Technology for the independent living of people with activity limitations

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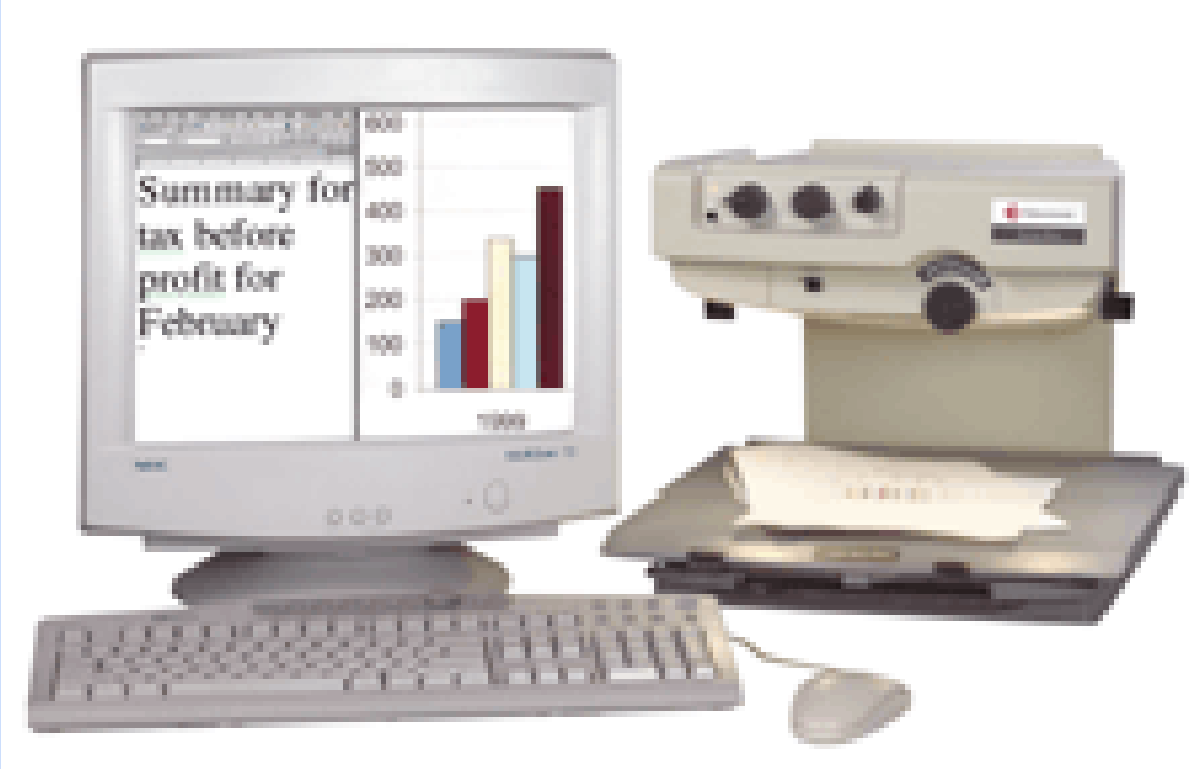
The traditional approach - accessibility

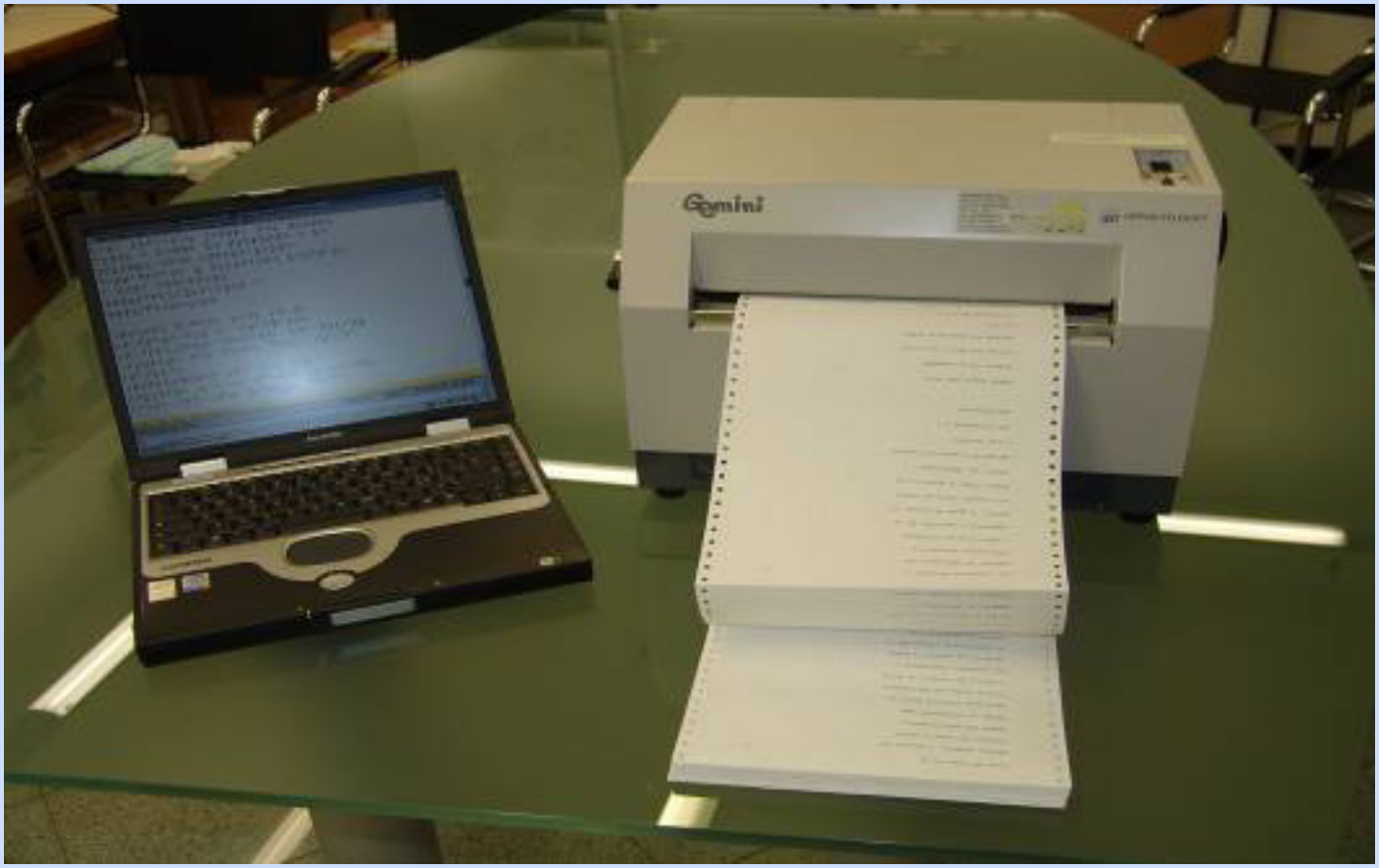
- Traditionally, inclusion in the ICT environment (eInclusion) has mainly been considered a problem of accessibility to systems and services
- Accessibility problems have been solved with adaptations (e.g. by changing the interface) using Assistive Technology (AT) products to allow access to ICT equipment and services
- AT products have been utilised for the adaptation of new technology (e.g. by changing the interface) in order to allow access to equipment and services and to use the new technology to grant people with activity limitations abilities not yet possible (e.g. people with visual limitations writing and controlling what they have written).

