been a period of inactivation. Provide automatic log-off if there has not been any key presses for a certain period of time. This could be set in the user profile for the set up of the terminal.

Guideline 4.2.3.4.c: Provide clear guidance on how a child should log-off a dial-up connection from the Internet

Provide clear guidance on how a child should log-off a dial-up connection from the Internet. Do not assume children know subtle conventions, such as the difference between ok, close and cancel. Provide explicit instructions on how to end an Internet session.

4.2.4 Navigation

Guideline 4.2.4.a: Consider placing the children's applications on the top menu level so that they can reach them directly

Consider placing the children's applications on the top menu level so that they can reach them directly. Children are not very good with complex search and navigation. Restrict the search path for children by placing the children's applications at the top level.

Guideline 4.2.4.b: Provide a "back" function for navigation on a web based system, so that the child can revert to a previous page

Provide a "back" function for navigation on a web based system, so that the child can revert to a previous page. Children have been found, like adults to rely on the "back" function when undertaking web navigation [39]. However, children will repeatedly follow unproductive paths in the absence of a 'back' function. Also consider other navigation functions e.g. "home".

4.2.4.1 Metaphors

Guideline 4.2.4.1.a: Use meaningful metaphors for children, designed for their own use

Metaphors used well can aid in the navigation for young children. An interface metaphor presents a representation of some object (e.g. a video recorder control panel) with which the user is familiar and from which the function and behaviour can be predicted. Children may not understand adult metaphors e.g. office metaphors.

Metaphors can help guide a child through a system, but the metaphor should be meaningful for the child. (Test out new metaphors with a representative group of children). New metaphors can be learnt by children if they are clear and consistent [43].

EXAMPLE: Use pictures to represent what is in a room.
Children understand a "drawer" metaphor for hiding items in, for example advanced tools could be hidden in a drawer.

Guideline 4.2.4.1.b: Adhere to existing stereotypes so as not to confuse children

If there are existing stereotypes these should be used. Operation of terminals will be easier for children if they can transfer knowledge from one device to another. Children from different cultures may not follow the same flow of action, for example flows from left to right should not be assumed as people from some countries write from left to right, right to left or top down [38]. Use the same symbol for turning the terminal on as is used on other devices such as televisions.

EXAMPLE:  For turning on a device.

4.2.4.2 Menus

Guideline 4.2.4.2.a: Design for no scrolling or hidden check boxes which may not be apparent to children

A menu presents the child user with a list of choices from which a selection can be made. Children may not understand that there may be information hidden below what they can currently see on a screen. Make lists that show all the options visible on the screen. Additional options should be provided through a clear navigation path.

Guideline 4.2.4.2.b: Provide easy access to the main menu, so that children do not get lost

Provide easy access to the main menu, so that children do not get lost. The main menu should be available and it should always be possible to return to it easily and quickly.

EXAMPLE: Make it clear at the start how to get back to the main menu e.g. by pressing the * key or a dedicated key.

4.2.4.3 Speech recognition interfaces

Guideline 4.2.4.3.a: Use speech recognition for children as a supplement to other input devices, as speech recognition may be unreliable for children

As standard speech recognition interfaces may not be robust enough for children, they should only be used as a supplement to other interfaces. However, they may still be useful in the limited vocabulary and speaker dependent form, and for child users that require alternative modalities than e.g. text input in order to use ICT. One cannot rely on speech recognition services for use to call emergency services as the child will be distressed and will call in an abnormal voice, thus increasing the risk of recognition failure and subsequent inability to complete the call.

Guideline 4.2.4.3.b: Use a speech recognition interface designed specifically for children, adult ones are not appropriate

Speech recognition interfaces can be a useful alternative for young children who do not necessarily have the correct written literacy skills to use text input. However, speech recognition interfaces designed for adults may not be appropriate for use by children. [12]. Children have different voice qualities than adults and their voices change. Therefore, speech interfaces should be tailored to children's vocal qualities. Children may need specially designed training procedures to train speaker dependent voice recognition systems.

Guideline 4.2.4.3.c: Ensure that activation and deactivation of speech recognition interfaces are easy for children

Even adults may have problems activating and using speech dialling on mobile phones. Speech recognition interfaces for children should be easy and intuitive to activate and deactivate, and give the child clear feedback and error correction strategies.

4.2.4.4 Help facilities

Guideline 4.2.4.4.a: Make available multimodal help, to take account of different abilities and disabilities of children

Help systems are used to aid users to successfully perform tasks. Help can be offered so that the user is informed about the purpose of a function key, or command. As young children do not necessarily have the literacy skills, and to take account of different abilities and disabilities, help should be available in a several modalities, this could be set up at configuration of the terminal.

Guideline 4.2.4.4.b: Use direct and simple language appropriate to children

Write the help information in short simple sentences and include what to do next and how to return to the main task. Girls are more likely to read instructions and help than boys [28]. Also see guideline 4.2.1.1.a.

4.2.4.5 Error handling

Guideline 4.2.4.5.a: Make the system/service error tolerant, as children are likely to make errors

Children in particular are likely to make errors when using communications devices. Therefore designers should assume that this is going to happen. However, they are unlikely to read error messages provided [13].

As children may not have the experience to recover from errors, the system should be designed to be as error tolerant as possible. The system should be able to cope with different number formats for date, etc. A child should not be allowed to re-configure a terminal or service. Children should be encouraged to contact the parent/carer for error recovery.

Guideline 4.2.4.5.b: Provide error messages in a language and style that a child can understand

Error messages should appear as soon as they happen and should be given in a language that a child will understand.

EXAMPLE: "You have dialled a wrong number, try again".

Guideline 4.2.4.5.c: Provide simple error recovery, in order to help the child correct mistakes

The provision of a consistent means of deleting the last key stroke would aid all users and children in recovering from errors. Children should be encouraged to ask parents/carers to help if they are experiencing any difficulties.

EXAMPLE: Use a "Delete" key to correct minor keying errors.

Guideline 4.2.4.5.d: Provide supervised help for very young children as they are unlikely to understand error messages

Provide supervised help for very young children as they are unlikely to understand error messages. Young children need more information than a response is either correct or not. As pre-school children do not have the literacy skills to understand explanations, it is important that a human helper is available for explanations [41].

Guideline 4.2.4.5.e: Provide instructions and support for the adults who are supporting the child as they may not be ICT literate

Those who are responsible for the child may not be ICT literate and therefore detailed instructions should be given to the parent on help recovery mechanisms.

4.2.5 Handling of information

Guideline 4.2.5.a: Allow children to store items referenced with their own labels or pictures to enable easy retrieval of the information

A child may want to store and use information such as telephone numbers frequently called, messages, web sites, photographs, etc. When storing for example telephone numbers, a label/picture should be associated with that number so that the child can easily recall and use the number. The storage of the child's data should be secure and should only be accessed by others with parental/carer consent. Children may not understand the need not to share other people's personal data with others.

Guideline 4.2.5.b: Provide feedback on available storage space on a way that is understandable by children

Children are likely to want to store videos, pictures and graphics. There should be enough storage space to accommodate this, with feedback being provided in a way that is comprehensible by children. Information needs to be provided on what to do.

Guideline 4.2.5.c: Provide recovery facilities for children's own data

Children are less likely to undertake back-ups than adults. Consider providing automatic back-up of data and easy understandability of recovery facilities.

Guideline 4.2.5.d: Provide easy retrieval of information, encouraging the use of "own" labels for storage

Children need to be able to easily retrieve what they have stored. The use of their own labels for storage will aid this. Also see guideline 4.2.5.a. Have pictures associated with phone numbers for easy recall.

4.3 Services

The key element of the present clause is the child's interaction with services and information, distributed from service centres and accessed through fixed or mobile networks, terminals and other devices. Certain issues directly applicable to the configuration, set-up and use of services, such as language, symbols, error handling, safety and security issues are addressed in clause 4.2, "Operational issues of terminals and services". For further, generic design guidelines and recommendations applicable to the user interfaces of mobile terminals and services (addressing mostly adult users), see EG 202 132 [8].

4.3.1 Generic guidelines for services

4.3.1.1 General

Guideline 4.3.1.1.a: Use colours to enhance children's experience of services

Use colours to enhance children's experience of services. However, colour should not be used alone to indicate vital functions and messages. Additional modes of information should always be redundantly provided. Also see guideline 4.1.2.c.

EXAMPLE: Colour displays in mobile phones improve the user experience of messaging and make gaming more enjoyable.

Guideline 4.3.1.1.b: Provide multimodal user interfaces, when possible

Young children who do not possess well developed literacy skills yet, may benefit from alternative representations to text. In addition this would be of benefit to children with special needs. Also see guideline 4.2.4.1.1.c.

Guideline 4.3.1.1.c: Provide a mechanism for potential service abuse information collection and make it available to the parent/carer

There needs to be mechanisms at the operator/service provider level for reporting and addressing service abuse, including feedback provisioning to the user/carer. This may ultimately lead to possible service exclusion for abusers. Also see guideline 4.2.2.3.e.

EXAMPLE: See the code-of-practice documents developed by the UK industry and its Regulator [57].

Guideline 4.3.1.1.d: Provide means to determine the identity and legitimacy of parties communicating with children

Provide means to determine the identity and legitimacy of parties communicating with children. Also see clause 4.2.2.3. Additional measures such as call barring and filtering can be used to ensure that a child is not in contact with unauthorized and undesired callers. Also see clauses 4.2.2.1, 4.2.2.2 and guideline 4.4.1.3.b.

EXAMPLE: Most operators support a subset of these well-established mechanisms, e.g. limiting outgoing dialling.

4.3.1.2 Service availability and access

Guideline 4.3.1.2.a: Indicate service availability/unavailability and possible service access in a way that children will understand

Indicate service availability/unavailability and possible service access in a way that children will understand. When a child experiences unavailability of a service, they need to know how to solve the problem. Give information to pre-registered parents/carers about the child's service unavailability.

Guideline 4.3.1.2.b: Provide and support the use of templates and user profiles to simplify children's access set-up, configuration, and use in a networked environment

With the advent of inter-worked and ad-hoc networking access to services for children is more complicated. Provide and support the use of templates and user profiles to simplify children's access set-up, configuration, and use in a networked environment. In certain situations, for example the school setting, profiles of the children can be used to limit access to only those services which are appropriate for them. The profiles can include aspects of culture, language, cost, safety and security options. See [70].

EXAMPLE: The school information and access systems used in Swedish schools in Nacka, Stockholm, operates across a number of networks and uses a single student ID.See [71].

Guideline 4.3.1.2.c: Always offer a child the possibility to be connected to its parents/carers

As children are likely to use up all of their credit, there should be the facility to connect the child to one specified number, for example their home number. In addition and if necessary, it should be possible to credit the cost of such a connection, to be settled at a later phase. This could be done by reserving credit or charging the cost a posteriori.

Guideline 4.3.1.2.d: Provide clear cost indicators to children for voice and data call services

Provide clear cost indicators to children for voice and data call services. This will ensure that they know how much credit they have and whether they can use services. Also see guideline 4.4.1.8.a.

4.3.2 Voice call services

Guideline 4.3.2.a: Provide call services in multiple modalities

Most children consider basic telephony functionality in a handset as the most important. For children with special needs, an alternative channel to voice needs to be provided. Video calls supporting the use and transmission of interaction involving lip reading and sign language at an affordable cost have improved the situation for many deaf child users.

EXAMPLE: The unforeseen success of 3G services among deaf Swedish users [72] is due to the provision of an affordable communication modality, supporting the use of sign language and lip reading.

Guideline 4.3.2.b: Call services should support access-agnostic relay services or provide similar, functional accessibility solutions

Deaf children and children with severe speech defects, who can read and write benefit from text telephones and mobile terminals with "teletype" capabilities accessing others through relay services (for further details, see TR 101 806 [3]). Video communication through a relay or similar service should be provided to children who rely on sign language (for further details see EG 202 320 [72].

EXAMPLE: As specified in the field trial of the Swedish regulator PTS, see [72].

4.3.3 Messaging services

Guideline 4.3.3.a: Provide clear instructions on how to initiate and close a communication channel

Messaging services are becoming more and more complex and difficult to understand for the child, because of the various names used by manufacturers and operators, the advanced functionalities and formats supported. It is essential that the child knows how to open and close communication channels with the correct and appropriate end point.

4.3.3.1 Text and data messaging

Guideline 4.3.3.1.a: Clearly indicate the status and different messaging states

Messaging is commonly used by children to interact with other children, parents, carers, schools, etc. Using a combination of text and data, a child can create messages in their devices. The child needs to be aware of the different messaging states, e.g. when a new message has been received.

Guideline 4.3.3.1.b: Provide easy selection of message types and indicate how the selection can be performed

There are now available many message types which may cause confusion for children. Provide easy selection of message types and indicate how the selection can be performed. Any applicable restrictions on format and size should be indicated to the child in a clearly understandable way.

Guideline 4.3.3.1.c: Inform the child if a terminal cannot present the necessary data formats required for the presentation of a received message

Inform the child if a terminal cannot present the necessary data formats required for the presentation of a received message. The information should be provided on what can be done in order to read the message. The interoperability of Multimedia Messaging Services (MMS) has been suffering due to the slow development of international roaming agreements and billing software. During this stage, children had considerable difficulties with retrieving received MMS messages from friends.

Guideline 4.3.3.1.d: Prevent children from accessing premium-rate information or communication services without agreement of a parent or carer

Children should be able to access premium rate services, which incur a special charge, only with parent or carer agreement. This is a legal requirement in several countries and can be implemented by an event-based or parental PIN over-ride or through pre-agreed configuration and settings. In addition, the consequences of the action should be clearly explained to the parent/carer.

EXAMPLE: Premium services of various kinds require commercial agreements to be entered, e.g. for accessing media content offered by 3G services. In other cases, such as voting during a song contest, no real limitations or control procedures are made available.

4.3.3.2 Voicemail (voice messaging)

Guideline 4.3.3.2.a: Provide easy access to voice-mail system by young children

Babies and toddlers may have problems using the current *de facto* way of accessing voice-mail, which is to use a long or double press on the "1" key. Provide easy access to voice-mail system by young children.

Guideline 4.3.3.2.b: Do not provide hidden functions or shortcuts to young children

Young children may not be aware that there are hidden functions. All functions should be presented and obvious for use. Also see guideline 4.2.3.b.

EXAMPLE: As children mostly use mobile terminals developed for adults often requiring or appreciating the availability of shortcuts, this has been difficult. However, as mobile phones designed for children begin to appear, this guideline should be taken into consideration.

4.3.3.3 Instant messaging

Guideline 4.3.3.3.a: Indicate to the child that certain settings are required before chatting is possible, and advice about adult assistance, when accessing a chat application for the first time

First-time use of the system will most often require assistance from an adult carer or an older child. Indicate to the child that certain settings are required before chatting is possible, and advice about adult assistance, when accessing a chat application for the first time.

