Function standards for interfacing mobiles with assistive devices

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N. Hine, F. Petersen, E. Zetterström. Function standards for interfacing mobiles with assistive devices. Gerontechnology 2008; 7(3):319-324. Today's mobile communications devices are already used for much more than just making phone calls, but also for taking pictures, playing music or games and for sending and receiving text messages. By adding other services this technology could allow the ageing user to remain part of our modern society where people can be in contact anytime, anywhere, anyplace, and obtain help and support at will. For persons with impairments which affect their use of these technologies, affordable, effective and usable assistive devices can be made available when based on standardization of technical interfaces to Information and Communications Technologies (ICT) devices. This article describes the work performed by the Technical Committee Human Factors at the European Telecommunications Standards Institute (ETSI HF). It provides a description of the functional requirements for interfaces of mobile devices that are specific to different types of assistive devices, and invites the mobile phone industry to participate in the extension of relevant AT (from ATtention) commands.

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In addition to the functionalities of mobile phones that most people enjoy (phone calls, text messaging, camera, and music player), way-finding technology[1,2], monitoring for health protection[3], and general remote control may be useful. Whether the mobile phone has been developed for the broad mass market or especially for older persons[3], people with certain impairments in the domain of using mobiles may be hampered in its use.

The European Union is facing unprecedented demographic changes. From 2005 to 2030, it is estimated that the number of people 65+ will rise from about 15% to about 25% of the population[4,5]. This results in an increasing demand for technology that can be adapted to different impairments.

Taking the needs of a broader spectrum of people into account in the design process is called 'Design for All', 'Barrier Free Design', 'Universal design', or 'Inclusive Design' and is defined as 'The design of products, services and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design'[6].

However, 'Inclusive Design' will never include all persons, and some will still need assistive technologies in certain environ-

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ments[6]. Unfortunately the assistive requirements for a specific impairment may conflict with those with a different restriction, leading to a series of different assistive devices that should all connect to the mainstream functionality. Examples are a speaking output for blind people or icon representation of functions for people with reduced reading skills. Responding to the demands for equal access to technology raised by the ageing population, the provision of standardized interfaces between assistive and mainstream device is expected to meet the aspirations and needs of individual users, while increasing the benefits for companies by also meeting their needs. The European Commission has supported the area of research of new technologies for older people and people with disabilities for many years and will continue to do so, stimulated by demographic change[7].

The European Telecommunications Standards Institute (ETSI) produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, converged, broadcast and internet technologies. It is officially recognized by the European Commission and is a not-for-profit organisation with almost 700 member organizations drawn from 60 countries worldwide. Our work on function standards is co-funded by EC/EFTA (European Commission/European Free Trade Association). The results are useful both in a European context, and worldwide. All ETSI's published deliverables are available for free[7]. The objective of this article is to highlight ETSI Technical Specification (TS) 102 511 on AT (ATtention) Commands for Assistive Mobile Device Interfaces[8-10].

ASSISTIVE INTERFACING FOR EQUAL ACCESS
In order to realise easy connectivity of assistive devices and mainstream mobile devices and services, standards for input/output functions are to be set. Without such standardization each adaptation will require significant technical expertise and effort, and will consequently be expensive and practically unrealistic, leading to societal exclusion, or unnecessary limitation of choices (for instance, style, design, functionality) for persons with certain disabilities.

In addition consumers may be forced to continue using older, outdated devices long after they have ceased to be supported by manufacturers and operators, simply because it is impossible to replace them with suitable new ones.

Current assistive technology is classified in the international standard ISO 9999[11]. It lists a number of devices ranging from abacuses to zippers, but only a few of these devices have the potential to be connected to ICT services and devices (*Table 1*).

Current standards for mainstream ICT devices do not include function standards for input/output to the assistive devices listed in Table 1. What should be standardized is treated below.

SCOPE OF AT COMMANDS
'AT' is the two character abbreviation of 'ATtention', used to start a command line sent from terminal equipment to a terminal adaptor. Originally developed for computer modems in 1977 by Hayes Microcomputer Products, AT commands have matured from being a modem control technology to a comprehensive and pervasive middleware platform for mobile devices. Since this technology is present in all mobile devices AT commands reduce the work involved in promoting increased accessibility and adaptability of mobile devices and is expected to be included in the upgrading of existing standards where the necessary AT commands do not exist as yet.

