Usability challenges in standards development:
Updating the character standard for the 12-key telephone keypad

Bruno von Niman¹, Martin Böcker², Karl Ivar Larsson³, Ian Rattigan⁴,
Matthias Schneider-Hufschmidt⁵ and Aino Wihervaara⁶ (ETSI STF 202)

¹ Ericsson Enterprise AB, Sweden (until December, 2003)
ETSI TC HF Vice Chairman and STF 202 Leader
bruno.vonniman@ericsson.com
², ⁵ Siemens AG, ICM, Germany
³ LWP Consulting, Sweden
⁴ Sony Ericsson Mobile Communications AB, Sweden (until September, 2003);
⁶ Nokia Mobile Phones. Finland

Abstract
The European Telecommunications Standards Institute (ETSI) has recently published a new standard (ES 202 130) specifying the assignment of characters on the 12-key telephone keypad for a range of European languages. For the first time, a standard now exists for letters, digits and special characters, including European language-specific letters (Latin, Greek and Cyrillic scripts) and other common characters (such as the Euro symbol and punctuation marks). This paper describes the development and reflects upon related usability challenges of the new standard, developed by Specialist Task Force (STF) 202 of the ETSI Technical Committee Human Factors (TC HF), during 2002-2003.

Key words: Usability, user interfaces, standards, 12-key keypad, ICT

1. General

Devices with telecommunication functionality represent the largest consumer product segment in the world. Telecommunication, converging with information processing and intersecting with mobility and Internet technology, is leading to the development of new interactive applications and services, offering global access.

At present, finding the characters necessary to enter a name in the terminal’s phone book, searching for a name, writing an SMS (text) message or logging on to a mobile Internet portal cannot always be performed easily, because different manufacturers apply different entry mapping and ordering for the characters on the keypad. Usage varies sometimes even between devices and applications from the same manufacturer. Standardizing the use of the characters on keypads will give users easier access to different communication devices and services, with
The original reason for assigning letters to the rotary dial pad and later to the numeric telephone keys was to provide alphabetic 'aliases' for digits, as mnemonics in dialling. The emergence of and need to use a telephone keypad for entering data was not envisaged. Neither was imagined the concept of 'phone books' stored inside a telephone, nor the successful facility to transmit short text messages, SMS, as an alternative to voice communication.

The only standard available previously, addressing assignment of characters to the 12-key telephone keypad, is limited to the assignment of the basic 26 Latin letters (a to z). Language-specific letters (e.g., ü, é, â, ä, ö) as well as other characters (e.g., the Euro sign) were not addressed. The lack of addressing such typically European issues has led to diverse and inconsistent solutions for European languages, obviously creating accessibility barriers to basic communication access in eEurope.

Europe has 230 indigenous languages- worldwide there are close to 7000. The largest number of languages presently supported by a specific ICT device or service is approaching 50. Cultural and linguistic diversity is one of the key strengths of Europe. However, in ICT, it raises issues that need to be considered and solved in order not to limit access to services, their availability and usability, on the basic as well as more advanced levels.

This development was aligned with the European Commission’s initiative eEurope, a program for accelerated uptake and inclusive deployment of new, important, consumer-oriented technologies (http://europa.eu.int/information_society/eeurope).

2. Scope of the work

The standard specifies the minimum repertoire and assignment of graphic (letter, digit and special) characters to standard 12-key telephone keypads on ICT devices with telephony functionality. It applies to public or private, fixed or mobile network terminals, without an alphanumeric keyboard but providing a 12-key keypad in hardware form (e.g. as push button keys) or software form (e.g. as soft keys on a visual display). It also applies to network-based services accessed through such terminal devices. It complements ETS 300 640 by additionally including European language-specific letters (Latin, Greek and Cyrillic scripts) and other common characters (e.g. the Euro sign and punctuation marks). It specifies solutions for both language-independent and language-specific keypad assignments, mapped to the 12-key telephone keypad, also providing common and language-specific information on character repertoires and ordering.

The standard is fully applicable to the languages of the European Union (EU) member states as of 2004 (also covering the official languages of the European Union) and those of near-term enlargement candidate countries and, additionally, to the official languages of the EFTA countries and Russian. In anticipation of future expansions, the language-independent repertoires and keypad assignments specified also include letters needed in some of the remaining European official languages. Future revisions of ES 202 130 document may include the letters of other languages and other characters.
This ETSI Standard does not cover any implementation related issues, e.g. specifics of predictive text input or user interface design.