Guideline 4.3.3.3.b: Support the set-up and use of restricted chat room member lists ("buddy lists") and include the possibility to instantly block certain members

There should be parental/carer/operator supervision and control of the buddy list. Blocking and un-blocking certain users from chatting should be controlled by an adult but also easily and instantly available to the child.

EXAMPLE: In the case of several interactive gaming applications, an adult moderator is available to monitor children's communication.

Guideline 4.3.3.3.c: Ensure the "buddy list" is easy to find, understand, maintain and efficient to use for children

Ensure the "buddy list" is easy to find, understand, maintain and efficient to use for children.

Guideline 4.3.3.3.d: Do not offer access to group chat rooms ("discussion forums") to very young children.

Do not offer access to group chat rooms ("discussion forums") to young children. Group chatting for children is not considered secure (c.f. "grooming" on Internet chat rooms).

Guideline 4.3.3.3.e: Use reliable age verification mechanisms to block adults from children-only chat rooms

Use reliable age verification mechanisms to block adults from children-only chat rooms. A well designed chat application should require, offer and manage credible age verification and access confirmation possibilities.

Guideline 4.3.3.3.f: Provide single and simple child user identification and log-in mechanisms and short connection times for instant messaging services

Provide single and simple child user identification and log-in mechanisms and short connection times for instant messaging services.

Guideline 4.3.3.3.g: Consider providing a dedicated key to push-to-talk over cellular (PoC) and other voice-based instant mobile messaging applications for children

Consider providing a dedicated key to push-to-talk over cellular (PoC) and other voice-based instant mobile messaging applications for children.

EXAMPLE: As was implemented on "walkie-talkies".

4.3.4 On-line gaming

Guideline 4.3.4.a: Inform the child about the financial implications of playing on-line games and obtain parental agreement to payment

Many games require the accumulation of credits via SMS or premium-rate numbers. In most European countries, the approval of these services can only be made by an adult, as it is illegal for children up to a certain age (mostly 18) to enter commercial agreements. Inform the child about the financial implications of playing on-line games and obtain parental agreement to payment.

EXAMPLE: Some interactive game require a pre-paid voucher number to be entered or a validated credit card to be made available for the monthly subscription fees.

Guideline 4.3.4.b: Ensure that no child can access gambling activities

In most European countries, gambling is not open to children as it is prohibited by law. Gambling as an activity offers the children the opportunity to gain something that they desire. Very little research has been conducted to understand either the gambling habits of young children, nor the dangers [45]. It is clear that public perception favours restraint on the gambling behaviour of children, as there are laws prohibiting access to many forms of gambling for children. For this reason, access to gambling via ICT should be prevented. It is also clear, however, that gambling is widely prevalent in European culture, so the boundaries of what would be considered acceptable gambling is difficult to determine. In general, however, young children will have difficulty weighing the chances of success against the chances of failure, and are therefore prone to waste available resources. For this reason, gambling targeted to young children should be prohibited.

EXAMPLE: Competitions with simple questions, cost money to participate, and promise attractive rewards but with very high odds against winning should not be made available to young children.

4.3.5 Transactional services

Guideline 4.3.5.a: Limit the maximum amounts allowed for transactions for children

Limit the maximum amounts allowed for transactions for children. Identity mechanisms should be supported, if required to prevent abuse of stolen equipment and subscriptions. Parental authorization should be sought and verified to provide confirmation of any (sales) transactions.

Guideline 4.3.5.b: Clearly indicate the cost implications to children when buying products

The use of already downloaded games or ring tones may generate a monthly cost that may not be clear to a child. Clearly indicate the cost implications to children when buying products.

4.3.6 Emergency call services

Guideline 4.3.6.a: Provide easy and direct access for children to emergency services

Access to emergency services through the European emergency number, 112, should always be supported, as it is a standard in most European countries and is explained to children at school at early ages. In addition, as children may contact the emergency services in stressful situations, children should be able to initiate an emergency call from any type of phone without further analysis or thinking. Young children will very rarely be alone and in need of making an emergency call. However, situations such as when a young child is at home with a parent who becomes very ill and the child needs to call the emergency services may happen. Children are likely to panic so making the call should be straight forward. See SR 002 180 [6] which provides more general information on the design related to emergency call handling.

There should be a set-up-procedure for emergency calling which uses no soft keys and no voice prompts during the confirmation dialogue to support children, including children with special needs and children not being able to understand the terminal language. This should be accessible to children in any of the following states: idle mode, keypad-locked, no SIM, before PIN-entry, or no registration with a network.

EXAMPLE: As implemented on most mobile GSM systems and phones currently offered in Europe.

Guideline 4.3.6.b: Ensure that emergency service centre staff are trained to interact with children

EXAMPLE: In the same way as emergency call centre agents are trained in handling panicked adults that should be prepared to interact with child callers, understanding, respecting and handling the attributes of such communication in the most proper way.

4.3.7 Passive location and positioning services

Guideline 4.3.7.a: Ensure that child location services are not open to abuse

Operators and location service providers should undertake all possible measures, in addition to possible legal and regulatory requirements, to ensure that child location services are not open to abuse. See the "Industry Code of Practice: For the use of mobile technology to provide passive location services in the UK", [57].

Guideline 4.3.7.b: Register every passive child positioning request initialized by other locators than the parent/carer and inform the parent/carer (if known or identifiable) immediately

Register every passive child positioning request initialized by other locators than the parent/carer and inform the parent/carer (if known or identifiable) immediately.

Guideline 4.3.7.c: Make passive child location services only available to a child's parents/authorized carers

There is a need to carefully verify, validate and register the identity of the locator and their relationship to the child. Make passive child location services available only to a child's parents/authorized carers.

EXAMPLE: The "Industry Code of Practice: For the use of mobile technology to provide passive location services in the UK", [57], describes available and recommended mechanisms and methods in the UK in detail.

Guideline 4.3.7.d: Provide correct marketing and support information on passive child location services to parents/carers

Take into account that knowing where a child's phone is does not reliably inform about the location of the child or the child's well-being. As technology is not always available nor completely reliable, parents/carers should not rely on the availability of positioning services only, fulfilling their guardian responsibilities. This should be clearly explained and understood.

Guideline 4.3.7.e: Inform and guide parents/carers about the functionality, set-up, configuration and reliable use of location services, including related safety measures

Location service providers in the UK are requested to provide an introduction to parents/carers to these services, see [57]. In addition, they are required to provide guidance and customer care services through multiple channels, including telephone, SMS, WAP, Web and e-mail. Inform and guide parents/carers about the functionality, set-up, configuration and reliable use of location services, including related safety measures.

Guideline 4.3.7.f: Ensure that the child consents to set-up and activation of passive location services and is clearly notified when s/he is being located

Ensure that the child consents to the initial set-up and activation of passive location services and be notified (including the identity of the locator) when s/he is located, using terminology understandable to the child. In addition, children's rights charters, such as those described by the United Nations Committee on the Rights of the Child (UNCRC), see [58], should be respected. Children should have the last say and their wishes may not be overridden, unless there are serious security concerns involved (to be explained to the child).

Guideline 4.3.7.g: Provide and present a simple procedure to the child to suspend, stop or deactivate a location service

Provide and present a simple procedure to the child to suspend, stop or deactivate a location service. If such a request is made by the child, the parent/carer should be notified.

Guideline 4.3.7.h: "Friend location services" and mobile games using passive location information should not be offered to children under 12

EXAMPLE: There are applications that can be made available to children to locate their friends or play interactive games, making use of the child's location. However, as the potential risks are higher than the potential benefits, their use is not recommended to under 12 year olds.

4.3.8 Internet access, browsing and applications

Guideline 4.3.8.a: Follow the applicable accessibility recommendations specified in the Web Content Accessibility Guidelines (WCAG) version 2.0

Follow the applicable accessibility recommendations specified by the World Wide Web Consortium (W3C) in the Web Content Accessibility Guidelines (WCAG) version 2.0, [22]. Many Web sites implement the recommendations found in version 1.0 of the Web Accessibility Initiative guidelines. This is now being superseded by version 2.0 and should be applied.

Guideline 4.3.8.b: Classify and control commercial and other unsuitable content to children

Classify and control commercial and other unsuitable content to children. Access to such content should, if possible, be restricted to children. In the UK, an independent classification body classifies "18" content and filtering mechanisms are applied in a corresponding way. Similar classification and filtering should be put in place for under 12 year olds. Also see clause 4.4.2.

4.4 Content

The following clause will focus on content delivered via Internet and telecommunications hosted services.

4.4.1 Appropriateness of Content

4.4.1.1 Comprehensibility to children

Guideline 4.4.1.1.a: Match language level in text material to be used to children's language and reading skills to increase understandability

The language and reading skills develop with age and are influenced by the cultural background of the child. Material that is intended to be understood by children should use vocabulary and language constructs that match the abilities of the target readers. Initially, readability should be tested by evaluating it against a culturally and linguistically equivalent standardized readability scale such as the Fry Readability Index or the Flesch-Kincaid Formula. More thorough comprehensibility testing for appropriateness of vocabulary, idiom and content should be undertaken in co-operation with a professional children's literature author and with a representative set of children.

EXAMPLE: Information for young children should be based on graphics, speech and multimedia, with text annotation wherever possible.

Guideline 4.4.1.1.b: Ensure spoken content is comprehensible for children

Children do not understand the full content of adult conversation. Where the content of spoken material is intended for children, care should be taken to ensure that it is at an appropriate level of vocabulary, grammar and meaning. This is best achieved by reviewing it with children that are representative of the target users.

EXAMPLE: Instructions for procedure such as how to ask an operator for assistance or directions to a location should be presented with a vocabulary appropriate to the target child users.

4.4.1.2 Harmful content

Guideline 4.4.1.2.a: Ensure that there is no portrayal of violence in content intended for use by young children

Although the portrayal of violence is an accepted part of the content disseminated by the entertainments and leisure industries in many cultures, there is considerable credible and independent evidence that young children under the age of 10 assimilate tendencies to violent behaviour that continue to be manifest in both short term aggressive behaviour and long term violent tendencies. Even portrayal of apparently justified violence can be interpreted as a justification for violence in general. For this reason, material that is intended for use by young children should rigorously avoid the portrayal of violence. Content that portrays violence should be identifiable as such before use and safeguards should be in place to prevent young children from accessing such content [44].

EXAMPLE: Web sites specifically providing content to young children should not include content that portrays violence.

Guideline 4.4.1.2.b: Ensure that the portrayal of violence in content is clearly contextualized, with the meaning justified, in content for older children

In order to avoid short-term aggressive violent behaviour, mindless violence should be avoided in content that is to be engaged with by older children. Violence should only be portrayed in a context that increases understanding and associates violence, and the damage done by violence, to real life scenarios. Content that portrays violence should be identifiable as such before use and safeguards should be in place to prevent older children from accessing such content. Some rating systems exist, however, they may not take into account recent research and should be adopted with caution.

EXAMPLE: Web sites specifically providing content to older children should properly contextualize the portrayal of violence.

Guideline 4.4.1.2.c: Ensure that there is no portrayal of sexual activity in content intended for young children

Whilst young children may not find nudity or sexual affection problematic, the portrayal of sexual activity can be extremely disturbing for young children as it can be misinterpreted as either dirty or violent. For this reason, portrayal of sexual activity should be prohibited until the age when puberty can safely be assumed to have been reached. Content that portrays sexual activity should be identifiable as such before use and safeguards should be in place to prevent young children from accessing such content

EXAMPLE: Entertainment services specifically providing content to young children should not include content that portrays sexual activity.

Guideline 4.4.1.2.d: Ensure that the portrayal of sexual activity in content is clearly contextualized, with the meaning justified, in content for older children

In order to reinforce the principles that sexual activity should be both consensual and should take place within contexts acceptable to the society within which the children are growing up, content providers should be sensitive to the norms of the society and should avoid the portrayal of sexual activity in material intended for older children. Where the portrayal of sexual activity is unavoidable, it should be discrete, clearly identified before being made available and set firmly in context. Content that portrays sexual activity should be identifiable as such before use and safeguards should be in place to prevent older children from accessing such content.

EXAMPLE: Entertainment services specifically providing content to older children should properly contextualize the portrayal of sexual activity and any such portrayal should be discrete.

Guideline 4.4.1.2.e: Ensure that visual image sequences are not likely to trigger adverse biomedical effects in children

Visual image sequences may in some cases have undesirable effects, including photosensitive epileptic seizures (as reported in Japan in 1997, for a TV animation program [63]), visually induced motion sickness (e.g. in video games) and visual fatigue (e.g. when watching particular geometric patterns). There are existing recommendations for the broadcast area, and ISO has started work on 'Image Safety' in all categories of image providers (e.g. for computer/video games, movies, videos and video pictures on web sites). The aim of the IWA [63] is to provide recommendations to both viewers and image providers on how to reduce the biomedical risks of visual image sequences. Children may be particularly susceptible to such effects, because they get easily absorbed in activities (e.g. video games) and do not take notice of or heed symptoms of discomfort.

4.4.1.3 Interpersonal Communication

Guideline 4.4.1.3.a: Ensure that facilities are in place to prevent on-going bullying of children using communication services

Reports of bullying of children using communication services are increasing. This can take the form of unsolicited messages with content that conveys bullying behaviour, or of bullies repeatedly directing harmful or unwanted content to other children. Service providers should not only provide mechanisms for blocking content from bullies, they should also provide mechanisms for reporting instances of bullying and a charter of actions to be taken when bullying occurs.

EXAMPLE: Blocking filters should be available for SMS messages that are as easy to use as a blocked buddy list in an online chat service.

Guideline 4.4.1.3.b: Ensure that children are free to communicate with peers without intrusion of adults masquerading as peers

It may be difficult for children to recognize that the communication partners may be adults pretending to be children. The adults may mimic the style of children's conversations, gain acceptance and trust within an on-line community, and then manipulate the children into on-line and subsequently offline activities that are harmful to either the child or the child's peers or families. These activities could range from persuading the child to divulge personal details, to discuss topics that are inappropriate for children, or to arrange to meet.

Children should be protected from situations where they can not anticipate this behaviour or from situations where this behaviour can be perpetrated. Forums intended specifically for children should protect them from this situation. Public forums should be accessed through gateways that ensure that interactions that are unsuitable for children take place only in places where children cannot gain access. General public forums should be moderated to ensure that the content is acceptable to children. Service providers should investigate mechanisms for verifying the age of participants in children's communications or conversations, mechanisms should be in place to block unwanted conversations, and content filters should be explored as a means of trapping inappropriate conversations. Also see guideline 4.3.1.1.d.

Guideline 4.4.1.3.c: Ensure that non-task based interruptions are prevented from intruding on children's conversations

Children can find interruptions such as adverts and intrusions by other people seeking to engage in conversations seriously irritating. There is evidence to suggest that tolerance to this type of interruption is very low, and that children will seek an alternative communication channel.

