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Foreword

ETSI Technical Reports (ETRs) are informative documents resulting from ETSI studies which are not appropriate for European Telecommunication Standard (ETS) or Interim European Telecommunication Standard (I-ETS) status. An ETR may be used to publish material which is either of an informative nature or is not yet suitable for formal adoption as an ETS or I-ETS. This ETR has been produced by the Human Factors (HF) Technical Committee of the European Telecommunications Standards Institute (ETSI).

A user's acceptance of new telecommunication services and products depends on their usability. Usability can be defined in terms of its two main components, performance and satisfaction. It is important to apply usability principles in all phases of the product development process.

In the checklist a number of usability components of a simple telephone set are identified, and each of them are checked against a set of statements, which encapsulate good human engineering principles. These principles are based on standards, guidelines and empirical knowledge relevant to the specific user-interface for achieving a high degree of usability.

This ETR includes a model for identification and structuring of the usability components which influence the usability of the specific user-interface.

In this ETR, this methodology has been applied to develop a usability checklist for a user-interface consisting of a simple telephone set.

At an early stage of the usability evaluation process the usability checklist can be used to obtain a rough estimate of the usability of the telephone interface. This is done by checking the degree of conformance between relevant usability components of the user-interface and agreed design rules.

Elaboration of the usability checklist methodology could be done by applying an application dependant weighting factor to each of the usability components identified. Comparison of different user interfaces could then be expressed by single usability measures.

It is intended to treat the special requirements of users with disabilities in a separate ETSI publication.

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1 Scope

In general, a usability checklist is based on standards, guidelines and empirical knowledge of what are good human engineering principles relevant to a specific user-interface. The usability checklist represents a set of minimum requirements to the usability components identified. Final usability evaluation of a product may still be needed e.g. by using ETSI DTR/HF-3001 [1].

The usability checklist for telephones is aimed at:

- developers of telephone sets;

- procurement staff for including usability requirements in their specifications;

- customers and consumers' associations producing test reports.

One problem in usability evaluation is the very large number of components that may influence the usability. Therefore, this ETR includes a model suitable for structuring the usability components of user-interfaces.

The checklist methodology is demonstrated for a user-interface consisting of a simple telephone set having the following basic functions for user task performance:

- setting up a call;

- receiving a call;

- performing voice communication;

- terminating a call.

The user-interface of a simple telephone set supports the service "voice telephony". During the set up of a call, information is exchanged between the user and the system (network). Some of this information is presented to the user as tone signals or spoken messages. Since this specific issue is studied by another group in ETSI, only "telephone set-related" usability components of the user-interface are included in the checklist.

Similarly special requirements for users with disabilities will be discussed in another OATS publication.

Checklists for other types of user-interfaces, e.g. business telephony, interactive information services, store-and-forward messaging, and network management and system administration may be developed by applying the structural model.

2 References

For the purposes of this ETR, the following references apply:

[1]   ETSI DTR/HF-3001: "Guide on usability testing methods for telecommunication terminals and services".

[2]   CCITT Recommendation P.35 (1988): "Handset telephones".

[3]   Applied Ergonomics (1988), 19.4, 271-274: "Weight and balance of a new telephone handset", E.T. Klemmer & K.A. Haig.

[4]   ISO/DP 9241-4: "Ergonomic requirements for office work with visual display terminals, Part 4: Keyboard requirements".

[5]   CCITT Recommendation E.180 (1988): "Technical characteristics of tones for the telephone service".

[6]   CCITT Recommendation E.181 (1988): "Customer recognition of foreign tones".

[7]   CCITT Recommendation E.182 (1988): "Application of tones and recorded announcements in telephone services".

[8]   CCITT Fascicle II.2, Supplement No.2 (1988): "Operation, numbering, routing, and mobile service. Recommendations E.100-E.333, Various tones used in national networks".

[9]   CCITT Blue Book, Volume V, Supplement No.2 (1988): "Telephone transmission quality - Methods used for assessing telephony transmission performance (Series P. Recommendations)".

[10]   CCITT Recommendation G.111 (1988): "Loudness ratings (LPs) in an international connection".

[11]   CCITT Recommendation G.121 (1988): "Loudness ratings (LPs) of national systems".

[12]   CCITT Blue Book, Volume V, Supplement No.10: "Telephone transmission quality (Series P. Recommendations)".