3. User requirements

Intended users of the standard are those implementing it, for example interaction designers and other developers of ICT devices and services, designing user interfaces deploying text input and output, applied to 12-key keypad arrays provided in hardware form (e.g. as push button keys) or software form (e.g. as soft keys on a visual display) and telecommunication network-based services accessed through such terminal devices.

Intended end users addressed are the consumers (end users) of the ICT devices and services mentioned above, ranging from first time to experienced advanced users, who can produce tactile stimuli in the form of a key press and perceive written text. The end users’ main goal is to efficiently use ICT devices and services under circumstances intended by these.

The deployment of ES 202 130 will enable users to reapply knowledge and previous experience between different ICT devices and services using a 12-key standard keypad array and a display. Control of common functions such as entering of characters and retrieval of text in a certain order will be simplified. Well-established services which rely on alpha mnemonics (e.g. '800 DOCTOR' rather than '800 362867' are not negatively influenced as the standard only complements ETS 300 640 [Fehler! Verweisquelle konnte nicht gefunden werden.].

For certain end users with special needs, ES 202 130 will proof helpful due to consistent implementations (same character always found in the same position, regardless of the terminal manufacturer). For certain disabilities, e.g. in the case of temporary or permanent difficulties caused by cognitive problems or the lack of necessary level of proficiency in the respective language and other communication impairments such as: visual impairments, the inability to produce distinctive tactile stimuli or difficulties in handling, distinguishing and understanding textual information, the present document is not expected to have any impact.

For detailed guidance, including specifics of user impairments and resulting handicaps, possible solutions on access-for-all achievable through assistive technologies, design for all and multi-modal interfaces, see Human Factors (HF); Requirements for Assistive Technology Devices in ICT, Human Factors: Design for all: guidelines for ICT products and services and Study of multi-modality of Icons, Symbols and Pictograms.

Uniformity in the basic interactive elements increases the transfer of learning between devices and services and improves the overall usability of the entire interactive environment. Such transference becomes even more important in a world of ubiquitous devices and services.

Guiding principles during the development of the ordering and assignments of the alphanumeric characters have been:

1) Consistent and harmonised across different devices and services
2) Easy to learn and remember
3) As natural as possible, matching previously acquired knowledge
4) Redundancy (multiple solutions possible to reach desired input)
4 Methodology

4.1 Initial survey
As start of the work to developing the standard, an informal survey of the key assignments in a number of mobile phone models was carried out on several major manufacturers’ handsets. The survey was based mainly on specifications and user manuals downloaded from Internet but also on 'hands-on' investigation.

4.2 Future-proofness
The standard is expected to have a considerable impact, not only in the sheer number of users that it could affect, but also in the functionality it may enable or – conversely – limit. The original reason for assigning letters to the numeric telephone keys was to provide alphabetic 'aliases' for digits, as an 'aide-memoire' (mnemonics) in dialling. That there would emerge a need to use a telephone keypad for inputting data was something that nobody envisaged. Neither was the concept of 'phone books' stored inside a telephone imagined, nor the – unexpectedly successful – facility to transmit short text messages as a complement to voice calls.

4.3 Characters needed
Approximately 240 Latin-repertoire letters are needed to cover the major European languages. With Greek and Cyrillic letters added, the number increases to well over 350. This can be compared to the 75 Latin-repertoire letters (mix of capital and small) supported by the present GSM 03.38. 7-bit scheme generally implemented in today's mobile phones and networks (85 letters all-in-all when the Greek capital letters of that scheme are included).

It was found necessary to include in the language-specific repertoires more letters than are contained in the "core" of those languages, called "Type A" letters. This is because in all languages there is a user need to input also foreign-origin words, some of them needing "foreign" letters. Further, in all countries there exist user preferences in spelling of some names with "foreign" letters, and possibly also a need to represent names – personal and/or geographical – correctly in recognised minority languages.

The repertoire tables therefore also include "Type B" letters. These parts of the tables shall be seen as "best-effort" in the development of the standard, and may become modified in the future.