4.4.1.4 Moral, ethical and cultural diversity

Guideline 4.4.1.4.a: Ensure that the cultural diversity of the European population is reflected in generic content in a way that does not discriminate against any group within society

The European population is a heterogeneous mix of cultures and ethical and moral perspectives. Citizens should not find their cultures being attacked or their views being ridiculed or ignored, nor should they be required to use services that seek to treat citizens as a single homogeneous market. Opportunities should be available for children from different cultural communities to have this reflected in their experience of information mediated by ICT. Children are may be readily persuaded to adopt views that conflict with the standards of their parents/carers or community if these views are presented in a compelling manner by a peer or someone with perceived authority. This should be avoided. They should also be protected from encountering discriminatory or inflammatory information.

EXAMPLE 1: Calendar systems should be able to reflect national and minority community anniversaries and special events.

EXAMPLE 2: Online forums for children should be moderated to ensure that cultural diversity is respected and discrimination does not occur.

4.4.1.5 Ability to exchange information within an acceptable use policy

Guideline 4.4.1.5.a: Clearly communicate the boundaries of acceptable content exchange to the children using the ICT

The exchange of information and the use of ICT services invariably implies a contract between the service/content provider and the user. The terms of the contract governing the use by children should clearly state the boundaries of responsibility of the child for their actions and of the advocate of the child for the actions of the child. Where the child is in any way responsible, care should be taken to ensure that the limits of use and responsibility can be communicated to the child in a way that they can comprehend, particularly where these govern the content being exchanged.

4.4.1.6 Misleading and misunderstanding by children

Guideline 4.4.1.6.a: Avoid marketing and advertising to children, as it is illegal in some countries and socially unacceptable in others

There is considerable public concern about the targeting of advertising to children, with the result that in some countries within Europe it is illegal. Children have poor ability to balance a variety of factors such as felt need, cost of satisfying the felt need, consequences of satisfying the felt need, etc. Advertising seeks persuade by portraying the need for goods and services in ways that are irresistible, and that the need should be satisfied. This is very compelling for young children, who are easily persuaded they have that need and that they need to have the goods. This can be observed not only for children specific good such as toys, but also for such products as domestic cleaning goods. Young children will not follow by looking for alternatives to satisfy the need, or even questioning it. This makes them very vulnerable targets for advertisers, particularly where they are in a position to make their own purchasing decisions.

EXAMPLE: Entertainment and Information services intended for use by young people should be free from advertisements.

Guideline 4.4.1.6.b: Clearly identify and explain copyright and ownership of content restrictions and terms of use in a way that can be understood by children

Children may misunderstand or ignore the limits of ownership of content that they purchase or access using ICT systems. This applies not only to material purchased or shared, but also to material used in educational assignments and for personal use The limits of ownership should be clearly identified, and the penalties, for the country of residence or the jurisdiction applying in the country of origin, should be presented in a way that can be comprehended by children.

EXAMPLE: The legal right of access and ownership should be provided, perhaps as part of the portal or service access and logon process.

4.4.1.7 Subliminal persuasion within content

Guideline 4.4.1.7.a: Ensure that content to be used by children does not intentionally carry subliminal messages

There is great debate, and sparse defendable evidence over both the existence and the effectiveness of subliminal suggestion as a means of advertising or persuasion. In principle, however, the idea of manipulating the thoughts, understanding and emotions of children in a hidden and surreptitious manner is generally not acceptable. Content delivered to young children should be simple and transparent and should not carry a hidden agenda. An example could be a story about a character intended to persuade a child to buy the toy representing the character.

EXAMPLE: Avoid the placing of branded products in material indeed for children where such products are irrelevant to the information being conveyed.

4.4.1.8 Enabling purchases without adult consent

Guideline 4.4.1.8.a: Ensure that it is not possible for children to enact a contractual agreement without fully understanding the scope of the consequences of the contract

The spending power of children may be more limited than they realize, particularly if a contract is in the form of a minimum term subscription. In some cases, children have committed to a purchase on the belief that it was a single payment for a single item, without realizing that they have committed to a subscription contract with a minimum term. Content providers should make the full terms of the contract, particularly the future obligations and costs, clear and understandable for children. Also see guideline 4.3.1.2.d.

EXAMPLE: Provide a clear time line or other representation of the boundaries and the term of the contract being entered into by the purchase.

4.4.1.9 Boundaries to data-mining customers behaviour

Guideline 4.4.1.9.a: Ensure that children consent to, and that parents/carers are informed about, content and usage monitoring

There is a growing trend for the ICT use by children to be monitored, both within the boundaries of data protection legislation and outside those boundaries. It has been reported that [46] that content sources specifically provided for children are particularly prone to surreptitious surveillance, ranging from reporting to a third party the web sites being visited through to key logging. Children are unlikely to be aware of this threat to their privacy, or the privacy of others using the same systems as they have been using, nor will they understand the consequences for themselves or others. Systems to be used by children should be protected with appropriate firewall systems and frequent checks should be made to ensure that systems have not become infected. Any usage statistics gathered about children should be within the boundaries of data protection legislation and should be consensual with the ability to opt out.

EXAMPLE: Systems used by children should be protected from non-consensual usage logging and checked and cleaned regularly.

Guideline 4.4.1.9.b: Ensure that systems used by children do not mine data that can be attributed to an individual without the explicit permission of the child and a parent or guardian

Data mining allows content and service providers to infer rules and patterns about personal and community intentions and preferences from their actions whilst interacting with ICT. Whilst this information could be used to improve the services and the quality of the content, used incorrectly it could treat all users as members of broad homogeneous classes, leading to justification for ignoring the needs and preferences of individuals. As children are in a very dynamic phase in their lives, it is unlikely that inferences made about them have lasting value. Furthermore, the purpose of data mining is often to inform advertisers so that they can target users based on a profile matched to the users usage behaviour. This would contradict guideline 4.4.1.6a and is to be discouraged. In principle, therefore, data mining should not be used to market to individuals, only to generate generic models of the behaviour of children that can be used to improve services and content. All data gathered for data mining purposes should be anonymized or users should be able to elect to opt out of a collection scheme.

EXAMPLE: Online games sites for children should inform parents/carers and children that their gaming habits are being monitored, they should explain how the data will be used and a clear opt out option should be provided.

4.4.1.10 Social Interaction

Guideline 4.4.1.10.a: Ensure that safeguards are put in place in public forums to block access for children or to moderate the interaction in the forum

ICT mediated social interaction, in common with face-to-face social interaction, may encompass topics and interactions that are not suitable for participation by children. Children may masquerade as adults in order to gain access to these forums. Because of this, public social forums should have clearly identifiable adult areas that cannot be accessed by children, or public areas that are moderated so as to be safe for children to join and participate in.

EXAMPLE: Age verification checks should be put in place in order to prevent children from accessing adult specific forums. Best practice examples from, for example, Internet videoconferencing, should be extended to cover phone chatting and other social forums.

4.4.2 Practical Safeguards

Guideline 4.4.2.a: Ensure that content available to children is classified with validated metadata against a standardized set of criteria

Traditional sources of information and content such as library books and films have established standardized classification labels and procedures. This model should be adopted for dependable reference information and content sources to be used by children. Whilst this is difficult to achieve with current heterogeneous information delivery mechanisms and information sources, the convergence of technologies and the architecture of the semantic web provide an infrastructural platform for this guideline to be realized.

EXAMPLE: Reference material intended for use by children should be classified according to content type and age based suitability level.

Guideline 4.4.2.b: Filters should be available to provide safe access or blocking of improper content

Filtering based on content parsing is both only partially effective and prone to manipulation. Examples of problems include the blocking of the names of sports personalities by filters looking for characters from religious stories, and blocking of political information by content service providers aligned to a particular political persuasion. Content providers should continue to develop effective content filters, but should also provide transparent access to the filter rules for modification by those with responsibility for the well-being of children. [74]. Also see guidelines 4.2.2.1.c and 4.3.8.b.

EXAMPLE: Content filters employed by a local education authority should be able to allow the names of local sports personalities who share names with religious characters to pass through filters blocking for religious content.

Guideline 4.4.2.c: Filters should be configured to have their most comprehensive blocking properties on by default

Filtering can usually be applied with various levels of effectiveness. It is important that the most comprehensive level is applied by default, but that those responsible for the well being of children should be able to progressively release the restrictions in a way that reflects the competence and vulnerability of the child users.

EXAMPLE: Older children should be able to access material that is not suitable for young children, but should still be prevented from access harmful material intended for use by adults.

5 Guideline listings

For the table we have used the age group classifications as follows:

- Babies (0 to 1 year).
- Toddlers (2 years to 3 years).
- Infants (4 years to 7 years).
- Preteens (8 years to 11 years).

The child age group classifications are approximate, as children develop differently. The guidelines may in some cases be relevant for younger children than is indicated, depending on the developmental level of the children in question. And the guidelines may equally well be applicable to children older than 12, although that is the scope of the guidelines here. We do not currently envisage extensive ICT use by babies, and therefore many of the guidelines are not relevant to babies. However, in the future, with ubiquitous computing, this may change and additional guidelines may be needed.

The guideline usage classification has used the following criteria for assigning values:

- Design: Guidelines to do with the actual design of devices or content in ICT terminals, systems and services (including product branding as part of deployment)
- Deployment: Guidelines to do with delivering services, deploying ICT equipment and services (e.g. in schools) or procuring such equipment.
- Regulation and Standardization: Guidelines that cover issues that are dependent on or relevant to regulation and standardization activities.
- All: Guidelines that are generally applicable and relevant.

Table 1 shows a classification of the guidelines with respect to child age group and guideline use.

Table 1: Classification of the guidelines

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.1 Physical Interaction with ICT			
4.1.1 General guidelines			
4.1.1.a	Design ICT to take into account that children are smaller, weaker, less dextrous and less careful than adults.	All;	All;
4.1.1.b	Consider whether ICT device use by toddlers and babies is appropriate and beneficial.	Babies; Toddlers;	Deployment; Design;
4.1.1.c	Use standardized hardware and software interfaces on ICT terminals for connection of assistive devices.	Toddlers; Infants; Pre-teens;	Design; Regulation and Standardization;
4.1.1.d	Specify and design public access and service terminals to be accessible by children.	All;	All;
4.1.2 Physical characteristics of devices			
4.1.2.a	Limit the weight addition to children's backpacks when deploying portable computer devices.	Infants; Pre-teens;	Deployment; Regulation and Standardization;
4.1.2.b	Design devices intended for children with "wear and tear" in mind.	All;	Design;
4.1.2.c	Style devices appropriately for child's age and intended use.	All;	Design;
4.1.2.d	Provide personalization of physical appearance for devices intended to be owned and used by older children.	Infants; Pre-teens;	Deployment; Design;
4.1.2.e	Make it obvious for children how to turn the device on and off.	Toddlers; Infants; Pre-teens;	Design;
4.1.2.f	Remind children to recharge devices, and make recharging easy.	Infants; Pre-teens;	Deployment; Design;
4.1.3 Input devices			
4.1.3.1 Keyboards and buttons			
4.1.3.1.a	Test button and keyboard characteristics with target child user group.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.1.b	Test size and spacing of keys and navigation controls with target child user group.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.1.c	Use alternatives to multiple, simultaneous key presses for young children.	Toddlers; Infants;	Design;
4.1.3.1.d	Use alternatives to toggle-functions for young children.	Toddlers; Infants;	Design;
4.1.3.1.e	Characters and symbols printed on device should subtend 20 minutes of arc for optimal readability.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.2 Pointing and selection devices			
4.1.3.2.a	Test physical size and characteristics of pointing and selection devices requiring fine motor skills with target child user group.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.2.b	Avoid rotary controls that rely on small angles of rotation for young children.	Toddlers; Infants;	Design;
4.1.3.3 Other input devices			

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.1.3.3.a	Make it easy for children to locate and use built-in input devices.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.3.b	Provide connectors and support for child-specific assistive input devices.	Toddlers; Infants; Pre-teens;	Design;
4.1.3.3.c	Consider tactile or tangible input devices for young children.	Toddlers; Infants;	Deployment; Design;
4.1.3.3.d	Consider using touch screen technology for young children.	Babies; Toddlers; Infants;	Deployment; Design;
4.1.4 Output devices			
4.1.4.a	Test visual indicators for understanding with target child group.	Toddlers; Infants; Pre-teens;	Design;
4.1.4.b	Test tones and earcons for understanding with target child group.	Toddlers; Infants; Pre-teens;	Design;
4.1.4.c	Provide connectors and support for child-specific assistive output devices.	All;	All;
4.1.4.d	Consider tactile feedback and tangible output devices for young children.	Toddlers; Infants;	Deployment; Design;
4.1.5 Child ergonomics			
4.1.5.a	Provide advice to children, parents/carers on good computer workplace design for children.	Toddlers; Infants; Pre-teens;	All;
4.1.5.b	Encourage children to vary working positions and take frequent breaks from ICT use.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.1.5.c	Provide advice to parents/carers on appropriate screen viewing distance to achieve good readability and avoid vision problems in children.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.1.5.d	Provide advice to parents/carers on adjustment of screen brightness to avoid vision problems in children.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.1.5.e	Provide advice to parents/carers on proper lighting for ICT device use to avoid vision problems in children.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.1.5.f	Provide advice to children/parents/carers on how to avoid RSI injuries.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2 Operational issues of terminals and services			
4.2.1 Comprehending instructions			
4.2.1.1 Style and format of language			
4.2.1.1.a	Use a style of language that is appropriate for the target age group to ensure understandability.	All;	All;
4.2.1.1.b	Present all information in the child's first language to ensure understandability.	All;	All;
4.2.1.1.c	Allow the selection of instructions in different media to cater for children with special needs.	Infants; Pre-teens;	Design; Regulation and Standardization;
4.2.1.1.d	Maintain a consistent readability level to ensure understandability.	Infants; Pre-teens;	Design;
4.2.1.1.e	Provide instructions when they are needed by the child bearing in mind the context of the situation.	All;	Design;
4.2.1.1.f	Use simple, relatively large fonts with good contrast for instructions.	Infants; Pre-teens;	Design;
4.2.1.1.g	Consider using shorter line lengths for children than for adults.	Infants; Pre-teens;	Design;
4.2.1.1.h	Consider using special fonts to increase accessibility of text.	Infants; Pre-teens;	Design; Regulation and Standardization;
4.2.1.1.i	Avoid the use of text over pictures in order to keep the message readable.	All;	Design;
4.2.1.1.j	Avoid using moving or animated text for instructions in order to keep the message readable.	All;	Design;
4.2.1.2 Jargon			
4.2.1.2.a	Avoid the use of technical or metaphorical jargon so that children understand what is being stated.	All;	Design;
4.2.1.2.b	Create meaningful category names for options to make it obvious for children.	Toddlers; Infants; Pre-teens;	Design;
4.2.1.3 Labels and abbreviations			