Image-enlarging video systems



Braille displays

Braille printers



Braille PDA

- PDA with Braille display and synthetic speech. It allows:
  - To take notes
  - To read documents and books using the Braille display or the speech synthesiser
  - To manage a calendar and lists of contacts
  - To make computations
  - To control a cellular phone via the Bluetooth connection
  - To listen to music and spoken books
  - To record voice notes

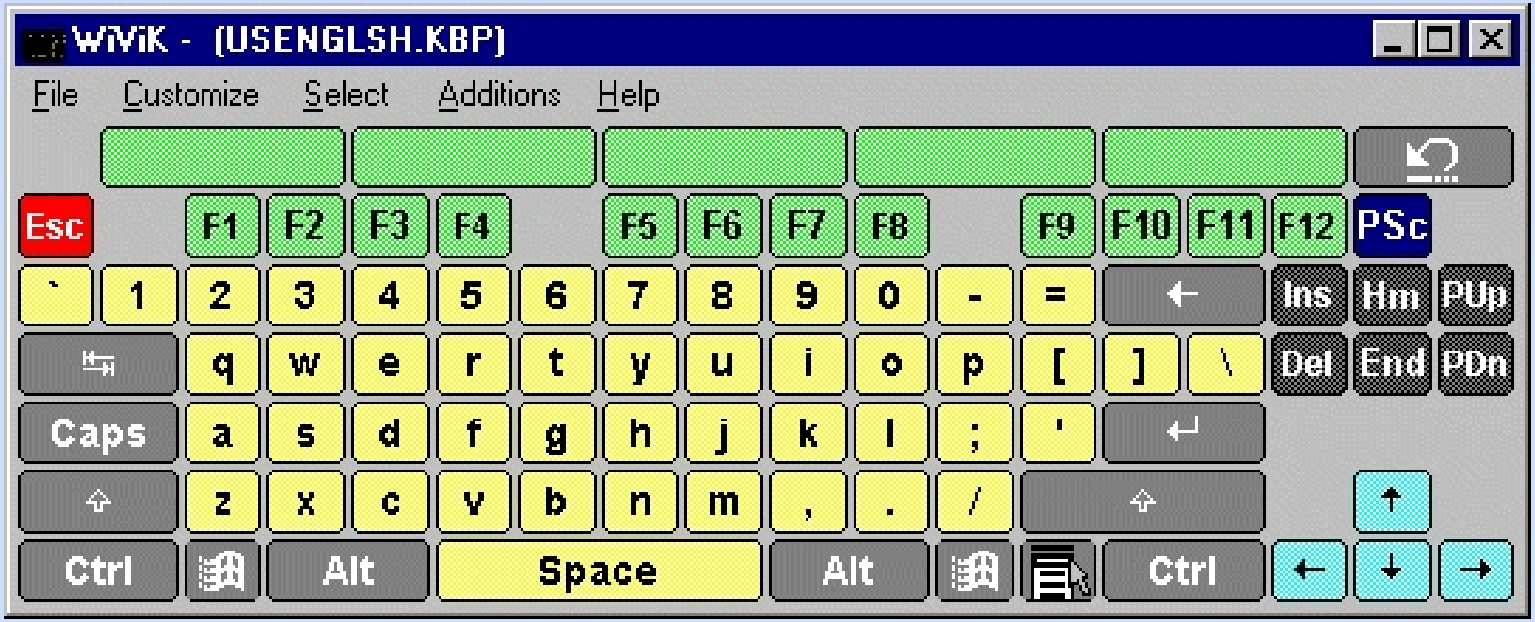
Mouse emulator

Expanded keyboard and mouse emulator

Dimensions 54x27.8 cm

Mouse emulator

Software keyboard



The software (WiViK2 REP) includes word prediction and expansion of abbreviations

GRID communicator

- The Grid software allows the design of grids with symbols, words and sentences
- The communication grids can be used as virtual keyboards on the screen or, when printed, as overlays for stand-alone communication systems
  - Examples: symbolic communicator, textual communicator and virtual keyboard

Universal access

- **Right of all citizens of being included in the emerging information society**
  - **Irrespective of functional, sensorial or cognitive activity limitations due to impairments, age or contextual situations**

The emerging approach - Why

- **Three components**
  - **Social attitude – Generalised definition of eInclusion**
  - **Technology – Emergence of the Information Society as an "Ambient Intelligence" environment**
  - **Rehabilitation – "International Classification of Functioning, Disability and Health" (ICF) published by the World Health Organisation (WHO)**

The social component - eInclusion

- *"e-Inclusion" means both inclusive ICT and the use of ICT to achieve wider inclusion objectives.*

  (excerpts from Pt. 4 MINISTERIAL DECLARATION APPROVED UNANIMOUSLY ON 11 June 2006, Riga) .

- **This means *not only* that ICT must be inclusive (mainly accessible), *but also* that ICT can be used explicitly to address some problems of people offering functionalities (services) that are themselves accessible and useful (e.g. alarm services etc)**

Measures related to eInclusion

- e-Europe 2002 Action Plan
  - Action line “Participation of all in the knowledge economy” assigning targeted objectives in the areas of “design for all” and “public Internet access points”
- e-Europe 2005 Action Plan
  - eInclusion underlies the priority given to modernisation of on-line public services (e-government, e-health and e-learning)
- i2010 Action Plan
  - eInclusion is supposed to be one of the key policy priorities through proposed specific activities

The technological component - IST

- Fusion of telecommunications, information technology and media industry
- Blurring, from the user perspective, of the border between access to information, interpersonal communication and environmental control in all living contexts