[13]   CCITT Recommendation P.37 (1988): "Magnetic field strength around the earcap of telephone handsets which provide for coupling to hearing aids".

[14]   CCITT Blue Book, Volume S, Supplement No.11 (1988): "Telephone transmission quality (P. Series of Recommendations)".

[15]   CCITT Recommendation P.11 (1988): "Effect of transmission impairments".

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

[17]   ETS 300 085 (1990): "Integrated Services Digital Network (ISDN); 3,1 KHz telephony teleservice, Attachment requirements for handset terminals (Candidate NET 33)".

3   The usability component model

The usability of a user-interface is related to specified users and to specified tasks in a specific environment.

The usability measure contains information on how well the interface/user combination is adapted to perform the task (the performance measures) and information on the user's attitude working with the interface (the attitude measures). More detailed information on the definition of the usability concept is contained in ETSI DTR/HF-3001 [1].

Designing and usability evaluation of a product includes the consideration of a large number of usability components each adding to the total usability of the product.

To be able to identify the relevant usability components, the following 3-dimensional model is used. The 3 dimensions are: user capabilities, user-system interface and application domains.

The user capabilities may be described by:

-        anthropometric factors, related to the measures of the human body;

-        motoric factors, related to the muscular strength of the human body;

-        perceptual factors, related to human perception, e.g. visual, auditive and tactile;

-        cognitive factors, related to processes in the human brain, e.g. thinking, learning, remembering and similar processes.

User-system interfaces may be described by:

-        physical interface, e.g. keyboard design, function buttons or graphic capabilities;

-        user input/output, terminal display and user input, e.g. screen displays, core commands or standard error messages;

-        user-interface dialogue, covering dialogue functions, application and communication functions, e.g. expressed by the menu structure or the state transition control.

For the application domain a number of related user-interface concepts can be identified e.g.:

-        simple telephone set;

-        business telephony;

-        interactive information services;

-        store-and-forward messaging;

-        network management and system administration;

realising that no single user-interface concept is appropriate for all application domains.

Graphically, the usability component model can be expressed as shown in figure 1.

Each cell on a frame represents a specific set of interface/user capability relations and each of the frames represent a user-interface related to a specific application domain.

A usability checklist for simple telephone sets should as a minimum include those usability components represented by the cells marked with full circles.

For more complicated telephone terminals, such as business telephones interworking both with branch exchanges and with the public telephone network or with mobile communications systems, the usability components represented by cells marked by broken or dotted circles should be included.
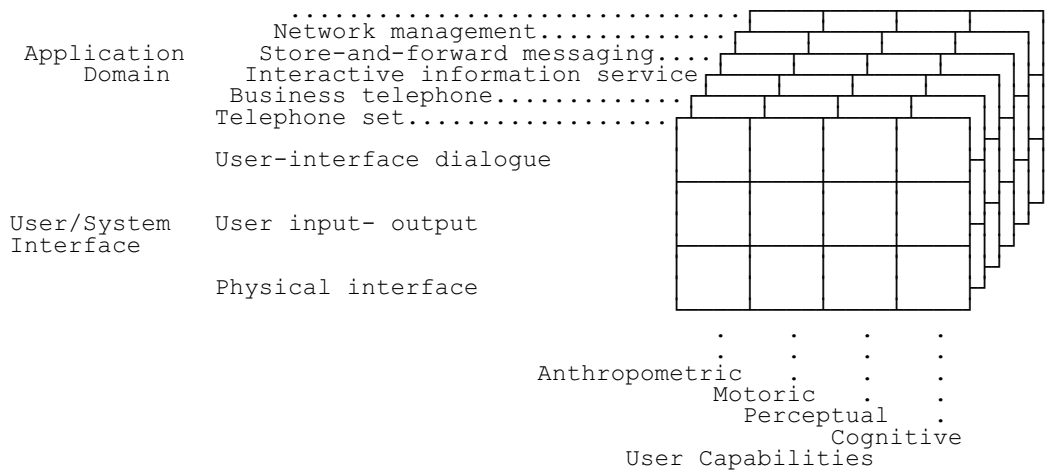
```
                    ..............................
                        Network management..............
   Application        Store-and-forward messaging....
       Domain        Interactive information service
                    Business telephone.............
                   Telephone set...................

                   User-interface dialogue


 User/System       User input- output
 Interface

                   Physical interface



                            .     .     .     .
                            .     .     .     .
                   Anthropometric  .     .     .
                            Motoric     .     .
                           Perceptual    .
                              Cognitive
                    User Capabilities
```

Figure 1: The usability component model

4 Usability checklist framework

When applying a usability checklist to a specific user-interface, information on user capabilities, the application performed and the specific environment shall be stated.