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.2.1.3.a	Avoid abbreviations which are not understandable by children.	Infants; Pre-teens;	Design;
4.2.1.4	Symbols and icons		
4.2.1.4.a	Use symbols and icons for overcoming literacy difficulties for children.	Toddlers; Infants; Pre-teens;	All;
4.2.1.4.b	Use existing standards and stereotypes for symbols if they exist rather than creating new ones in order to avoid confusion by the child.	Toddlers; Infants; Pre-teens;	Design;
4.2.1.4.c	Use recognized sets of symbols for communication impaired children.	Toddlers; Infants; Pre-teens;	All;
4.2.1.4.d	Design icons to be visually meaningful to children.	Toddlers; Infants; Pre-teens;	Design;
4.2.1.5	Notification of status		
4.2.1.5.a	Present status information in more than one modality to provide redundancy.	Toddlers; Infants; Pre-teens;	All;
4.2.1.5.b	Make it clear to the child that a device is switched on so that they are aware of the status.	Toddlers; Infants; Pre-teens;	Design;
4.2.1.5.c	Make it clear to the child whether a device is connected or not connected to a network so that they are aware of the status.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2.1.5.d	Make it clear to the child that a device is keypad locked so that they know that they have to unlock it before use.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2.1.5.e	Make it clear to the child that the battery is low on the device so that they know that the device needs recharging.	Infants; Pre-teens;	Deployment; Design;
4.2.1.5.f	Make it clear to the child that a device is ringing so that they can answer it.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2.2	Configuration and set-up		
4.2.2.a	Make configuration as simple as possible for parents so that it is suitably set up for the child.	All;	Design;
4.2.2.b	Make it clear to parents/carers what are the implications of the configuration options.	All;	All;
4.2.2.c	Ensure only parents/carers have access to complex and critical configuration options.	All;	All;
4.2.2.d	Provide default settings for children, which can be used by a parent/carer who may not be very ICT aware.	All;	All;
4.2.2.e	Provide additional features for children only with parental approval, so that the default is the safest setting for the child.	All;	All;
4.2.2.f	Make systems tolerant of different formats of input for date, etc.	Infants; Pre-teens;	All;
4.2.2.g	Provide longer timeouts for inputting data.	Infants; Pre-teens;	Design; Deployment;
4.2.2.h	Ensure that devices owned by a 3rd party but used by children, can reflect ownership, to prevent devices from being stolen.	Infants; Pre-teens;	Design; Deployment;
4.2.2.i	Ensure wireless connected devices used by children are not discoverable or visible to others on that network, to prevent inappropriate people being able to contact children.	All;	All;
4.2.2.1	Control of outgoing calls		
4.2.2.1.a	Provide clear information to parents/carers about the need for barring calls and access.	All;	All;
4.2.2.1.b	Consider allowing parents/carers to restrict outgoing call numbers to avoid inappropriate calls.	Toddlers; Infants; Pre-teens;	All;
4.2.2.1.c	Provide the ability for parents/carers to set up closed communication groups for children's use.	All;	All;
4.2.2.3	Control of incoming calls		

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.2.2.2.a	Ensure that it is possible to restrict incoming calls and connections, except from callers personally known to the child and authorized by the parents/carers.	All;	All;
4.2.2.2.b	Provide feedback to parents/carers if the privacy preferences set for the child are being altered.	All;	All;
4.2.2.3 Identification as legitimate user			
4.2.2.3.a	Provide a system for verification for both adults and children.	All;	All;
4.2.2.3.b	Consider the use of biometrics for verification.	All;	All;
4.2.2.3.c	Provide information on whom the call is coming from.	All;	All;
4.2.2.3.d	Ensure that national and EU legislation on data protection and privacy are adhered to.	All;	All;
4.2.2.3.e	Provide easily accessible means for children to report unsafe situations that they are not happy about.	Infants; Pre-teens;	All;
4.2.3 Operation			
4.2.3.a	Provide detailed guidance for young children, to help them complete operations.	Toddlers; Infants;	Design;
4.2.3.b	Provide "shortcuts" for experienced (older) child users to allow speedy operation and to avoid frustration.	Pre-teens;	Design;
4.2.3.c	Provide clear expressions of functions to ensure easy operation.	Toddlers; Infants; Pre-teens;	Design;
4.2.3.1 Turning on a device			
4.2.3.1.a	Consider other means than a PIN-code/password to turn on devices, as children may reveal PIN-codes/passwords.	Infants; Pre-teens;	Deployment; Design;
4.2.3.2 Initiating a communication			
4.2.3.2.a	Provide a "call home" function, for ease of access to parents/carers.	Toddlers; Infants; Pre-teens;	All;
4.2.3.2.b	Provide easy initiation of calls directly from phone lists for children.	Infants; Pre-teens;	Design;
4.2.3.2.c	Provide clear labels or symbols on the off-hook key, so that the child knows how to make a call.	Infants; Pre-teens;	Design;
4.2.3.2.d	Provide the means for parents/carers to control a child's connection to the Internet.	Infants; Pre-teens;	All;
4.2.3.2.e	Provide parents/carers with advice and mechanisms to avoid children accidentally invoking modem hijacking.	Infants; Pre-teens;	All;
4.2.3.3 Receiving a communication			
4.2.3.3.a	Make call-waiting obvious and understandable to the child.	Infants; Pre-teens;	All;
4.2.3.4 Ending a communication			
4.2.3.4.a	Provide automatic call ending, as young children may not successfully do this manually.	Toddlers; Infants;	Deployment; Design;
4.2.3.4.b	Provide automatic log-off from the Internet, for dial-up services, if there has been a period of inactivation.	Infants; Pre-teens;	Deployment; Design;
4.2.3.4.c	Provide clear guidance on how a child should log-off a dial-up connection from the Internet.	Infants; Pre-teens;	All;
4.2.4 Navigation			
4.2.4.a	Consider placing the children's applications on the top menu level so that they can reach them directly.	Infants; Pre-teens;	Design;
4.2.4.b	Provide a "back" function for navigation on a web based system, so that the child can revert to a previous page.	Infants; Pre-teens;	Design;
4.2.4.1 Metaphors			
4.2.4.1.a	Use meaningful metaphors for children, designed for their own use.	Toddlers; Infants; Pre-teens;	Design;
4.2.4.1.b	Adhere to existing stereotypes so as not to confuse children.	Toddlers; Infants; Pre-teens;	Design;

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.2.4.2 Menus			
4.2.4.2.a	Design for no scrolling or hidden check boxes which may not be apparent to children.	Infants; Pre-teens;	Design;
4.2.4.2.b	Provide easy access to the main menu, so that children do not get lost.	Infants; Pre-teens;	Design;
4.2.4.3 Speech recognition interfaces			
4.2.4.3.a	Use speech recognition for children as a supplement to other input devices, as speech recognition may be unreliable for children.	Toddlers; Infants; Pre-teens;	All;
4.2.4.3.b	Use a speech recognition interface designed specifically for children, adult ones are not appropriate.	Toddlers; Infants; Pre-teens;	All;
4.2.4.3.c	Ensure that activation and deactivation of speech recognition interfaces are easy for children.	Toddlers; Infants; Pre-teens;	Design;
4.2.4.4 Help facilities			
4.2.4.4.a	Make available multimodal help, to take account of different abilities and disabilities of children.	Toddlers; Infants; Pre-teens;	All;
4.2.4.4.b	Use direct and simple language appropriate to children.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2.4.5 Error handling			
4.2.4.5.a	Make the system/service error tolerant, as children are likely to make errors.	Toddlers; Infants; Pre-teens;	Design;
4.2.4.5.b	Provide error messages in a language and style that a child can understand.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.2.4.5.c	Provide simple error recovery, in order to help the child correct mistakes.	Infants; Pre-teens;	Design;
4.2.4.5.d	Provide supervised help for very young children as they are unlikely to understand error messages.	Toddlers;	Deployment; Design;
4.2.4.5.e	Provide instructions and support for the adults who are supporting the child as they may not be ICT literate.	All;	All;
4.2.5 Handling of information			
4.2.5.a	Allow children to store items referenced with their own labels or pictures to enable easy retrieval of the information.	Infants; Pre-teens;	Design;
4.2.5.b	Provide feedback on available storage space on a way that is understandable by children.	Infants; Pre-teens;	Design;
4.2.5.c	Provide recovery facilities for children's own data.	Infants; Pre-teens;	Design;
4.2.5.d	Provide easy retrieval of information, encouraging the use of "own" labels for storage.	Infants; Pre-teens;	Design;
4.3 Services			
4.3.1 Generic guidelines for services			
4.3.1.1 General			
4.3.1.1.a	Use colours to enhance children's experience of services.	All;	Design;
4.3.1.1.b	Provide multimodal user interfaces, when possible.	Toddlers; Infants; Pre-teens;	All;
4.3.1.1.c	Provide a mechanism for potential service abuse information collection and make it available to the parent/carer.	Infants; Pre-teens;	All;
4.3.1.1.d	Provide means to determine the identity and legitimacy of parties communicating with children.	Toddlers; Infants; Pre-teens;	All;
4.3.1.2 Service availability and access			
4.3.1.2.a	Indicate service availability/unavailability and possible service access in a way that children will understand.	Infants; Pre-teens;	All;
4.3.1.2.b	Provide and support the use of templates and user profiles to simplify children's access set-up, configuration, and use in a networked environment.	All;	All;
4.3.1.2.c	Always offer a child the possibility to be connected to its parents/carers.	Toddlers; Infants; Pre-teens;	All;

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.3.1.2.d	Provide clear cost indicators to children for voice and data call services.	Infants; Pre-teens;	All;
4.3.2 Voice call services			
4.3.2.a	Provide call services in multiple modalities.	All;	All;
4.3.2.b	Call services should support access-agnostic relay services or provide similar, functional accessibility solutions.	Toddlers; Infants; Pre-teens;	All;
4.3.3 Messaging services			
4.3.3.a	Provide clear instructions on how to initiate and close a communication channel.	Infants; Pre-teens;	Design;
4.3.3.1 Text and data messaging			
4.3.3.1.a	Clearly indicate the status and different messaging states.	Infants; Pre-teens;	Design;
4.3.3.1.b	Provide easy selection of message types and indicate how the selection can be performed.	Infants; Pre-teens;	Design;
4.3.3.1.c	Inform the child if a terminal cannot present the necessary data formats required for the presentation of a received message.	Infants; Pre-teens;	All;
4.3.3.1.d	Prevent children from accessing premium-rate information or communication services without agreement of a parent or carer.	Toddlers; Infants; Pre-teens;	All;
4.3.3.2 Voicemail (voice messaging)			
4.3.3.2.a	Provide easy access to voice-mail system by young children.	Toddlers; Infants;	Deployment; Design;
4.3.3.2.b	Do not provide hidden functions or shortcuts to young children.	Toddlers; Infants;	Deployment; Design;
4.3.3.3 Instant messaging			
4.3.3.3.a	Indicate to the child that certain settings are required before chatting is possible, and advice about adult assistance, when accessing a chat application for the first time.	Toddlers; Infants; Pre-teens;	All;
4.3.3.3.b	Support the set-up and use of restricted chat room member lists ("buddy lists") and include the possibility to instantly block certain members.	Toddlers; Infants; Pre-teens;	All;
4.3.3.3.c	Ensure the "buddy list" is easy to find, understand, maintain and efficient to use for children.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.3.3.3.d	Do not offer access to group chat rooms ("discussion forums") to very young children.	Toddlers; Infants;	All;
4.3.3.3.e	Use reliable age verification mechanisms to block adults from children-only chat rooms.	Toddlers; Infants; Pre-teens;	All;
4.3.3.3.f	Provide single and simple child user identification and log-in mechanisms and short connection times for instant messaging services.	Infants; Pre-teens;	All;
4.3.3.3.g	Consider providing a dedicated key to push-to-talk over cellular (PoC) and other voice-based instant mobile messaging applications for children.	Infants; Pre-teens;	Design;
4.3.4 On-line gaming			
4.3.4.a	Inform the child about the financial implications of playing on-line games and obtain parental agreement to payment.	Pre-teens;	All;
4.3.4.b	Ensure that no child can access gambling activities.	All;	All;
4.3.5 Transactional services			
4.3.5.a	Limit the maximum amounts allowed for transactions for children.	Toddlers; Infants; Pre-teens;	All;
4.3.5.b	Clearly indicate the cost implications to children when buying products.	Toddlers; Infants; Pre-teens;	Deployment; Design;
4.3.6 Emergency call services			
4.3.6.a	Provide easy and direct access for children to emergency services.	All;	All;
4.3.6.b	Ensure that emergency service centre staff are trained to interact with children.	All;	Deployment; Regulation and Standardization;
4.3.7 Passive location and positioning services			

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.3.7.a	Ensure that child location services are not open to abuse.	All;	All;
4.3.7.b	Register every passive child positioning request initialized by other locators than the parent/carer and inform the parent/carer (if known or identifiable) immediately.	All;	Deployment; Regulation and Standardization;
4.3.7.c	Make passive child location services only available to a child's parents/authorized carers.	All;	Deployment; Regulation and Standardization;
4.3.7.d	Provide correct marketing and support information on passive child location services to parents/carers.	All;	All;
4.3.7.e	Inform and guide parents/carers about the functionality, set-up, configuration and reliable use of location services, including related safety measures.	All;	All;
4.3.7.f	Ensure that the child consents to set-up and activation of passive location services and is clearly notified when s/he is being located.	Pre-teens;	All;
4.3.7.g	Provide and present a simple procedure to the child to suspend, stop or deactivate a location service.	Pre-teens;	All;
4.3.7.h	"Friend location services" and mobile games using passive location information should not be offered to children under 12.	All;	All;
4.3.8 Internet access, browsing and applications			
4.3.8.a	Follow the applicable accessibility recommendations specified in the Web Content Accessibility Guidelines (WCAG) version 2.0.	All;	All;
4.3.8.b	Classify and control commercial and other unsuitable content to children.	All;	All;
4.4 Content			
4.4.1 Appropriateness of Content			
4.4.1.1 Comprehensibility to children			
4.4.1.1.a	Match language level in text material to be used to children's language and reading skills to increase understandability.	Infants; Pre-teens;	Design;
4.4.1.1.b	Ensure spoken content is comprehensible for children.	All;	Design;
4.4.1.2 Harmful content			
4.4.1.2.a	Ensure that there is no portrayal of violence in content intended for use by young children.	Babies; Toddlers; Infants;	All;
4.4.1.2.b	Ensure that the portrayal of violence in content is clearly contextualized, with the meaning justified, in content for older children.	Pre-teens;	All;
4.4.1.2.c	Ensure that there is no portrayal of sexual activity in content intended for young children.	Babies; Toddlers; Infants;	All;
4.4.1.2.d	Ensure that the portrayal of sexual activity in content is clearly contextualized, with the meaning justified, in content for older children.	Pre-teens;	All;
4.4.1.2.e	Ensure that visual image sequences are not likely to trigger adverse biomedical effects in children.	All;	All;
4.4.1.3 Interpersonal Communication			
4.4.1.3.a	Ensure that facilities are in place to prevent on-going bullying of children using communication services.	All;	All;
4.4.1.3.b	Ensure that children are free to communicate with peers without intrusion of adults masquerading as peers.	Toddlers; Infants; Pre-teens;	All;
4.4.1.3.c	Ensure that non-task based interruptions are prevented from intruding on children's conversations.	Toddlers; Infants; Pre-teens;	All;
4.4.1.4 Moral, ethical and cultural diversity			
4.4.1.4.a	Ensure that the cultural diversity of the European population is reflected in generic content in a way that does not discriminate against any group within society.	All;	All;
4.4.1.5 Ability to exchange information within an acceptable use policy			