Information society

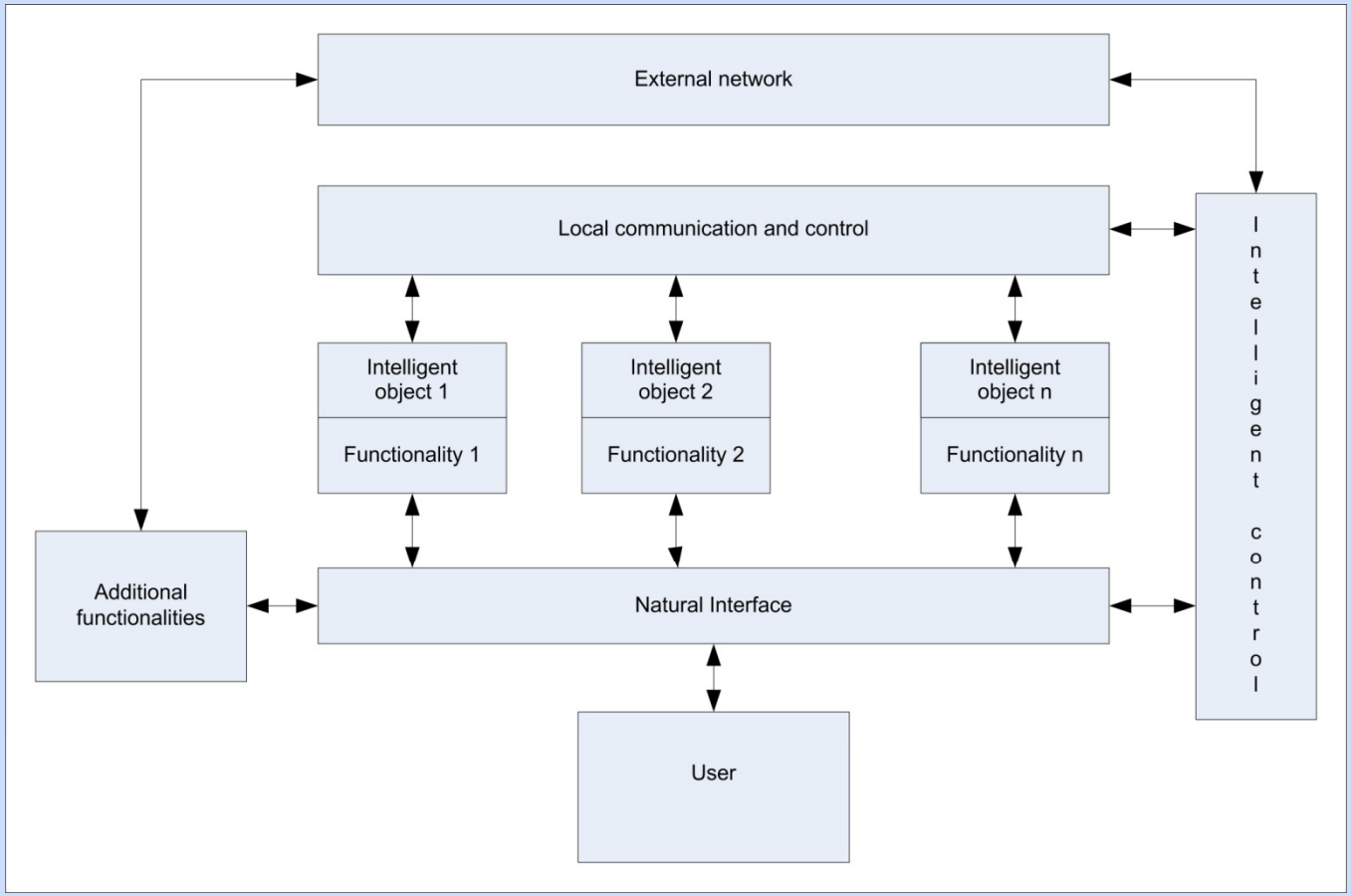
Information society (AmI) 1/2

- Not an increased use of computers and terminals as presently available
- But an 'Ambient Intelligence" (AmI) environment populated by a multitude of intelligent devices, no longer perceived as computers, but rather as augmented elements of the physical environment offering useful functionalities
  - Hand-held and wearable personal (e.g., wrist-watches, bracelets, personal mobile displays and notification systems, health monitors)
  - Public in the surrounding environment (e.g., wall-mounted displays)

Information society (AmI) 2/2

- Computational power and interaction peripherals are distributed and equipped with facilities for multimodal interaction and alternative input/output, including
  - E.g., voice recognition and synthesis, pen-based pointing devices, vibration alerting, touch screens, input prediction
  - Accessories facilitating alternative ways of use (e.g., hands-free kit)

Ambient Intelligence (AmI)



Intelligent office

Intelligent house

Emergence of the AmI environment

- (1) Environments which contain intelligent objects
- (2) Environments which contain intelligent, communicating objects – environments contain appliances and objects which function intelligently in their own right and which also exchange information between one another to increase functionality
- (3) Connected environments – environments connected with internal and external networks, allowing interactive and remote control of systems, as well as access to services and information
- (4) Learning environments – patterns of activity in the environments are recorded and the accumulated data are used to anticipate users' needs and to control the technology accordingly
- (5) Attentive environments – the activity and location of people and objects within the environments are constantly registered, and this information is used to control technology in anticipation of the occupants' needs

The situation today

- So far most of the AmI activity has been in introducing intelligence in the single objects, in interconnecting them and in developing natural interactions with the objects themselves and with the environment trough them
- Since broadband is becoming more widespread, available smart environments are shifting within the hierarchy from environments which contain intelligent, communicating objects to connected environments
- AmI will materialise when the individual AmI-like islands will merge and when enough intelligence will be available to guarantee functionality and security of the infrastructure and the corresponding services throughout the entire society

The rehabilitation perspective - ICF

- New WHO “International Classification of Functioning, Disability and Health (ICF)”, where a balance is sought between a purely medical and a purely social approach to the identifications of problems and opportunities for people in their social inclusion
- When dealing with the problems of people who experience some degree of activity limitation or participation restrictions, “ICF uses the term disability to denote a multidimensional phenomenon resulting from the interaction between people and their physical and social environment

The rehabilitation component - ICF

- People may have impairments, activity limitations or participation restrictions that characterise their ability (capacity) to execute a task or an action (activity), but their performance is influenced by the current environment. This is very important, because it allows grouping and analysis of limitations that are not only due to impairments.
- The environment can increase the performance level over the capacity level (and therefore is considered a facilitator) or can reduce the performance below the capacity level (thus being considered as a barrier)
- People, irrespective of their ability in executing activities, may have different performances due to the different contexts. Therefore the environment must be structured in order to facilitate their performances.