Currently AT commands provide control of calls, the SIM card, phone information, phone settings, packet domain, network

Table 1. A not exhaustive list of assistive devices mentioned in ISO 9999[9,10] that may be connected to ICT systems

Classification	Description
12 39 06	Electronic orientation aids
12 39 09	Acoustic navigation aids (sound beacons)
21 06 03	Image enlarging video system
21 06 06	Character reading machine
21 09 03	Input units (e.g. speech recognition)
21 09 06	Keyboard and control systems
21 09 09	Printers and plotters (e.g. Braille)
21 09 12	Displays
21 09 15	Devices for synthetic speech
21 09 27	Software for input and output modification
21 15 09	Dedicated word processors
21 15 15	Electric Braille writers
21 24	Aids for drawing and handwriting
21 33 09	Decoders for videotext
21 33 12	CCTV
2136 06	Mobile telephones and car telephones
21 36 09	Text telephones
21 36 10	Visual telephones and videophones
21 42 09	Portable dialogue units
21 42 12	Voice generators
21 42 15	Voice amplifiers
21 45	Hearing aids
21 45 15	Tactile hearing aids
21 48 03	Door signals
21 51 03	Personal emergency alarm systems
21 51 06	Attack alarms for epileptics
21 51 09	Fire alarms
24 09	Operating controls and devices
24 12	Environmental control systems

services, and mobile termination in the mobile device. A set of AT commands for mobile devices has been standardized in the 3rd Generation Partnership Project, 3GPP™ that brought together a number of telecommunications standards bodies, including ETSI[12]. ETSI Technical Committee Human Factors (ETSI TC HF) identified users' needs in this project. The exact definition of the syntax for these AT commands is not within the scope of ETSI TC HF.

LIMITATIONS TO OVERCOME
Standardized AT commands are not yet complete for input/output with assistive devices. Additional technical problems result from designers' frequent use of proprietary products that have little or no interoperability with products of other vendors[13]. Only a very limited range of assistive solutions is nowadays available for mobile devices.

After analysing the current set of standardized AT commands[12] and their use in mobile devices we found that many mobile devices have not fully implemented the standardized set. In addition, manufacturers have extended themselves the AT command set to cover additional functions in the phone such as file storage, camera, etc. In some but not all cases these functions have appropriate (non-standard) AT commands associated with them that are publicly available.

USER REQUIREMENTS: METHODS
The ETSI project concerned has collected requirements from a range of stakeholders. The consultation phase included face to face discussions, online questionnaires, and a forum discussion with disabled people who attended a day centre run by Capability Scotland. That session consisted of six hands-on demonstrations where practical examples of typical use of mobile technologies could be tried by and discussed with the users with impairments. The type and severity of impairments varied and included users with motor, speech, or cog-

nitive impairments. The requirements depend therefore on the individual's specific aspirations, needs and capabilities.

Some general conclusions could be drawn as a result of this workshop. Firstly, the users' abilities to use mobile devices can be improved by using assistive devices. Secondly, people with impairments may not have the same view on which is the most useful functionality, as compared to people without impairments. Those with a cognitive impairment or speech impairment might not see phone calls as the most interesting or useful functionality, but might prefer taking a photograph, listening to the radio, download and listen to music, do some web browsing for looking up information, or use remote control.

An important conclusion is that for people with impairments, there is the need for basic functionality supported by a limited set of AT commands, and in addition there is also a need for using a full range of functionalities on the mobile device and the corresponding AT commands.

NEW NEEDS FOR AT COMMANDS

When collecting requirements and mapping these requirements with existing standardized AT commands[12], the need for new standardized AT commands was identified, as described below.

Colour: People with a visual impairment and some dyslexic persons often find it easier to read if a specific text and background colour is used. However, for legibility, luminance contrast is generally more important than colour contrast, but colour may be helpful for visual search.

Cursor control: Users with mobility impairments may need alternative pointing devices (stylus, finger, head pointer) to control the on-screen cursor.