Number	Guideline title	Child age group All; Babies; Toddlers; Infants; Pre-teens	Guideline usage All; Design; Deployment; Regulation and Standardization
4.4.1.5.a	Clearly communicate the boundaries of acceptable content exchange to the children using the ICT.	All;	All;
4.4.1.6 Misleading and misunderstanding by children			
4.4.1.6.a	Avoid marketing and advertising to children, as it is illegal in some countries and socially unacceptable in others.	All;	All;
4.4.1.6.a	Clearly identify and explain copyright and ownership of content restrictions and terms of use in a way that can be understood by children.	Infants; Pre-teens;	All;
4.4.1.7 Subliminal persuasion within content			
4.4.1.7.a	Ensure that content to be used by children does not intentionally carry subliminal messages.	All;	All;
4.4.1.8 Enabling purchases without adult consent			
4.4.1.8.a	Ensure that it is not possible for children to enact a contractual agreement without fully understanding the scope of the consequences of the contract.	All;	All;
4.4.1.9 Boundaries to data-mining customers behaviour			
4.4.1.9.a	Ensure that children consent to, and that parents/carers are informed about, content and usage monitoring.	Infants; Pre-teens;	All;
4.4.1.9.b	Ensure that systems used by children do not mine data that can be attributed to an individual without the explicit permission of the child and a parent or guardian.	All;	All;
4.4.1.10 Social Interaction			
4.4.1.10.a	Ensure that safeguards are put in place in public forums to block access for children or to moderate the interaction in the forum.	Toddlers; Infants; Pre-teens;	All;
4.4.2 Practical Safeguards			
4.4.2.a	Ensure that content available to children is classified with validated metadata against a standardized set of criteria.	Toddlers; Infants; Pre-teens;	All;
4.4.2.b	Filters should be available to provide safe access or blocking of improper content	All;	All;
4.4.2.c	Filters should be configured to have their most comprehensive blocking properties on by default	All;	All;

Annex A (informative): Rationale for the Guidelines

The main reason for the present document line is that the market for ICT products and services to very young children (under 12 years of age) is now opening up. This market is significantly different from the traditional, generic market for these products. It is, in effect, a protected market (see annex B) for a further discussion of the principle characteristics of this market sector). Consequently, designers and developers of suitable products and services for this market sector need specific guidelines on how to incorporate the right features into these new products and services. Clause A.1 deals with the consequences of the use of advanced ICT by young children. The consequences for industry stakeholders is covered in clause A.2. Finally clause A.3 defines the target users of the present guideline.

A.1 Consequences for children

Children have the right to grow to their potential and to be given the opportunity to become fully developed, well balanced citizens. Children are not little adults however, they are future adults. As children, they think, act, and appreciate the world around them very differently from adults.

ICT has the potential to provide children with opportunities to have wide and beneficial community, cultural, educational and leisure experiences. Properly delivered, it can immeasurably assist children in the process of growing and maturing, and can contribute to their day to day security, well being and entertainment. The stimulation provided by information and experiences delivered by ICT can positively contribute to the constant growing and maturing that characterizes childhood.

It should, however, be recognized that this facility to stimulate and influence the growth and development could harm as well as help children. Stimulation and education should always progress in a balanced and holistic manner, always recognizing the developmental stage that children are pass through. Over stimulation of one faculty could encourage unusual growth in that area at the expense of a balanced overall development. Early stimulation may confuse and mis-educate a child, with lifelong negative consequences. The opportunities to engage with ICT delivered services and content should not neglect to protect children from inappropriate influences and material that they are not ready to be able to handle.

Furthermore, children do not have the strength, stamina and mental instrument to operate unsupported in an adult world. Being required to behave as adults, either physically or mentally, before they are sufficiently mature to do so, will harm and scar children. Delicate and vulnerable organs such as eyes and ears can be permanently harmed, growing skeletons can be strained and distorted and cognitive process can be stunted and damaged. Care needs to be taken to provide children with ICT systems designed to fit their strength, stamina and cognitive ability rather than providing systems designed to be used by adults.

Traditionally, children have been able to experience only their immediate environment. Wandering story-tellers, books and newer technologies such as telephony, radio and television have allowed children to be "transported" into worlds beyond their own, encountering new cultures and environments. Recent and future advances in ICT provide essentially limitless opportunities to explore realities and fantasies. Children have poor ability, however, to distinguish between reality and fantasy. Additionally, they have a strong tendency to respect and follow the leading of those more mature than themselves. Because of this, children are vulnerable to being encouraged to share their reality and explore fantasies with people who are not responsible for their well-being and may indeed have an interest in harming or abusing them or their communities. The preservation of the safety and well being of children as they explore the worlds opened up to them through ICT is the responsibility of all citizens in society, not least those who promote or provide the access to ICT systems and services.

The guidelines presented in the present document provide some of the essential concrete principles that will enable the ICT industry to provide children with the ICT experience that will enable them to grow to fulfil their potential within society, in safety.

A.2 Consequences for stakeholders

The stakeholders who are the intended users of the present guide include:

- Standards developers.
- Manufacturers.
- Designers.
- Service providers.
- Policy developers.
- Educators.
- Groups working with children.
- Parents/carers.

The guidelines in the present document can be used in different contexts, and by different guidelines users. Manufacturers, service providers and developers of ICT will receive guidance in how to develop ICT systems to be used successfully and safely by children, thereby also securing financial returns. The guidelines may serve as input in developing requirements for the procurement of ICT to be used by children, thereby ensuring that the ICT procured are indeed fit for use by children. Policy makers and educators will find practical information about the benefits and possible dangers of ICT use by children, and guidance for how ICT can be designed in the best interest of children. Parents/carers will find advice and guidance e.g. on how to organize and supervise children's use of ICT, and what are the desirable attributes of ICT to be used by children.

The consequences of not applying guidelines for the design of ICT systems to be used by children, and children's use of ICT, may in the short term lead to lower sales for manufacturers of such systems. Policy makers and educators may be unable to ensure effective and safe use of ICT for children.

The main adverse effect is of course that children will be subjected to ICT software and hardware that does not cater for the specific needs of children, and that does not take into account the cognitive, social and physical development of children. This in turn may lead to short - and long-term effects, ranging from e.g. emotional damage due to access to inappropriate content, psychological and physical damage due to contact with predatory Internet users, through to permanent physical damage (e.g. RSI and musculoskeletal disorders). Straker et al. (2000) [18] formulates this succinctly:

"*We know from adults that unless computer use is very well managed physical and psychological scarring can occur. Unless we quickly develop some accurate and valid guidelines for use of computers by children - and see them implemented - we risk permanent scarring of a generation of children*".

A.3 Rights and responsibilities regarding children's use of ICT

The UN Convention on the rights of the child [58] specifies a number of children's rights and actions to be encouraged for the protection of children. Of particular relevance to the design, development and use of ICT by children are the following articles:

- Children have the right to express opinion, and to have that opinion taken into account, in any matter affecting the child (Article 12).
- Children should have the right to seek, receive and impart information and ideas of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media of the child's choice (Article 13).
- Children have the right to protection from interference with privacy (Article 16).

- The UN encourages the development of guidelines for the protection of children from information and material injurious to his or her well-being (Article 17).
- Children should be protected from all forms of violence, injury, abuse (including sexual abuse), neglect, maltreatment or exploitation, while in the care of parents, guardians or carers (Article 19).
- Disabled children should enjoy a full and decent life, in conditions which ensure dignity, promote self-reliance and facilitate the children's active participation in the community (Article 23).
- The UN member states (that have ratified the convention) will take all appropriate measures to prevent the exploitative use of children in pornographic performances or materials (Article 34).

The convention clearly states that children should have the right both to access ICT, but also have the right to be protected from any damage due to the use of ICT. This has consequences not only for children, but for all the stakeholders discussed in clause A.2.

There are a number of industry driven initiatives in order for ICT industry to take into account the rights and needs of children and young people. In many countries, the industry has developed codes of practice (mobile operators, Internet service providers, etc.) which also deal with child-specific issues.

In the UK code of practice for the self-regulation of new forms of content on mobiles [74], content providers are required to self-classify as 18 all content unsuitable for customers under the age of 18, and an independent classification body is appointed. The UK code of practice for the self-regulation of new forms of content on mobiles refer to the ICSTIS (2004) Code of conduct [c], which covers children's services (for the under 16 s). ICSTIS is the UK industry-funded regulatory body for all premium rate charged telecommunications services.

- In June 2004, the European Commission Safer Internet Programme hosted an exploratory meeting with leading associations of Internet Service Providers and industry leaders to discuss the scope for a European Code of Conduct for Internet service providers, particularly in the field of protection of minors [d]. The European Internet Services Providers Association (EuroISPA) is working towards such a code of conduct, and the EuroISPAs president, Professor Michael Rotert is quoted as saying: *"EuroISPA is committed to promoting the rights and interests of all Internet users and pays particular attention to ensuring that youngsters and vulnerable members of the society can also reap the benefits of and, most importantly enjoy the online experience."* [e].
- The guidelines contained in the present guide can help the ICT in fulfilling the responsibilities of the codes of conduct.

Annex B (informative): Children as users of ICT products and services

B.1 Introduction

The emphasis of this clause is to highlight the ways in which children differ from adults and differ in their abilities and use of ICT. In addition, children's most common disabilities are introduced and their significance for and impact on the design and use of ICT intended for children illustrated.

Children should be introduced to ICT in a supervised way, when they are able to use it without harm. An aim of this clause is also to show what children are capable of doing at certain age spans.

According to data recently reported in "Future of the Internet According to Kids 2004" report, see [f], children's use of ICT products and services is maturing and increasing sharply. These recent figures indicate, for example, that children's ownership of mobile terminals has increased more than 110 % since 2001 and ultra-light laptops and mobile phones are the most in-demand products for use in the future. The majority of children view the ultra-light laptop as being the desired tool for playing multi-player games, doing their homework and surfing the Internet wirelessly. In addition, over 50 % of the children who have shopped on-line expect to use this channel more in the future.

In order to illustrate the importance of child development and its impact on children's use of ICT, three illustrations are provided below, highlighting children's differences in these three dimensions.

Figure B.1 emphasizes that a child of 7 years of age is much smaller than an adult but is expected to use a system that has been built to be used by an adult. The child using this system for any length of time is going to be uncomfortable and is risking permanent growth distortions.

Figure B.1: Example in differences in physical stature between a child and an adult

Figure B.2 emphasizes the fact that children do not have either the blend of sensory and motor skills nor the cognitive processing skills to undertake complex tasks such as driving. In addition, they are not able to drive safely as their awareness of the world around them, and of the consequences of their actions is not sufficiently developed. We do not, as a society allow children to harm themselves and others by allowing them to drive on public roads, yet we often allow children freedom to use complex technologies and to be exposed to subtle adult interpersonal interactions that they are not able to handle.

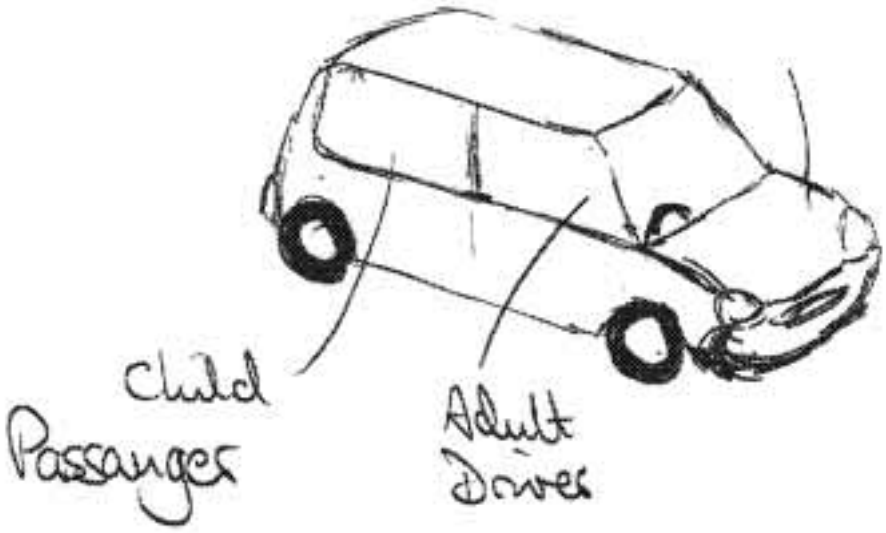

Figure B.2: Example of a highly physically and cognitively demanding task that is beyond the capabilities of children

Figure B.3 emphasizes the spectrum of knowledge and life experiences that we imbibe as adults but have not been encountered or understood by children. This should caution service and content providers against exposing children to content and situations that they are not able to deal with. The disconnected and virtual nature of the Internet can give a false sense of security but transactions, whether formal or social, can be understood as just as real as face-to-face, and children can be held accountable in unexpected ways.

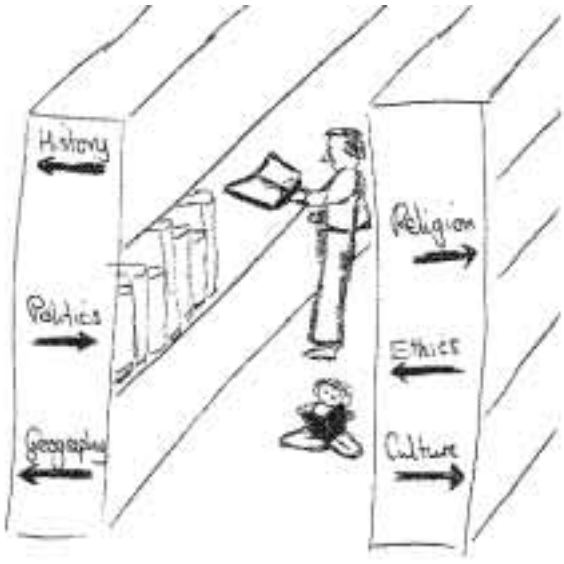

Figure B.3: A wide variety of situations and comprehension of a wide spectrum of social and ethical issues is beyond the experience of children

As children use technology, they will interact with different parts and subsets of systems. By considering these, the implications for the use by children can be systematically explored, and the relevant issues exposed- as suggested previously in TR 102 133 [7]. In order to illustrate that children are different from adult ICT users and develop in stages, rather than chronological ages, three specific cubes will be developed, showing different angles on the arrow, set in the context of different use situations.

B.2 Primary end users

The intended primary end users of ICT, hereafter called *end users* (and *children*) for the purpose of the present document, are children under 12 years of age, with or without motor, sensory, cognitive, communication or other impairment(s).

B.2.1 Goals

The end user's main goal, for the purpose of the present document, is to be provided and able to use ICT terminals, services and applications with fun, under their intended circumstances.

The goal of the use of ICT by children is to gather and exchange information with other people, in all aspects of their lives, including recreation, social interaction, practical tasks and increasingly, education.