4.4 Character ordering
Ordering of characters is a highly complex problem, and has been the subject of very large amounts of work in several standardisation bodies, both national and international. Earlier ETSI and ISO/IEC standards specify principles based on a "multi-level" approach for the ordering of strings of characters. However, it was found necessary to adopt a simplified "single-level" method for this standard, considering the limited capabilities of telephone devices as compared to computer systems.

As regards letters, the two language-independent repertoire tables specify a deterministic ordering. For the language-specific repertoire tables, however, some additional criteria were applied because of established practices in telecommunications, e.g. for printed telephone directories.

In all European languages, the letters A–Z are considered part of the alphabet even if, in many of them, some of the letters are not used in any indigenous-origin words. Also some languages have special-shape letters, like the Icelandic þ and the German ß (which remains in
use, also after recent spelling reforms). Additionally, all languages use special variants of letters A–Z with diacritical marks, like the acute accent and the cedilla (e.g. É and Ç). For ordering, most languages consider such variants equivalent to the basic letter. In some languages, however, a few of them are considered letters of their own, and ordered differently. For instance, the letter Ö is ordered in Swedish as the last letter of the alphabet.

As far as possible, national conventions were followed for the language-specific repertoire tables. This may possibly cause "non-deterministic" ordering in specific cases. Although unsatisfactory in principle, it was concluded that this could be accepted for the relevant applications.

4.5 Device dependencies

For mobile phones, there exists four interacting but independent cases of language dependencies:

1) User interface related settings (e.g. menu language)
2) Ordering (e.g. of lists such as the list of phone book entries)
3) Keypad layouts (i.e. character assignment to keys)
4) Dictionaries for 'predictive' text input (e.g. T9).

4.6 System and network constraints

The present generation of system network implementations for applications such as SMS messaging have different constraints, bounded by the ETSI standard GSM 03.38. Part of that standard was originally taken over from paging, with only a rudimentary set of characters defined: the “ASCII set” complemented by a few specifically European-language letters, amongst them the ten Greek capital letters not having a corresponding visual representation in the Latin alphabet. The Cyrillic alphabet was not covered at all.

The GSM 03.38 standard applies only to what is transmitted between a mobile phone and the “Mobile Switching Centre” (MSC), not to how SMS generation is handled inside the phone. Naturally it is however not very meaningful to generate SMS messages with characters that can then not be transmitted, so the character limitations of the standard also limits what needs to be generated. With the original – “default” – SMS character set, multi-linguality is therefore completely unsatisfactory.

In GSM Phase 2, an alternative to the original character set was introduced, in principle permitting about double the numbers of characters of the original SMS scheme. This alternative was designated “user-defined”, i.e. no scheme was specified in the standard. It appears no user – i.e. Operator – has utilized this possibility.

With GSM Phase 2+, another alternative was introduced, namely the coding scheme of ISO/IEC 10646-1, also known as Unicode. With this scheme there is, in principle, no longer any limitation on the repertoire of characters that can be represented in SMS messages. European multi-linguality is therefore enabled, as far as representation of characters is concerned.

4.7 Keypad input sequences

In today's keypad-input implementations - foremost in mobile phones - the digits are generally placed as the last character in the key-press sequence, following not only the standardized
letter assignments (ABC on key 2, DEF on key 3 etc.) but also all special letter variants assigned to the keys. The same principle was considered for the present document. However, the special needs of visually impaired users make the principle questionable. It was therefore decided to place, instead, the digits immediately following the presently standardized letter assignments; i.e. as the fourth key-press on all keys except 7 and 9 (PQRS and WXYZ) where it is the fifth.

References

ETSI references are available free of charge at www.etsi.org.

ETSI ES 202 130 Human Factors; User Interfaces; Character repertoires, ordering and assignment to the 12-key telephone keypad (European languages)

ETSI ETS 300 640 Human Factors (HF); Assignment of alphabetic letters to digits on standard telephone keypad arrays

ETSI TS 100 900 Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information (same as GSM 03.38 version 7.2.0, Release 1998)

ETSI TR 102 068 Requirements for Assistive Technology Devices in ICT

ETSI EG 202 116 Design for all: guidelines for ICT products and services

ITU-T Recommendation E.161 (02/01) Arrangement of digits, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network


EU Convention documents for EU Enlargement; Athens, Greece, April, 2003