Font size: Small visual details on the interface of mobile devices cause problems for people with visual impairments. They need the option to change the font size.

Menu: The use of menus is the main difficulty for visually impaired people[14]. Currently, the personalization of menus in mobile phones is poor. This includes size of menu text, mode (text or spoken menus), colours of text and background. Preferences are to be stored in user profiles to make them available to a range of devices and services[15].

Screen: People with vision impairments find the screens of mobile devices too small. The 'send screen dump' functionality sends the screen dump to the assistive device, where it can be presented in a larger size. It is also useful, in some situations, to be able to rotate the screen of the mobile device to better accommodate the contents of the screen.

Speech-to-text: To be able to control the mobile device, speech-to-text is required by some users.

Text telephony: Hard of hearing or deaf people have traditionally used text telephony for communication. Recently, mobile text telephony services have been made available that should also be included in mobile assistive devices for use with the mobile phone.

Text-to-speech: Hard of hearing, mute or visually impaired users find it useful to use the Text-To-Speech (TTS) functionality. Being able to sound out text is useful for people with speech impairments. Those with visual impairments need to listen to text messages, such as SMS (Short Message Service).

Time-out: Users with reduced dexterity or visual impairments have problems with mobile devices because of poor haptic feedback or tiny interface buttons. An AT command for a longer time-out period for functions is needed.

Video telephony: For users who are hard of hearing or deaf, mobile video telephony increases the quality of life because it enables these users to have a conversation anywhere with someone in sign language. Unfortunately AT commands for rotating the screen and switching the viewed video to full screen mode are still lacking.

Volume: Audio services, such as media players or radio broadcast for listening to news and music are increasingly popular on mobile devices. Users should be able to change the volume of media played from their assistive device.

Applications: An increasing number of applications are either included in the mobile device at purchase, or they can be included later. However, the use of application functionality at a content and information level is beyond the scope of the present document, but a minimum requirement is that all applications shall provide input, output and control functionality that is usable by all users.

Audio stream: For people with speech impairments, feeding an audio stream from an external assistive device to the mobile device is necessary. This will enable a person with speech impairment to have a normal text conversation using a synthetic voice from an external device.

Calendar: Another function where a standardized AT command is lacking, is the calendar, which is a function most non-impaired people take for granted.

Camera: The camera functionality incorporated in mobile phones is popular, but no assistive device is sold yet.

Location services: People with visual impairments and those with cognitive impairments such as reduced memory may often encounter difficulties to locate where they are and where they are going.

Location services using GPS and base station triangulation is suitable for them.

Messaging: People with hearing impairments and those with speech impairments are particularly interested in using messaging services. AT commands for SMS are standardized[16], but there are no standardized AT commands yet for MMS (Multimedia Messaging Service).

Voice channel input and output: Users who are hard of hearing and depend on an assistive device, may want to connect their hearing aid directly to the assistive device (and not to the mobile phone). Users with speech impairments, who use an assistive device to amplify their speech, or use their assistive device to speak for them will also benefit from connecting their assistive device directly to the mobile phone and use their assistive device both for audio input and output.

The published technical specifications of new AT commands[8] describe in more detail the requirements of the functions listed above, and also suggest examples of syntax. AT commands is a mature technology that provides a useful interface to assistive devices since it is used in all mobile devices. New mobile device technologies are developing rapidly. The standardized AT command set will need a periodical update.

CONCLUSIONS

Implementations of standardized AT commands in mobile devices would:
(i) offer users with impairments a wider range of choices when purchasing mobile devices;
(ii) make it possible for these users to use the full range of functionalities in their mobile devices;
(iii) reduce costs for developing assistive devices, thus making them cheaper.

The ETSI project team encourages the mobiles industry to actively take part in

standardizing new AT commands by extending the current set of standardized AT commands, in ETSI TS 127 007[12] or in another document.

We recommend that mobile device producers implement the whole set of standardized AT commands. If this were widely adopted, assistive device manufacturers will gain confidence that their products and services will work reliably with mobile terminals. And mobile manufacturers and suppliers could gain access to a larger more diverse consumer base.

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