Age has a considerable impact on children's approach to and use of ICT, reflected by our approach (including the recommendations provided previously in the present document).

B.2.2 Attributes and requirements related to child development

The present clause provides a brief summary and update of the issues highlighted about children's use of ICT in TR 102 133 [7]. It also explores those attributes of the developing child that have relevance to its use of ICT.

Number of different aspects of children are maturing throughout childhood. This complex development process is a primary characteristic of childhood, and is essentially the core of the differences between childhood and adult hood. For the purposes of TR 102 133, the following attributes will be explored:

- physical;
- perceptual;
- cognitive;
- language;
- personality; and
- social.

This exploration will not give an exhaustive account of child development, but will focus on those aspects that have an impact on the use of ICT by children, and as a result, should be considered when designing for children.

Physical attributes

Children are smaller and weaker than adults. Children increase in height throughout childhood and reach maturity at around the age of 16 for girls and 18 for boys.

Whilst it is evidently possible for children to use the same equipment as adults, they will not always be able to use it the intended way, the way that adults do. At the age of five, children are only 60 % of their adult size. At the age of 8, when many are regularly using ICT unattended, children are still less than 70 % to 80 % of their adult size. Physical growth after this period is rapid and ICT use during this phase is also likely to be intensifying. In order to handle equipment designed to be used by adults, children have to find strategies to enable them to reach and manipulate devices such as keyboards, keypads and pointing devices whilst also positioning themselves in such a way as to read a display. Permanent and crippling damage can result from prolonged use of poorly designed systems, used in ways that attempt to compensate for the physical limitations of size and strength.

Perceptual attributes

Children perceive the world differently because their sense organs are not fully developed. The sense organs of babies and toddlers do not work as an integrated sensory system, but operate as a set of discrete senses. They begin to function as an integrated set of senses during the infant stage of childhood, but each sense organ continues to develop towards mature functioning during the pre-teen years. This evolution of functional development affects the ability of children to co-ordinate motor skills. Where a child has a strong incentive to succeed in certain motor skills that their sensory system is not sufficiently mature to support, the brain can compensate by developing the necessary functionality prematurely, generally at the expense of subsequent normal development and location of brain functions.

The core perception skills that children develop as babies are:

- seeing, developing into looking;
- hearing, developing into listening;
- smelling; and
- touch and motion.

An area of particular importance in the use of ICT and technology mediated communication, is the perception of emotion on the part of others. At the age of 4, children can discern the difference between emotions such as happy sad mad, loving, scared, when seen on the face and heard in the voice of another person. As they mature, from being toddlers into infants, they learn to understand that the emotions expressed by others arise from their own actions, and they begin to sense other more subtle emotions such as shame and pride. Before this, however, they are likely to not be inhibited about asserting themselves, often repeating facts about themselves or their families that should not be shared with those outside their immediate life circle.

Importantly, the ability to see through a veneer of emotion and its expression does not come until after a child enters the pre-teen phase of development. At this point, and not generally before, they discover the ability in themselves and in others, to mimic the appearance of emotion without actually needing to feel them. This makes young children particularly prone to respond to emotion in others, and therefore vulnerable to emotion based duress.

Cognitive attributes

Cognitive development progresses through a variety of overlapping stages throughout childhood. This development is linked to the ongoing process of brain maturation, with different functional regions of the brain becoming "wired" at different times. Cognitive development is heavily dependent on the nature of the stimulation available to the child as it matures. A working delineation of the various stages of development are given below. It should be stressed that these stages overlap, and that a child may be exercising early examples of skills from a later stage whilst honing skills in an earlier stage ([g] and [h]).

- The sensory motor stage: This is the stage where babies practice using their senses in co-operation with their developing prowess in motor control skills. Key achievements towards the end of this stage are the ability to control the thumb/first finger pincer action. The degree of motor control involved represent an ability at the lowest limit necessary to successfully manipulate ICT equipment.

- The pre-operational stage: This is the stage where toddlers learn how to behave (to recognize the situation and what response to make to it) in specific situations with specific people. Immersion in a wide variety of social situations during this stage is beneficial for training in appropriate responses to different situations. Inappropriate responses learned during this phase (e.g. attitudes to violence, race etc) become very difficult to redress later in life, suggesting that the exposure of children in this phase to, for example, violent content delivered via ICT could seriously damage the cognitive development of a child.

- The concrete operation stage: Infants and pre-teen children pass through this phase, where they learn how to abstract and generalize rules of behaviour from one situation to other situations where it might apply. During this phase children learn to balance the influence of others who have had primary input into their lives so far (parents/carers, teachers etc) with that of other influences such as peers and other adult role models. The ability to have strategies and rules of behaviour depend on knowledge. The more knowledge and experience the child can gather during this phase, the more comprehensive and appropriate their portfolio of responses to different situations.

At times children seem to display remarkable expertise, particularly in the use of ICT. It seems likely that, in general, this expertise is often based on knowledge rather than understanding, as children progress through the pre-operational (simple belief and learning) phase towards a concrete operational (thinking about how to apply knowledge to new situations) phase. For this reason, children can be expected to quickly learn operational procedures, but should not be expected to "problem solve" or be responsible for system configuration or "contract negotiation".

Language attributes

Language is a special skill that children begin to develop as toddlers, although they can respond to the use of language by others whilst they are still babies. By the time they reach the pre-teen years most children have a working vocabulary of several thousand words, and have good working knowledge of the essential aspects of the grammar of their native language(s). It is not until they enter their pre-teen years that they develop a sense of abstract aspects of vocabulary such as clustering words of common meanings or relating adverbs and adjectives that have the same root word. Having grasped these more abstract and subtle aspects of language, these children are able to add many new words to their vocabulary.

The important aspect of this development is that pre-teen children may use words whose meaning is not fully understood, or they may be unfamiliar with the meaning of words being used in an unfamiliar context. Because of this, younger children can be readily mislead, particularly if familiar words are used in unfamiliar ways.

Personality attributes

Personality refers to the blend of responses and behaviours that distinguish individuals. Personality traits are clustered and described under the five broad categories of Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness or Intellect. The development of the individual as they mature through childhood is encapsulated in the development of their individual personality. The following four factors have been recognized as influencing the development of the personality of the maturing child:

- inborn temperament;
- reinforcement patterns (rewarding behaviour in one context so that it becomes a reflex used in other contexts);
- interactions with parents/carers and other social interactions; and
- beliefs about oneself.

These influences can reflect knowledge gained whilst utilizing ICT systems and can have a profound influence in shaping the life-long personality. The influences of one culture on the inhabitants of a different culture or community can lead to personality changes so profound that the child no longer feels part of that community.

Social attributes

As children pass through childhood they become increasingly aware of others around them, and develop a sense of social responsibility. There seems to be a stronger gender bias to develop friendships with children who are of the same sex as the child in all but the youngest children. As children mature, they tend to become more integrated into social communities, accepting the communities restraints and responsibilities. For children at this stage of their development, influence from parents/carers reduces in favour of other peer and adult influences. This has the implication that children become increasingly vulnerable as they seek to compliment their parents/carers influence with those with apparent wisdom or authority, however misguided that impression may be.

Table B.1 is based on Piaget's research [g] and [h] and recommendations provided by the Child Computer Interaction Group (ChiCi, see [i]) and presents child development sequences in relation to age and meta-recommendations for interactive product design.

Table B.1: Child development and product design recommendations

Development stages	Ages	Key points for interactive product design (Software service focus)	Key points for design of terminals and devices
Sensori-motor	**Babies (0 to 1 year)**	Babies rely on what their senses perceive; unable to interact with products.	Babies rely on what their senses perceive; unable to interact with products.
Pre-conceptual thought	**Toddlers (2 years to 3 years)**	Brief attention span, can only hold one thing in their memory at a time. Unable to read, but can understand simple instructions. May need auditory UI elements.	Sense organs do not work as an integrated system but as discrete senses. Attention span is brief. Manual skills are not fine tuned. Present only easy manual tasks e.g. click on a key. Feedback should be immediate. Directions should be verbal.
Intuitive thought	**Infants (4 years to 7 years)**	Children understand and can use symbols and words and distinguish reality from fantasy. In the latter part they can take into account the viewpoint of others.	Age 5 children only 50 % of adult size. Senses start to integrate but still develop. Strength and physical ability are increasing. Language skills blossom. Child can now read well.
Concrete operations	**Preteens (8 years to 11 years)**	Children can classify things and understand the notion of reversibility and conservation. Can think logically but not abstract yet.	Age 8 children are 70 % to 80 % of adult size. Senses reaching mature functioning. Pre-teens have sufficient motor skills and hand-eye co-ordination to operate computer functions. Reading ability means can follow written instructions.
Formal operations	**12 years on** (not addressed)	Thinking is about ideas, they can consider various solutions without having to act them all out - can deal with hypothetical situations.	The age group is not covered by the present document.

Some of the recommendations are derived from Baumgarten [b].

Figure B.4 represents child development sequences in relation to age.

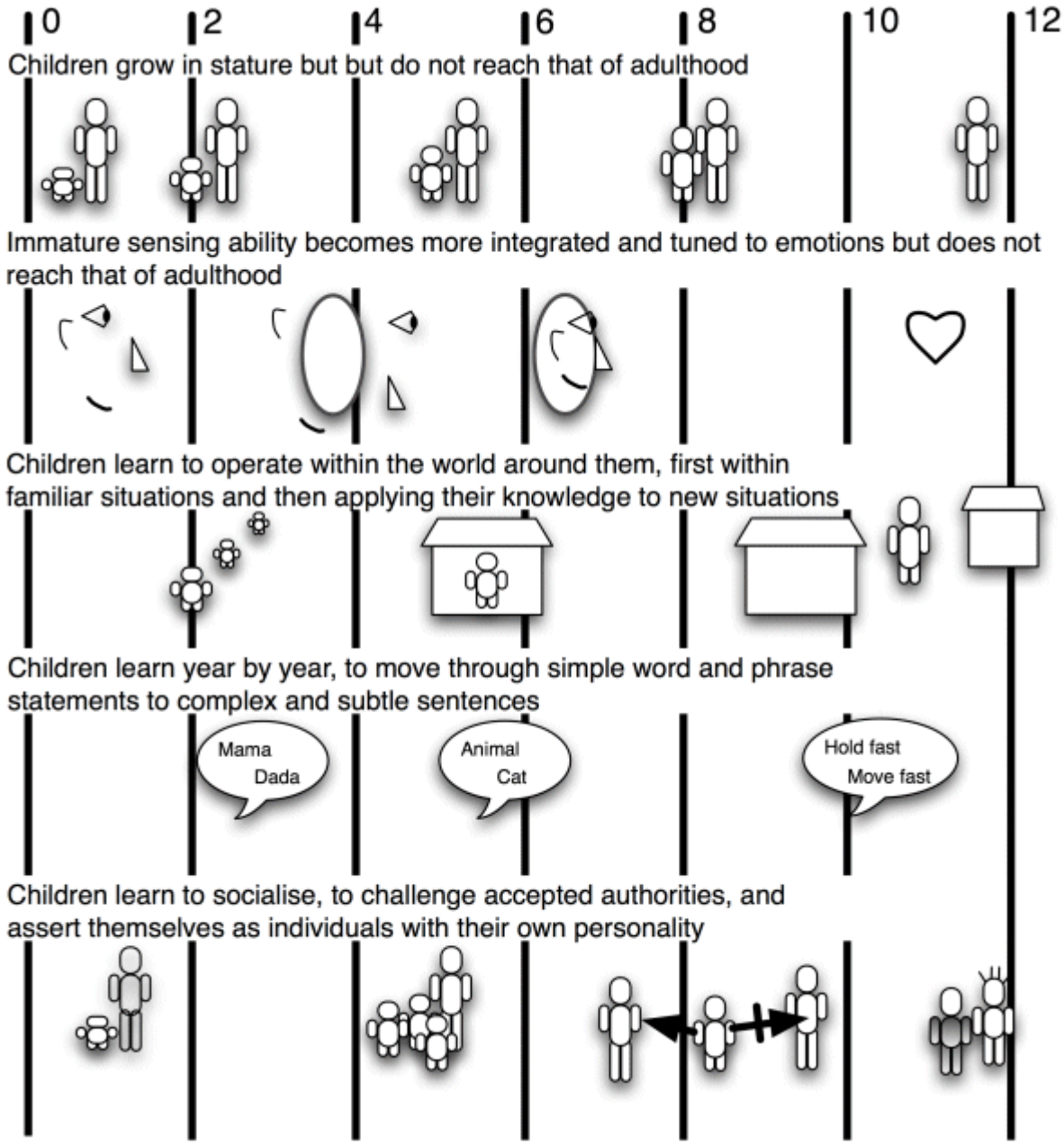

Figure B.4: Child development in relation to age

B.2.3 Gender

Information and communication technologies exist in social contexts. A review of empirical studies on gender and computers [23] indicates an overall picture of male dominance (boys used computers more than girls, especially for programming and game playing. The study clearly indicates that girls utilize computers to connect with others, and boys used computers more to compete with others. Girls' most predominant uses centered around communication: e-mailing friends and family, chatting with friends, making new friends. Boys' most predominant uses centered on competitive, often violent, gaming activities such as war games and killing simulations, and sporting games. In terms of school-related use, girls focused on the numerous ways they used computers, including word processing, creating multimedia presentations, writing multiple drafts of papers, and producing neat, professional looking work. Boys, however, mentioned that they used computers for homework and schoolwork only now and then, and the only tool they mentioned was the Internet.

In terms of Internet use, each gender identified several uses not mentioned by the other gender.

Clear evidence that girls lag in interest and participation is provided by [j]. Designers and developers should do their best to make technology more inviting to other underrepresented users. For girls, making the computer culture more reflective of their interests and values depends on their ability to influence the popular discourse about cyberculture and education. Many valid criticisms of computer culture by teachers (and female students) serve as useful counterbalances to the rampant technophilia of our age:

- Girls have reservations about the computer culture.
- Statistics on girls' participation in the culture of computing are of increasing concern, from the point.
- Of view of education, economics, and culture.
- Girls' current ways of participating in the computer culture are a cause for concern.

The gender differences surrounding technology are not differences in competence, confidence, or frequency of use, see [23]. Instead, the differences lie in how adolescent girls and boys view computers and the way they choose to use them. It is imperative that we understand that the culture of computer use in schools is changing, and that females are embracing technology in numerous new ways as computes evolve into a more versatile and complex tools that can be used in a wide variety of ways depending on the user.

B.2.4 Comprehension of content

Children comprehend content differently to adults, as the full set of brain functions of an adult brain do not fully develop until the teenage years, and because their life experience does not provide a comprehensive framework of knowledge with which to value new information and experiences. This affects the ability of a child to comprehend the set of meanings and intentions in information content in the following ways.

B.2.4.1 Language

Language is a fundamental medium for communication and the conveyance of information. Children have a remarkable special language learning skill that is lost before they reach their teenage years. The rate at which they can acquire language, attribute semantics to vocabulary, and construct utterances with appropriate syntax is remarkable, particularly when compared with the difficulty that adults experience when attempting to learn a language later in life.