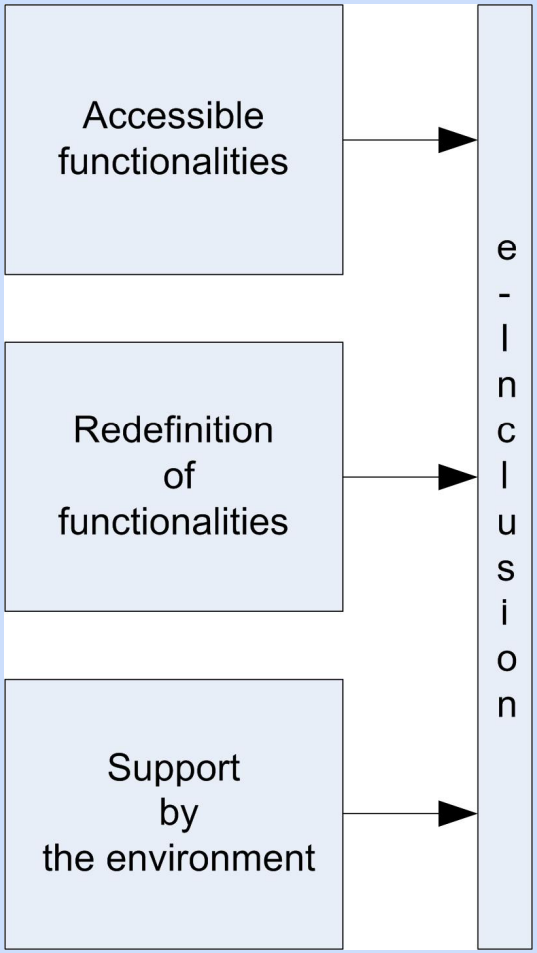
The rehabilitation component - ICF

- **WHO approach**
  - **Difficulties in carrying out activities are not only due to limitations of people but also to contextual factors**
  - **They can be alleviated not only augmenting the capacities of people or adapting systems and services, but also making available in the environment functionalities (services), which reduce the needed level of capacity**
- ***From* people with disabilities due to impairment *to* people with activity limitations due also to the context**

Change of paradigm

- ***From*** **equipment that is accessible or supports people *to* services and applications that offer useful functionalities to users**
- ***Emphasis*** **not on technology itself, but *on useful functionalities* that the environments could or should offer, irrespective of the real technical implementation**
- **Integrated support: artefacts in the environment are interconnected and integrated in *an "intelligent" control system*, which is able to support their cooperation for favouring eInclusion**

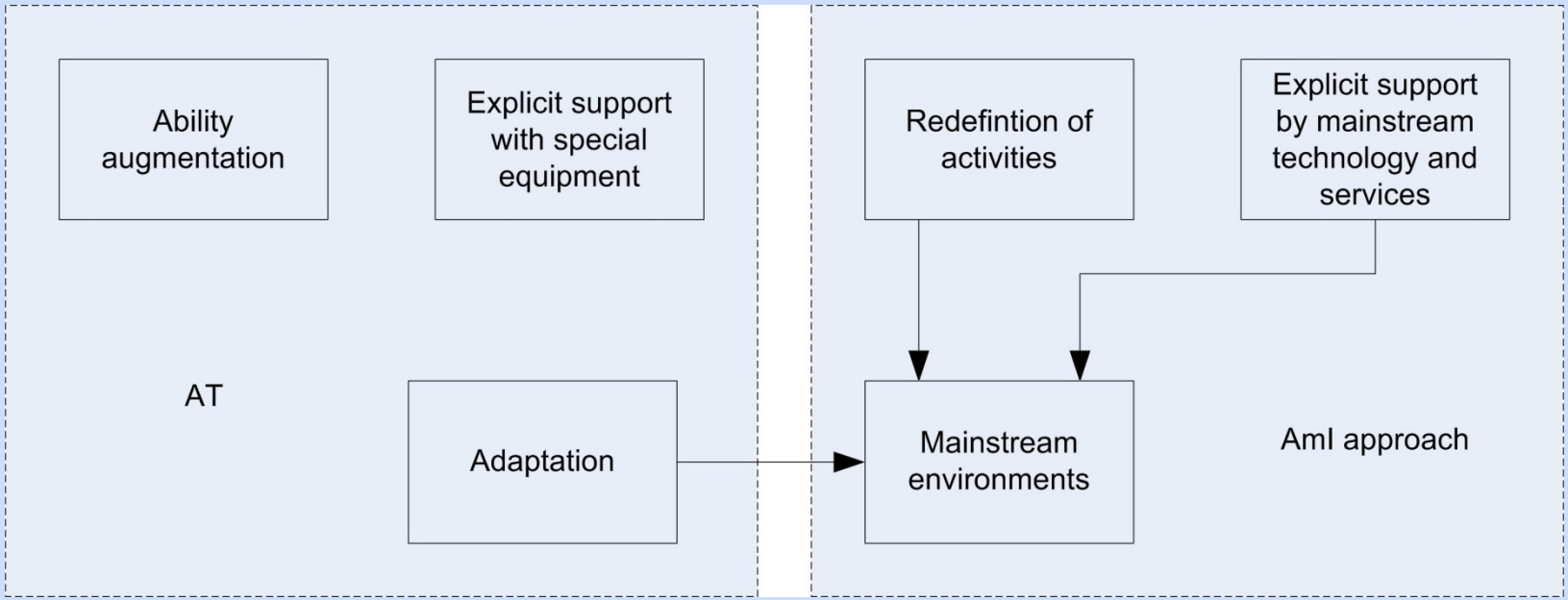
e-Inclusion approaches



Classical approach: design or adapt (Assistive Technology) functionalities for accessibility

Additional AmI approaches

Mainstreaming e-Inclusion



- ***From*** **adaptation of the user and the environment**
- ***To*** **design of usable environments**

Design for All (DfA)

- **Definitions**

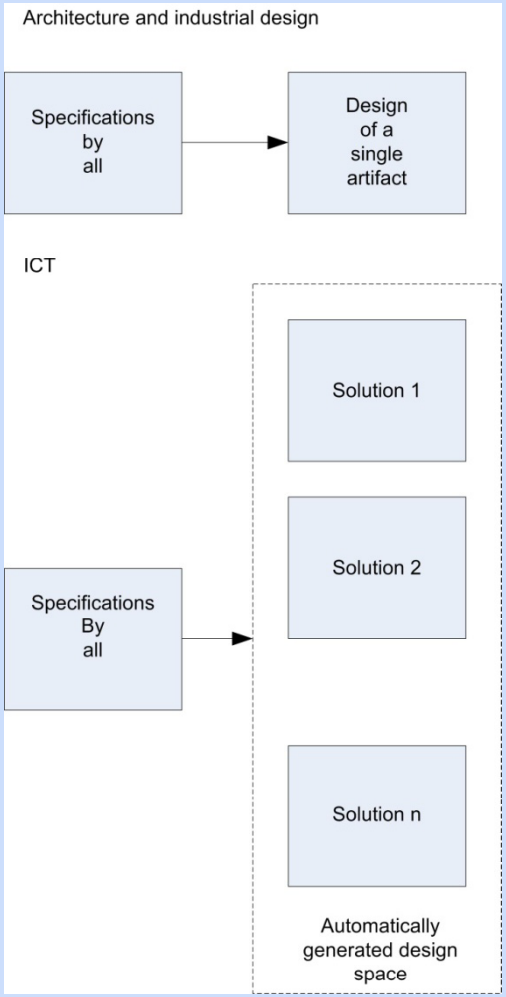
  The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design