For a usability checklist for simple telephones the following is specified:

4.1 Context of use

A simple telephone set is intended for use in an office or household environment.

4.2 Intended usage

For the sake of simplicity, only the "generic" functionality of a telephone set is considered:

- setting up a call;

- receiving a call;

- performing voice communication;

- terminating a call.

4.3 Intended users

It is assumed that the users have learned the meaning of the tone signals and spoken messages used in the network. They also know the necessary procedures for operating the telephone set.

Special requirements of users with disabilities are not specifically addressed in this ETR.

4.4 Environmental requirements for use.

The telephone set is intended to be used in an environment where the physical access to the instrument, the light setting, the acoustic room noise level and electromagnetic disturbances do not have an impact on the functionality of the instrument.

5   Identification of usability components

For each of the applications it is possible by using the usability component model, to identify the usability components contributing to the usability of the telephone set's user-interface.

Setting up a call - lifting the handset.

Physical interface/anthropometric factors:

-        size of handset relative to human hand;

-        weight and balance of handset;

-        shape of earpiece.

User input - output/perceptual factors:

-        acoustic level of signalling tone.

Setting up a call - entering a telephone number.

Physical interface/anthropometric factors:

-        physical dimensions of dial/key pad.

Physical interface/motoric factors:

-        forces needed to activate dial/key pad buttons.

Physical interface/perceptual factors:

-        identification of numbers and letters related to dial/key pad buttons.

User input - output/perceptual/cognitive factors:

-        feedback (nature and timing) from push button activation.

User-interface dialogue/cognitive factors:

-        key pad configuration.

Setting up a call - call progress.

User input - output/perceptual factors:

-        acoustic level of tone signalling.

Receiving an incoming call.

Physical interface/anthropometric factors:

-        size of handset relative to human hand;

-        position of handset on the telephone set.

Physical interface/motoric factors:

-        weight and balance of handset.

Physical interface/cognitive factors:

- identification of the handset.

User input - output/perceptual factors:

- acoustic level of telephone bell/tone ringer, or perceptual characteristics of visual alerting signal.

User input - output/cognitive factors:

- understanding of incoming signal.

Performing voice communication.

Physical interface/anthropometric factors:

- shape and weight of handset.

User input - output/motoric factors:

- speech level needed for proper operation of the microphone.

User input - output/perceptual factors:

- acoustic level of speech signals in the telephone.

Terminating a call.

Physical interface/anthropometric factors:

- size and form of the cradle in relation to the handset.

6 The usability checklist

Based on the above analysis, a usability checklist for a handset telephone set with basic telephony functions has been developed. The checklist contains a number of statements and includes references to standards, guidelines and agreed design rules, for which each statement is known to assure good user performance and user satisfaction.

6.1 Statement 1: Size and shape of the handset

> A usability goal is that the handset shall be convenient to hold in the hand during conversation.
>
> The size of the handset shall allow sufficient room for the fingers that hold it.
>
> The shape of the handset shall make it possible to place the receiver and the microphone correctly relative to the human ear and to the human mouth. The shape of the earpiece shall ensure an appropriate sealing to the human ear.

The size and the shape of the handset can be evaluated in comparison with CCITT Recommendation P.35 [2].

6.2 Statement 2: Weight and balance of the handset

> The weight of the handset has a preferred value in the range 150 to 200 grammes (excl. weight of the cord), and the preferred balance is the weight being distributed equally between the microphone end and the receiver end.

See E.T. Klemmer and K.A. Haig: "Weight and balance of a new telephone handset". Applied Ergonomics 1988, 19.4, 271-274 [3].

6.3 Statement 3: Physical dimensions of dial/key pad

> The usability goal is that the signalling from the dial or from the key pad of the telephone instrument is performed without any errors caused by imprecise stopping of the dial or by the user pressing two or more buttons at the same time. A "pip" on the "5" button may improve orientation on the key pad.

Key-pad dimensions can be evaluated in comparison with ISO/DP 9241 part 4 [4].

6.4 Statement 4: Acoustic level of signalling tones

> The usability goal is that the signalling tone is presented to the user at an acoustic level sufficient to identify the specific tone.