Because language skills are developing throughout childhood, children do not have as comprehensive a vocabulary as adults, particularly for words that carry subtle semantic nuances that are differences from the more general words. In some cases, however, they use words that are unknown to adults. This may be because they have yet to outgrow the childish vocabulary used with and by small children. Alternatively, they may incorporate a set of words into their vocabulary that are known only to their immediate peer group.

The spoken language skills of children develop rapidly as they enter their second year, and the ability to learn new languages generally becomes less proficient from the age of seven onwards. It is a remarkable characteristic of children, however, that they can assimilate and use several languages simultaneously. This trait is linked to the particular language learning abilities that are prevalent during childhood, and this ability tends to be lost as children approach their teens. Languages that are not used tend to be forgotten.

Reading ability tends to start in children around the age of 4 to 6, although the skill level increases until around the ages of 16 to 18, or as long as full time education continues. Language skill, and particularly reading skill, is a product of both vocabulary and grammar, and continues to increase significantly as new topics with their own vocabulary are being encountered and discussed.

B.2.4.2 Learning

The impression of reality as perceived by children changes, as they develop. Young children have a very categorical and immediate outlook on the world. As the brain develops and the children encounter a wider set of experiences, they develop the ability to imagine situations other than the one they currently find themselves in. They move form believing everything that they are presented with as true representations of fact to a position where they are able to weigh and value information within a framework of ethics, knowledge and influences. They change from unquestioning acceptance to healthy scepticism. This change is a process that continues through childhood and beyond. Until they have developed the forensic skills to weigh and evaluate, they are absolutely vulnerable to influence from those who convey harmful information in a compelling way, just as they are open to accepting an appropriate cannon of information and associated ethical framework. It is very difficult for a young child, however, to recognize that the information that they have received or the experiences that they have had do not necessarily reflect the norms of the society that they are a member of, or reflect the norms of other societies.

B.2.4.3 Engagement

Children engage with their environment and with information in ways that are very different from adults. All their senses are tuned to appreciate different qualities (colours, tastes, sounds) than those that appeal to adults. This attribute has two important consequences. Firstly, information that is intended to be comprehended and engaged with by children should be presented in ways that appeal to or are tuned for the specific appreciation that children have. On the other hand, information that is intended for adults may either be misunderstood by children or be rejected by children because they cannot appreciate its qualities. Children's senses need to be educated but not desensitized.

B.2.5 Children's location and context

Children use technology in many different locations and for many different activities. This raises a wide variety of issues specific to the fact that children are the users. The context of use can affect the ease of operation of a product or service. With regard to children it may also affect the amount of security that is required to operate the service.

A number of issues with regard to the location and the context within which the equipment is being used are important for children. These include; whether the equipment is in a fixed location or if it is a portable device; whether the equipment is being used at home, at school, whilst travelling or in a public place. The issue of supervision is also important, whether the child is using the equipment alone, with peers or supervised by parents/carers/teachers. The use of the equipment can be affected by the external environment, e.g. the noise and lighting conditions.

B.2.5.1 Mobility

Stationary use

Internet access terminals are generally large and located in a fixed place, however, laptop computers can be moved and used in any location. It is more difficult to get the associated workplace ergonomics correct for a laptop computer than for a fixed terminal.

Mobile use

Mobile phones and PDAs are designed to be portable and hence can be used in any location. It is easy for a child to use a mobile phone unsupervised and there is unlikely to be any direct parent/guardian control of what the child is doing. Child profiles can be used to restrict the calls that are made or received on the mobile phone.

Children need to be educated as to the risks of using the mobile phone whilst on the move, e.g. whilst riding a bicycle or whilst crossing the road.

Children also need to be educated about the anti-social aspects of using a mobile phone in a public place.

Laptops are also designed to be moved from location to location and therefore may also be used in an inappropriate setting.

If a child has a portable device which also includes games there may be a tendency for them to play the games whilst travelling for example to school. Again they need to be educated about the dangers of not paying attention to their surroundings whilst on the move.

B.2.5.2 Location

Home

In the home environment it is the parents/carers who are responsible for where an Internet terminal is located and how mobile phones are used. There is a development towards the "bedroom culture" culture and ICT use with children. See [74]. The social life of children is moving towards their own living spaces, having music, televisions and computers in their own rooms. It is a lot more difficult for parents/carers to supervise what children are doing with ICT in this location.

Recent surveys show that both computers and Internet access over the last few years in the home is increasing for all children, including pre-school children [42].

Children may also use equipment in environments at home that are not idea. For example a child may use a mobile phone in bed in the darkness with the brightness turned down which may damage their eyes.

Pre-school

Children are being introduced to computers and ICT in general at an early age. They will use ICT in the home and also will be introduced to ICT at nursery or pre-school.

The type of equipment that this is likely to be is interacting toys and software targeted at pre-school children. In the pre-school setting this use of ICT should be very carefully controlled. Predominately the ICT used in the pre-school setting is stand alone computers, however, there is an increasing use of the Internet and e-mail. Pre-school children use computers for play much more than constructed learning. Young children need to be taught the basics of ICT use, so that the children know how to look after the computer, how to shut it down properly etc. [41] Even so, computers used by this age group are prone to damage from children constantly turning on and off the machines. The main problem here is that pre-school supervision may well be done by those who are not very ICT literate. It is therefore essential that those who will be supervising the pre-school use have undergone training in its use and abuse. Although there may be some general training available e.g. the European Computer Driving Licence (ECDL) pre-school staff need training targeted to their needs, which may need to include basic fault diagnosis and repair.

Children in this setting are more likely to share computers and perform co-operative interaction with the computer. As the computers are usually placed in the area with other communal activities there is likely to be no awareness of good workspace layout for the computer use.

It should be remembered that teachers and helpers in the pre-school setting have needs as secondary users in this area.

School

Use of ICT in school should always be supervised. However, we know that teachers are very stretched and cannot supervise what all children are doing at all times. It is essential that any Internet terminals have restricted access to web sites to ensure that young children are unable to access adult sites and that adults are unable to contact children in a school setting.

In addition the use of ICT in schools is likely to be undertaken by a group of children rather than by a child on its own. Peer interaction will play a big role here. Computers in school for use by children may be located in the classroom, in special computer rooms, in libraries and for pre-schools in corridors [42]. Depending upon the setting it may not be easy to control the ergonomic environment of the location.

A number of schools have rules about the use of mobile phones in school. The school should be made aware if bullying of children is taking place via mobile phones.

The requirements of the school here can be against the requirements of the parents/carers who feel that they may have a need to be in constant contact with their children.

It should be remembered that teachers and helpers in the school setting have needs as secondary users in this area.

Public places (inside and outside)

It is much more difficult to control the environment of public places. For example, it may not be possible to view the display in the optimum lighting conditions if the product is being used outside.

Other public places where children may encounter ICT are libraries, Internet cafes and exhibition centres. Here the access to the terminals is likely to have very limited supervision.

B.2.5.3 Context

Alone

In order to ensure that the use of the ICT system is appropriate the provider of the system or service may consider the need to ask for details about the user and the location and context of use. This may raise issues of confidentially of information and its secure storage and use.

Depending on the location and context of use, it may be inappropriate for the child to be interrupted by additional unsolicited information being presented to them. A child should always be encouraged to seek a parent or guardians help if they are asked for information about themselves on an Internet terminal or mobile phone.

When contacting the emergency services in stressful situations, children should be able to easily initiate an emergency call from any type of terminal without further analysis or thinking. These calls should always be free of charge and be answered by professional agents, speaking the caller child's language.

Parental rules in the use of media do not work. Parental example is much more powerful than parental rules [k] for example children whose parents/carers watch a lot of television are likely themselves to watch a lot of television. The same holds true for other media use.

With peers

Children learn from each other. In many situations at school and at home they will interact with other children when using ICT. This may be two or three children accessing the Internet on a computer terminal or interacting with each other via mobiles etc. By the age of 7 children will be spending social time with peers and friends as well as with adults. ICT has become a wide used tool for social interaction by young children [l].

Many fear that ICT encourages isolated behaviour, however, many young child programmes aim to encourage communication and collaboration with others.

Situations may arise where young children are encouraged to access web sites that are inappropriate to their age group by older children or siblings. This again shows the need for parents/carers and guardians to be aware of what their children are doing and to install filtering and restrictions onto the terminals.

Supervised

In the home situation parent/guardian should supervise what a child is doing and has access to with ICT. Parents/carers usually say that they have the Internet at home for children to use as an educational tool. It is important that parents/carers discuss with their children the use of the Internet and pass on their own values regarding its use. In the school situation the teacher should supervise what a child is doing and has access to with ICT.

It is therefore important that all parents/carers/teachers are educated about the use and mis-use of ICT.

It has been recommended that information should be given to parents/carers and children about Internet safety at a number of key times, e.g. when a computer is purchased for the home; when a family first signs up with an ISP; when parents/carers in the UK are asked to sign an "Internet acceptable use policy" from school and when the Internet is first introduced to children at school, see [m].

A recently published set of recommendations has been developed by the EC-funded project SAFT - Safety, Awareness, Facts and Tools, a cross-European project that aims to promote safe use of the Internet among children and young people, [x]. The project's aim was to educate children and teenagers about how to reduce "risk" behaviour and become responsible Internet users. The recommendations provided in the SAFT Safe Use Guide [a] are addressing problems such as inaccurate information, harmful material, intrusive advertising and online harassment, while at the same time emphasizing the positive aspects of Internet use among young people.

B.2.6 Children with impairments and special needs

As the mobile phones and Internet find their way into the primary schools and the public arena in general, it becomes increasingly important to secure access for *all.* A goal of the present document is to provide guidance for satisfying the requirements of children with special needs, including sensory, physical, cognitive, communication and other impairments. It is acknowledged that some children with very extensive and complex disabilities may have highly specific requirements - those are beyond the level addressed in the present document, taking a more generic approach, instead of focusing on special and difficult cases. However, we would like to state that with today's advanced technologies, providing access is not a matter of technical capabilities but an issue of focus, resources and social ambitions.

The categorization of impairments of specific relevance for the purpose of the present work, together with key characteristics, are provided below, partly based on EG 202 116 [4], updated to apply specifically to children addressed by the present document.

B.2.6.1 Sensory impairments

Children's sensory impairments are those facilities that affect their ability to experience the world around them. The senses with a specific relevance to ICT use, covered within this clause, include impairments related to sight, hearing, touch and balance. Impairments with a lower ICT significance relating to taste and smell are not addressed in the present document.

Sight (or vision) refers to the ability to sense the presence of light and to sense the form, size, shape and colour of visual stimuli. There are a number of visual impairments that can lead to a disability when using ICT equipment (but can normally be corrected with suitable lenses):

- myopia (short sightedness);
- hypermetropia (long-sightedness); and
- astigmatism.

Even when vision is suitably corrected, there can still be difficulties with small character sizes and poor contrast. Typically, the simpler the image and the clearer its definition, the easier it is to read. Some liquid crystal displays with poor contrast may be difficult to read, especially in environments with strong light and reflections.

Approximately 7 % of all boys (but less than 0,5 % of girls) have problems in distinguishing red from green, an effect known as protanopia and deuteranopia. In addition, there are other variants of colour blindness with a lower penetration.

The most severe form of visual disability is blindness or loss of central vision. Blindness can be classified in terms of perception of light. Some children cannot perceive light at all, some can distinguish between brightness and darkness, and some can perceive slight movement or some images. Loss of sight can involve one eye, leading to a loss of depth perception, or can involve both eyes. When vision is reduced to 10 % of normal vision or less in the best eye, a person is generally considered "legally blind" in most European countries, see [4].

Any form of blindness or tunnel vision makes the acquisition and development of reading or writing very difficult, if not impossible. Blind children usually cannot effectively use ICT products and services that rely on visual displays and graphical user interfaces. They have to rely on tactile and audible signals and multimodal user interfaces. This can make design for all impractical and these children will most commonly need to rely on assistive devices or products offering multimodal user interfaces. Design for all should allow for the connection of such devices through a suitable interface.

Hearing impairments are typically divided into three categories, depending on the degree of children's hearing loss:

- moderately hard of hearing children (with an average hearing loss (AHL), of 50 dB and 60 dB);
- severely hard of hearing children (AHL between 70 dB and 92 dB); and
- profoundly deaf children (AHL greater than 92 dB).

Children with an AHL in the range 24 dB to 34 dB, who report some difficulty in normal conversation, do not have appreciable problems using the telephone. Children with AHLs of up to 54 dB can hear satisfactorily over the telephone at normal speech levels. The use of a second earpiece can be beneficial to people with a more serious hearing loss.

Children who are moderately hard of hearing may have difficulty in hearing warning tones, call progress tones and other auditory indicators. They benefit from multimodal presentation of the signals provided by, for example, flashing lights or vibration capabilities.

Children severely hard of hearing generally use hearing aids. It is beneficial to provide inductive coupling facilities for such hearing aid users.

Hearing loss can basically be classified into conductive and sensori-neural loss. Conductive loss occurs when some defect, infection or damage to the outer or middle ear makes the ear less efficient in transmitting vibrations to the inner ear (often treatable and can be helped by a hearing aid).

Sensori-neural loss occurs in the inner ear when the nerves which transmit sound in the inner ear do not work properly and can be congenital or acquired (commonly called nerve or perceptive deafness). Sensori-neural loss cannot be cured but can sometimes be alleviated by a hearing aid.

Profoundly deaf children are traditionally divided into two categories: pre- and post-lingual deafness.

Children born deaf (or who have lost their hearing before they learnt to speak) are called pre-lingually deaf. These children will typically have no speech or poor speech intelligibility and poor or no reading abilities. Their first language will be the manual sign language of their country and not the native tongue spoken in their environment.

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

Deaf children who cannot hear over a telephone, but have a reading ability, require some form of text communication. Text telephones and relay services are necessary to enable them to communicate with telephone users without that facility. Guidelines for such services are provided in TR 101 806 [3]. Children who rely on sign language require video communication through a relay or other service- reference the ITU-T and ongoing ETSI development by DUST, EG 202 320 [72].

Touch and balance impairments

Touch, the ability to sense surfaces, their texture, quality and temperature relies upon tactile sensitivity and early feedback on shape, temperature or pain. In conjunction with malfunctioning fine motor control capabilities, this means that manipulation requiring fine adjustment or touch discrimination will be compromised (in comparison to children who have already developed these skills).

If a child lacks touch sensation, they may not be able to use touch sensitive screens or touch-pads on ICT devices.

Furthermore, children with hypersensitive touch my be hurt by stimuli from sharp points or edges, which might only cause discomfort to other children. Surfaces should therefore be free from sharp points and edges.

In addition, poor blood circulation (that occurs with diabetes) is a major cause of loss of tactile sensitivity and leads to considerable difficulties for diabetic blind children to learn and use Braille.