  Ron Mace (adopted by the Trace Center)

  The design products, services, and environments so that as many people as possible can use them regardless of their age and physical characteristics -e.g., height, visual and hearing abilities, and arm mobility

  Fujitsu

DfA in ICT - Methodology

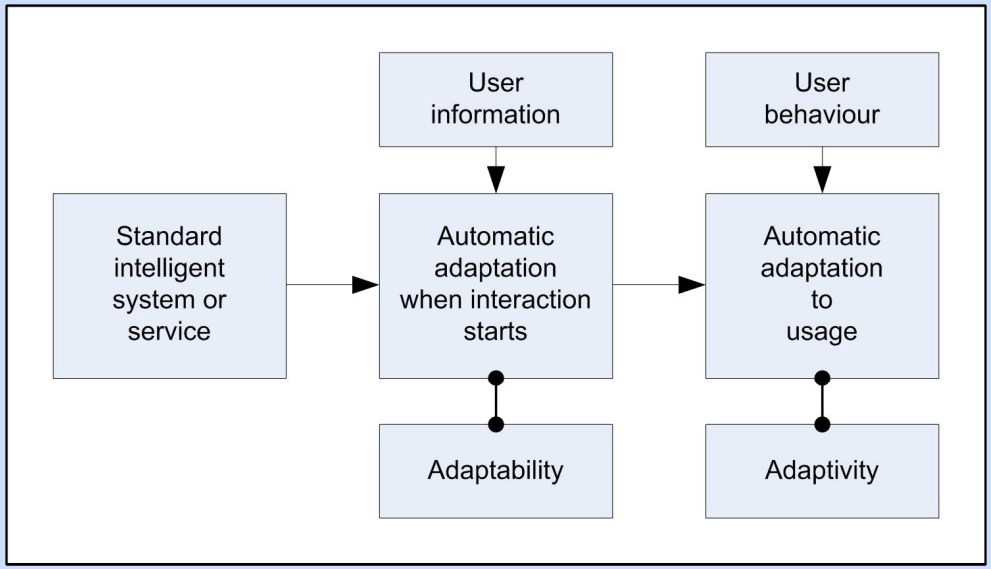


Design of an artefact (e.g. a building) usable by all users.

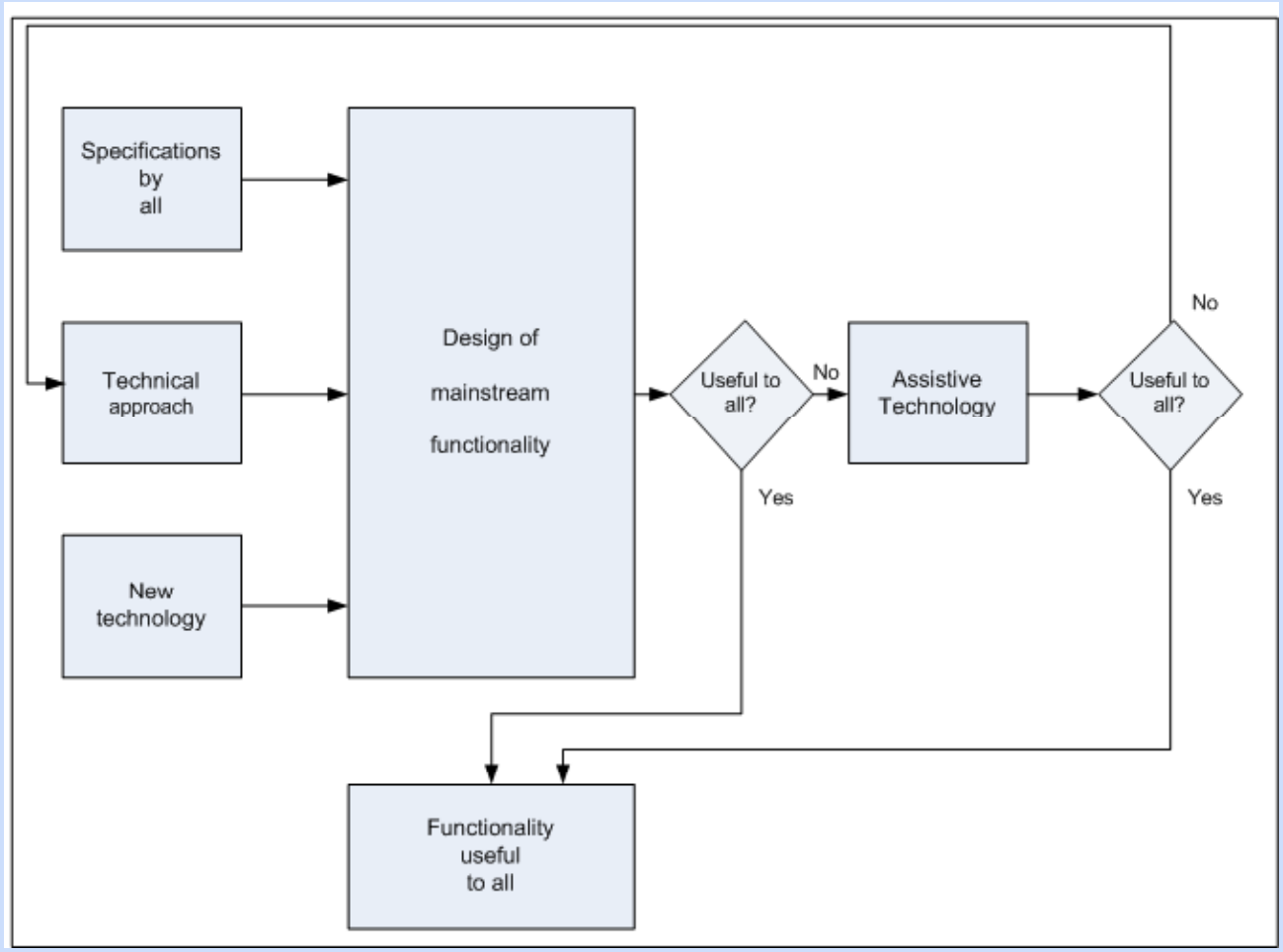
In ICT the outcome of the process is not intended to be a singular design, but a design space populated with appropriate alternatives, together with the rationale underlying each alternative, that is, the specific user and usage context characteristics