Guidelines concerning technical characteristics of tones for the telephone service are found in CCITT Recommendations E.180 [5], E.181 [6], E.182 [7] and CCITT Fascicle II.2 Supplement No.2 [8].

6.5 Statement 5: Electro-acoustic sensitivity for sending and receiving

> The electro-acoustic sensitivity for sending and receiving of a telephone set normally shall comply with the national transmission plan.
>
> Other factors contributing to the usability, e.g. sound quality, need not to be subject to a mandatory approval.
>
> One usability goal is that the speech in the telephone receiver has a level equal to "Preferred Listening Level". This can be achieved by introduction of a volume control on the handset.
>
> Another usability goal is that conversational information can be interchanged at the user's natural speech level.

The transmission performance of the telephone set can be evaluated in comparison with the following CCITT Recommendations:

CCITT Blue Book, Vol. V - Supplement No.2 [9] specifies possible measuring methods.

CCITT Recommendations G.111 [10] and G.121 [11] deal with the transmission quality, i.e. loudness ratings for international and national telephone connections, respectively.

Design considerations for telephone sets are contained in CCITT Blue Book, Volume V, Supplement No. 10 [12]. Inductive coupling to hearing aids shall comply with CCITT Recommendation P.37 [13].

6.6 Statement 6: Sidetone attenuation

> The sidetone attenuation prevents the user's speech from being transmitted from the microphone to the user's own receiver.
>
> Sidetone affects the talking level of the user and may impair the conversation in environments with high-level room noise.
>
> The usability goal is that no adverse sidetone effects are identified during a conversation.

The sidetone attenuation of a telephone set can be evaluated in comparison with CCITT Blue Book, Volume V, Supplement No.11 [14] and CCITT Recommendation P.11 [15].

6.7 Statement 7: Size of numbers and letters on dial/push buttons

> The usability goal is that numbers and letters on the dial or on the key pad can be identified visually by the user without any difficulty.
>
> In all push-button dials, the figures, letters and symbols should be unambiguously associated with the corresponding buttons, preferably, if adequate space is available, by being on the faces of the buttons themselves.

The size of numbers and letters can be evaluated in comparison with the recommendations given in ISO/DP 9241-4 [4].

Position of figures, letters and symbols on push-button sets. See CCITT Recommendation E.161 [16], § 3.6.

6.8 Statement 8: Key pad lay-out

> The usability goal is that the configuration of buttons and the arrangement of figures, letters and symbols on the telephone set shall correspond to the user's achieved experience.

The dial/key pad lay-out can be evaluated in comparison with CCITT Recommendation E.161 [16].

6.9 Statement 9: Push button operation feed-back

> A general ergonomic principle is that action on a user interface shall be followed by some "acknowledgement" signal. The usability goal is that actuation of a key should be accompanied by tactile or auditory feedback or both. If the design allows for only one then the tactile feedback is to be recommended.

Tactile and auditory feedback can be evaluated in comparison with ISO/DP 9241-4 [4], subclause 6.2.4.

6.10 Statement 10: Incoming call indication

An incoming call is indicated by a sound signal coming from a telephone bell or from a tone ringer. Indication by a light signal may also be used.

The usability goal is that the signal in a specific environment is able to attract the attention of the user.

It is recommended that the intensity of an auditory or visual indication can be adjusted to adapt to the user in the specific environment.

The usability goal is that the intensity of an indication can be adjusted to the user's preferred level in the environment where it is used.

In an environment with several telephone sets, it is recommended that the acoustic character of an indication can be changed making it possible to distinguish between indications from different telephone sets.

The usability goal is that the character of an indication can be varied in such a way that a user can distinguish between indications from different telephone sets.

Audible alerting indications can be evaluated in comparison with ETS 300 085 [17], specifying minimum and maximum sound pressure levels.

6.11 Statement 11: Answering and terminating a call

Usually, a telephone set is activated by lifting the handset from the cradle. Some telephone sets are activated by operating a switch e.g. on the handset.

Correspondingly, answering and terminating a call is normally done by lifting and replacing the handset.

A usability goal is that the position of the handset and the mode of operation is clearly indicated to the user.

Another usability goal is that the connection function is secure e.g. by including an indication to the user or by having a proper size and form of the cradle in relation to the handset.

At present there is no rule or recommendation available for checking the degree of conformance with this statement.

Annex A (informative): Usability checklist for telephones - list of additional information

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History

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