The ability to maintain **balance** is dependent on the co-ordination of visual stimuli, feedback from the balance mechanism in the inner ear and the appropriate movements of limbs. Most activities performed by children require a well functioning control of balance.

The incidence of balance impairments, in many cases combined with visual impairments, can reduce the ability to avoid hazards and lead to injury. They can also hinder the use of (mostly public) terminals and other ICT equipment, designed to be used when standing.

B.2.6.2 Physical impairments

Physical impairments with an impact on children's use of ICT include impairments relating to dexterity, mobility, strength and endurance, and less significantly to touch and balance.

Dexterity is defined as the skill of manipulation and implies co-ordinated use of hand and arm to pick up and handle objects, manipulating and releasing them using the fingers and thumb of one hand.

Dexterity impairment includes an inability to bring fingers and thumb together or an inability to separate them normally. More complex operations, such as simultaneous push and turn, which require both sustained pressure and twisting of the wrist, may be painful or impossible. Children with involuntary movements or spasms have problems with tasks that require precision.

Mobility is the ability to move freely from place to place. Mobility problems can extend from minor difficulties in movement, to being confined to a wheelchair or being bedridden. Some children with impaired mobility have difficulty with control, where muscles are tense and contracted (spasms). They may have extra, involuntary, uncontrolled and purposeless movements. They may have small or missing limbs.

Wheelchair users often find that the use of mobile or cordless telephones is very convenient.

Strength and endurance Strength relates to the force generated by the contraction of a muscle or muscle group and can be the force exerted with a specific part of the body on a specific object. It also depends on endurance or stamina (the capacity to sustain such a force) and can be related to heart and lung function.

B.2.6.3 Cognitive impairments

Cognitive impairments with a considerable impact on the design and use of ICT include impairments related to the intellect, memory and language.

Intellect is the capacity to know, understand and reason. As addressed in clause B.1.2, children go through a development process during which the intellect is shaped and can by no means regarded to be on the similar level as mature adults.

Children suffering of cognitive impairments will have, in a way similar to very young children, considerable difficulties concentrating and paying attention to the same task for a longer time.

If used, time-outs should be generous or variable and there should be no need to memorize information to perform a task.

Impairments of the developing intellect leads to developmental problems, as well as difficulties in perception and problem solving and can include difficulty in taking in information. Children with intellectual impairments will typically not develop the necessary reading skills to read and understand written instructions. They may recognize simple icons and be able to follow graphic instructions. They can often function well in a familiar environment but can easily be confused when required to respond quickly.

Memory

Children with impaired short-term memory can forget where they are in a sequence of operations. Therefore, ICT equipment should have a simple input interface which does not burden the memory.

Learning

Children with learning difficulties may be impacted by an impaired cognitive instrument, attention and concentration deficits or loss of education.

B.2.6.4 Speech and language impairments

Speech and language can affect a child's ability to communicate and can lead to associated impairments in social skills.

Speech is the most important sound produced by the voice. Impaired speech may result from damage to the voice system (mouth, throat and vocal chords), cognitive or learning difficulties or loss of speech following a traumatic incident. Hearing impairments may indirectly affect speech due to changes in the perceived feedback and problems of stammering can be accentuated by excessive echo or sidetone, as is the effect of hearing one's own speech in the earphone.

Children with severe speech defects will generally use a symbolic communication medium, progressing, where possible, to the use of text-based communication. The use of synthetic speech generators is a recommended option as part of an augmentative or assistive communication (AAC) service for these children. As many children will already have a technology based AAC device tailored to their specific and individual requirements, suitable interfaces between such a device and the ICT system should be provided and supported.

Video telephony can provide support for lip reading or manual sign language, although this facility is sometimes not useful to those who lack control of lip movement due, for example, to cerebral palsy.

Language and literacy, under development in children, may arise from the specific mental functions of recognizing and using signs, symbols and other components of language, from lack of practice in using the language as a result of a hearing or speech impairment, or as a result of under-exposure to language for educational or cultural reasons.

Dyslexia is often considered an impairment of language, although there is some evidence that it can be classed as a defect of vision. Children suffering from dyslexia have difficulties with reading and writing. Mild forms of dyslexia are very common, and it is therefore very important to keep the wording of signs and instructions as simple and short as possible.

Children with undeveloped language skills or with language impairments may face risks in most everyday circumstances, if they are unable to comprehend written warnings or instructions.

B.3 Secondary end users

For the purpose of the present document, *secondary end users* are defined as adults providing the necessary set-up, configuration and other pre-requisites and means of operation to the primary end users, the children. Secondary end users non-exhaustively include carers, parents, guardians, teachers and other adults.

B.3.1 Goals

The secondary end user's main goal under the circumstances of the present document is to provide a well-functioning, understandable, safe, secure and hazardless environment to the primary end users, the children.

B.3.2 Attributes and requirements

Secondary end users are assumed for the purpose of the present document to have normal, generic attributes, skills and pre-requisites and be ICT users themselves.

Their most important requirements include the provision of:

- an ICT environment designed and developed for children;
- an affordable, well-functioning, stable, fun and understandable ICT environment requiring the minimum level of set-up, configuration, error handling and other support activities;
- a safe and secure ICT environment; and
- hazardless use.

However, even if secondary users are most often legally and/or practically responsible for children's use of ICT, there is no guarantee that these, mostly adult, users will possess the necessary skills, knowledge and other required prerequisites to be able to achieve the above described goals and provide a safe, secure and well functioning environment to the children they are responsible for in assisting.

B.3.2.1 Secondary end users with impairments and other special needs

Secondary end users with impairments and other special needs are not covered by the present document.

Annex C (informative): Usability Testing with Children

There have been many documents produced on usability testing and evaluation of ICT with adults. For a review of techniques see EG 201 472 [16]. This is a useful tutorial on the subject, which discusses the advantages and disadvantages of many techniques e.g. heuristic evaluation; focus groups; questionnaires; audio-video recording, etc.

However, not all of these techniques are appropriate for use with children. In particular the child's age, gender, verbal competence and extroversion level can affect which method will work best [o]. In addition products that are intended for children need to take into consideration the child's language abilities, their understanding of metaphors and analogies, and the way in which they are likely to navigate through these.

In the context of designing for children a different definition of usability may be needed. There is as yet no agreement on what this should be, but a usability definition containing aspects of fun or pleasure, which are important to children, needs to be derived. [p] [q].

This clause of the guide provides some information on how to involve children in the design process and gives some guidance on the selection of appropriate techniques for usability evaluation with children.

When undertaking any involvement of children in usability trials, researchers/designers should make sure that they have obtained the relevant agreements from the parents/carers of the children.

C.1 Involving children in the design process

Bruckman and Bandlow [12] state that designers of software for children start out at an advantage, because they tend to believe in their users. However, they may also be at a disadvantage, because they no longer remember the physical and cognitive difficulties of being a child. It is very important to involve children, if they are the target users, in the design process.

Druin [r] has developed a technique called co-operative inquiry. In this technique children and adults work together as research and design partners. Both the adults and the children act as observers, take notes and interact with the child test subjects. Children are involved from the beginning of the design, not once the adults have come up with the initial ideas. In general it has been found that this technique is most appropriate for 7 years to 10 years olds. Children under 7 have problems expressing themselves, and children over 10 have pre-conceived ideas of what things should be like. This can be a useful technique, but is very labour intensive.

Alborzi et al [s] make a useful suggestion that at the start of any session with children there should be a "snack time", where the children and adults involved can engage in dialogue, so that the children get to know the adults involved. Talking about their birthday or favourite subject at school is a good starting point. It is also recommended that experimenters use first names and dress informally, so that they do not seem too superior to the children [r].

The set up for involving children in any test session has been reported in Hanna, Risden and Alexander (1997) [t]. They give advice on the following issues:

- Show the parents/carers and children around the laboratory before hand so that they are familiar with the set up.
- Provide a warm up session with the equipment, so that the child has familiarized themselves with the controls.
- How the experimenter should behave, i.e. to encouraging children when they fail at a task, and repeating the task if the child forgets what to do. Provide positive feedback that they are performing well.
- That the experimenter should not ask a child if they want to do something as this gives them the chance to say no. Instead words such as "now I need you to .." , "Let's do this …" or "It's time to …." are much more encouraging for a child to participate in the tasks.
- How the presence of adults and parents/carers in the room affects the performance of the children. Children up to 8 will need a parent in the room with them for reassurance and encouragement. Parents/carers should be informed that they should interact with the child as little as possible.

- How the decoration of the room can affect the ambience of the testing environment. The addition of some colourful posters will also make the room more child-friendly. But this should not be overdone.
- How to arrange the layout of the room, so as not to let children face a camera or one-way mirror, as they may "play" to this rather than interacting with the task. Ensure that microphones are near the child to pick us their soft voices.
- How to structure the experimental session, i.e. to give shorter tasks to younger children and for pre-school children only having the session lasting for 30 minutes. Older children can probably cope with an hour long session.
- If planning a series of tasks, vary the order to children to overcome the fatigue effect.

There appears to be some disagreement over the use of video in usability testing sessions with children. Druin [r] suggests that children "freeze" or "perform" to the camera and therefore prefers not to use them. Hanna, Risden and Alexander [t] state that children's behavioural signs are much more reliable than a child's responses to questions, as children want to please adults and may say that they like something just to please the experimenters. This particularly being true for younger children. There may also be legal considerations in the use of video with children.

C.2 Techniques appropriate for use with children

Many of our specific guidelines earlier in this clause state that only design features selected e.g. symbol and icon design (clause 4.2.1.4) can be verified by testing with a representative sample of users (children) for the product. In conducting usability evaluation it is very important to stress that it is the system or the software that is being tested and not the child's ability. The experimenter can stress that they are trying to find out what parts of the system under test that the child finds awkward or in the wrong order (illogical). Children do not have adult "workarounds" and therefore easily highlight usability problems.

Expert evaluation is a technique often used for evaluation of ICT products. For this technique the designer/HF expert takes on the role of the target user group. This may be possible up to a point for adult users, but it is probably impossible for an adult to behave and think like a child, so this technique is unreliable for children's products.

A number of researchers have compared different usability testing techniques with children For example a group of researchers at Eindhoven University [p], [u], [o], [v] used children ranging from 6 to 14.

In order to compare the usability testing techniques, the number of usability problems identified by the children were counted. A problem was taken as any part of the system that made it unpleasant, inefficient, difficult confusing or impossible for the child to achieve their test tasks. In addition a problem can be seen as any time the child required assistance from the experimenter. The results of these experiments are discussed in clauses C.2.1 and C.2.2.

The techniques which have been tested with young children have been found useful up to a point. Currently investigations have only been undertaken with stand alone systems not communicating systems. Further work is needed in this area.

Table C.1 shows a range of methods that can be used with children at different ages.

Table C.1: Appropriate Usability Testing Method in relation to a child's age

Method	Age relevance	Comments
Thinking Aloud	Most useful for 8 years to 14 years old.	Children have varying abilities to verbalize.
Active Intervention	Produces best results for 6 years to 8 years old.	Place questions on a piece of paper next to child. A script is required.
Retrospection		Test becomes twice as long and may be a problem with attention span. Legal issues with regard to video use and children.
Co-discovery	Cannot be used for children under 5 as they do not co-operate.	Two children work collaboratively and therefore requires twice as many test subjects.
Peer tutoring		Child who is tutoring may take over the task.
Post task interview	Better than questionnaires for 4 years to 7 years old.	Children may not be able to express their opinions. Ask questions after short tasks due to short attention span.
Post task questionnaire	Can be used for 8 years to 11 years old if is simple.	Only use positive question structure.

C.2.1 Verbal Protocol Techniques

There are many different techniques which encourage the test participant to talk about what they are doing or thinking during the test session. The techniques can also explore the source of the usability problems.

The variations of the technique include:

Thinking Aloud, where the subject has to think aloud during the whole session. Children may need prompting to think aloud if they go quiet during the session. This can have a distorting influence on the outcome.

Active Intervention is similar to think aloud but the experimenter asks the subject questions during the interaction. Questions can be related to what the user expects to happen, why something happened, and explore where the problems lie. As an aid to this technique with children, the questions that the experimenter wants answering can be placed on a piece of paper next to the child. Questions such as "Did you need help solving the task?" and "What, if anything, happened that you did not expect or want?". Again if the child remains quiet, the experimenter will need to prompt the child. Phrases such as "keep talking", "remember the questions" have been found useful [o]. It was also found that it is essential to prepare a script for prompting young children during the evaluation, to ensure consistency between subjects.

Retrospection consists of undertaking a standard usability evaluation while recording it on video. The test subject then watches the video with the tester and questions are asked during the play back. The disadvantage of this technique is that the test becomes at least twice as long and may be a problem for children who have limited attention spans. The question of legal issues in the use of video with young children needs to be addressed.

It has been suggested that co-discovery, where two child users work collaboratively on the tasks set by the experimenter, can overcome the problem of evaluator intervention. The assumption here is that the children will behave more naturally with another child than with the experimenter being present. Richer data will be gathered about the opinions and expectations of the children. The disadvantage of this technique is that it uses twice as many test subjects.

A further technique is Peer Tutoring where one child tutors another child. The second child then tutors a third child and so on. The main problem with this technique is that the child who is tutoring can take over the task, and competition can get in the way of co-operation. When considering any co-operation test situation it should be remembered that the way children play changes from parallel to co-operative between the ages of 2 and 5. This also depends upon when the child starts school.

In general, Van Kesteren et al [v] have found that Active Intervention is the method which leads to most verbal statements within a limited time frame and number of subjects with 6 years to 8 years old.

The advantage of verbal protocol techniques is that the children do not have to remember what they were doing or thinking after the test session. However, the techniques do have some disadvantages when using them with children. Firstly the child has to both use the system and provide verbalizations at the same time which may be too much of a cognitive load. And secondly the child may feel awkward disclosing what they are thinking to an adult . Donker and Markopoulos [o] have found that these techniques work better with older children in the age range 8 to 14. The ability of children to verbalize evolves a they grow up and at lower ages could impair their ability to verbalize usability problems.

Extrovert children, like extrovert adults are more likely to name usability problems with a think-aloud technique than introvert children.

C.2.2 Post task interview/questionnaires

Breakwell [w] has found that interviews work better than questionnaires for formal surveys with young children (4 to 7). In addition children are sometimes unwilling to assert themselves or to contradict adults and consequently interviewing young children needs special care. Very young children are very literal.

Children aged between 8 and 11 are able to complete simple questionnaires. For adults, it is recommended that both positive and negative statements are used for surveys. However, one has to be careful with the construction of sentences for use with children, as they can be very literal and are unable to easily understand negative questions.

For any survey with children whether written or verbal, the language used is crucial. The language needs to be the language of the target group, in this case children, and needs to be meaningful for the least articulate of the users. To ensure that the correct language is used, a pilot study should be conducted and the language should also be checked with those who work with children of this age group, for example teachers of that group.

Due to the short attention span of children, questions that the experimenter wants answering should be administered after each task. It has been found that the use of pictorial smiley faces can be useful for a child to indicate their agreement or disagreement with a positively phrased statement.

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