DfA in ICT -Technical approach

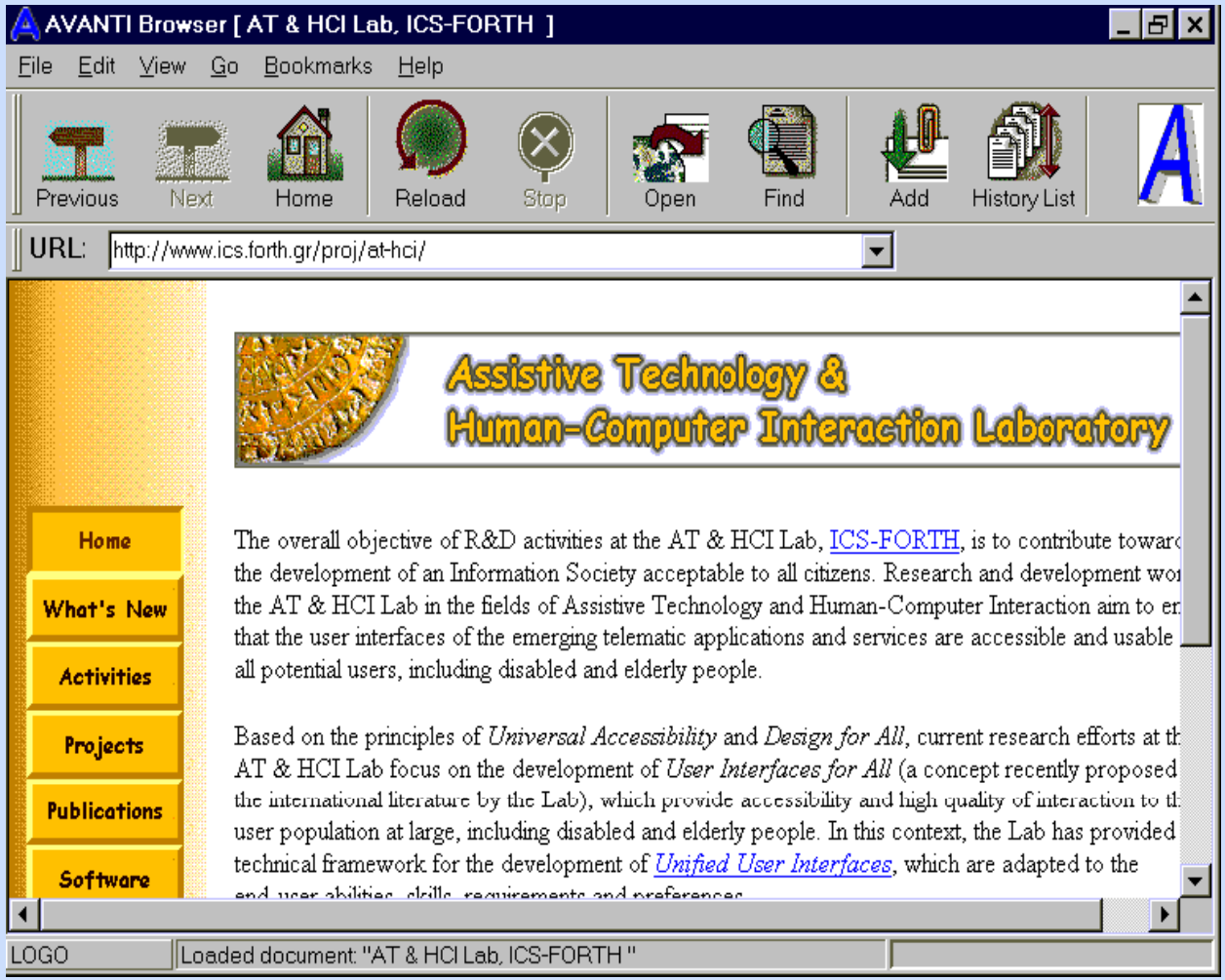
- **An approach proposed in a sequence of European projects is based on the concepts of adaptability and adaptivity. The central idea is that the variety of possible users and contexts of use can be served only if the systems and services are able to adapt themselves automatically to the needs, requirements and preferences of every single user. The adaptation must be guaranteed at run time (adaptability) and, dynamically, during interaction (adaptivity).**



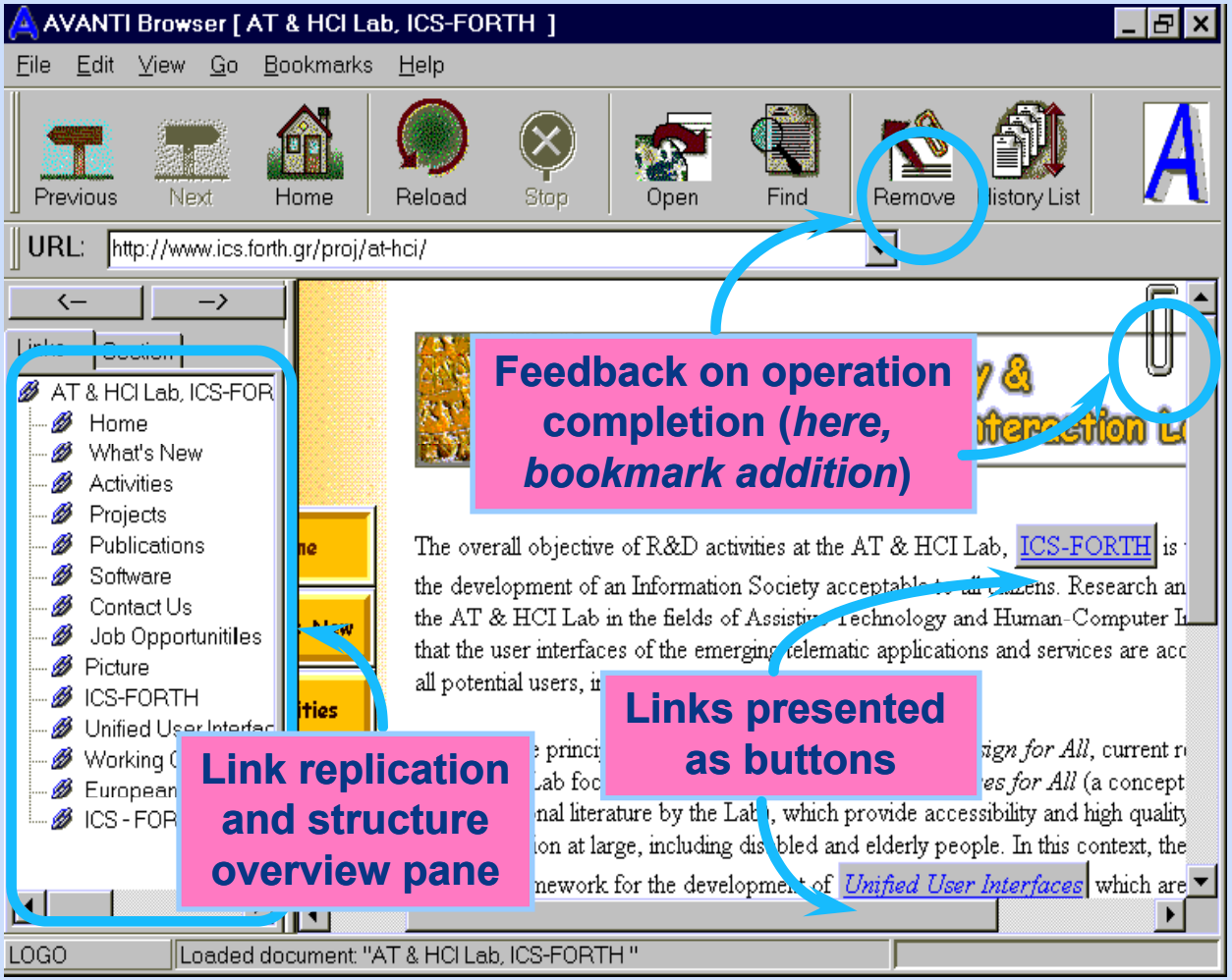
AT and DfA


Specifications by all
Technical approach
New technology
Design of mainstream functionality
Useful to all?
No
Assistive Technology
Useful to all?
No
Yes
Yes
Functionality useful to all

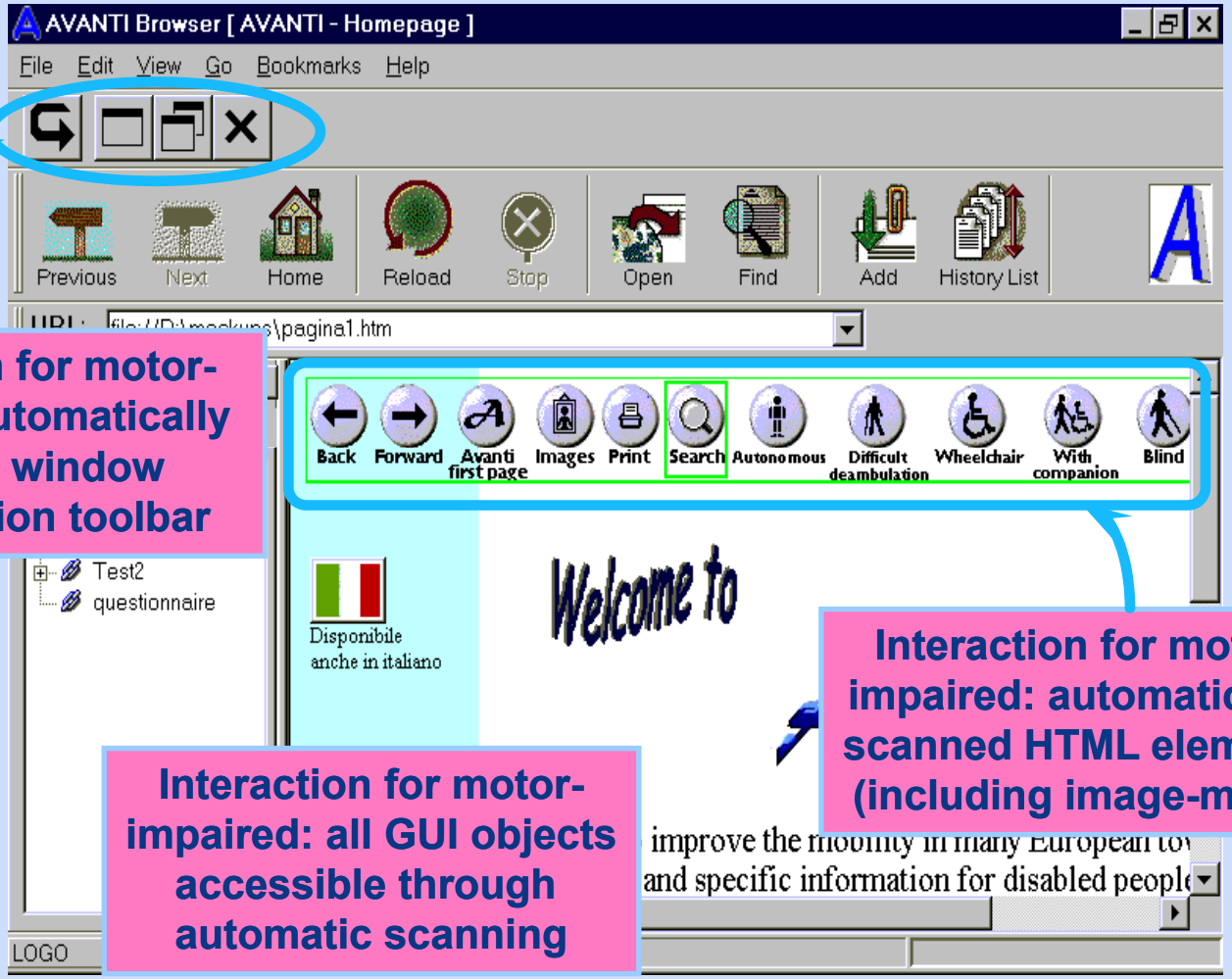
Typical browser



Adaptability – examples (1/4)



Adaptability – examples (2/4)

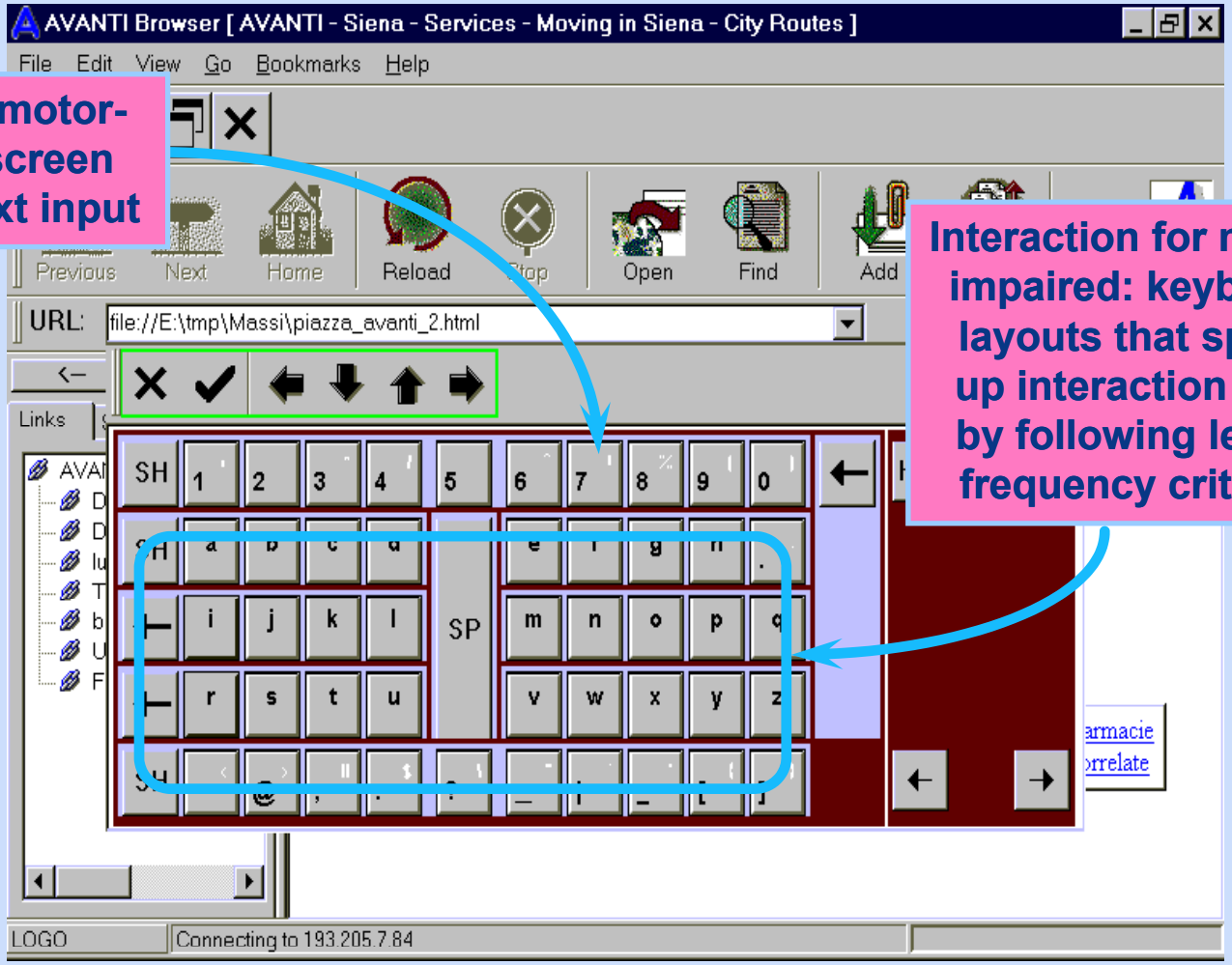


Interaction for motor-impaired: automatically scanned window manipulation toolbar

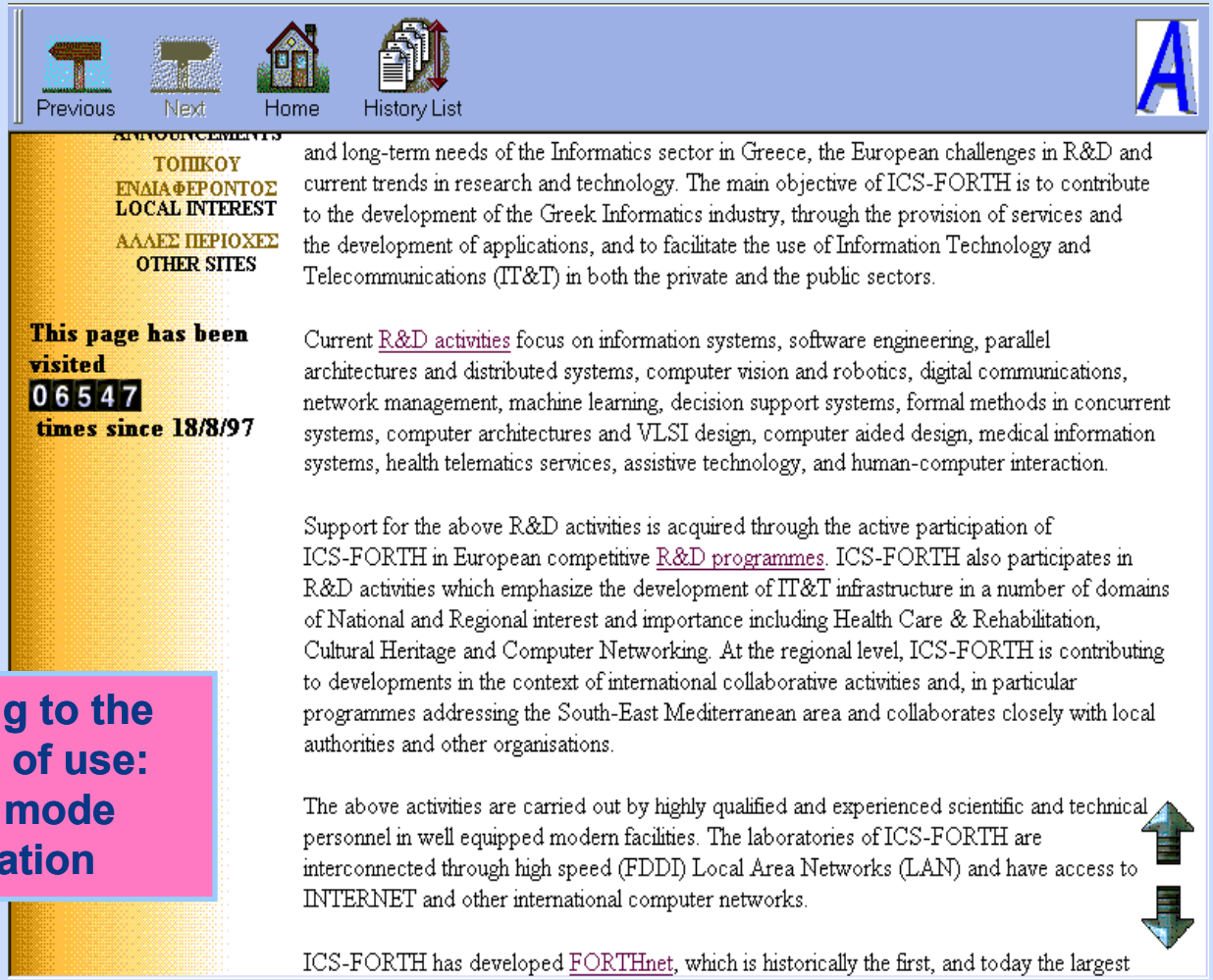
Interaction for motor-impaired: automatically scanned HTML elements (including image-maps)

Interaction for motor-impaired: all GUI objects accessible through automatic scanning

Adaptability – examples (3/4)

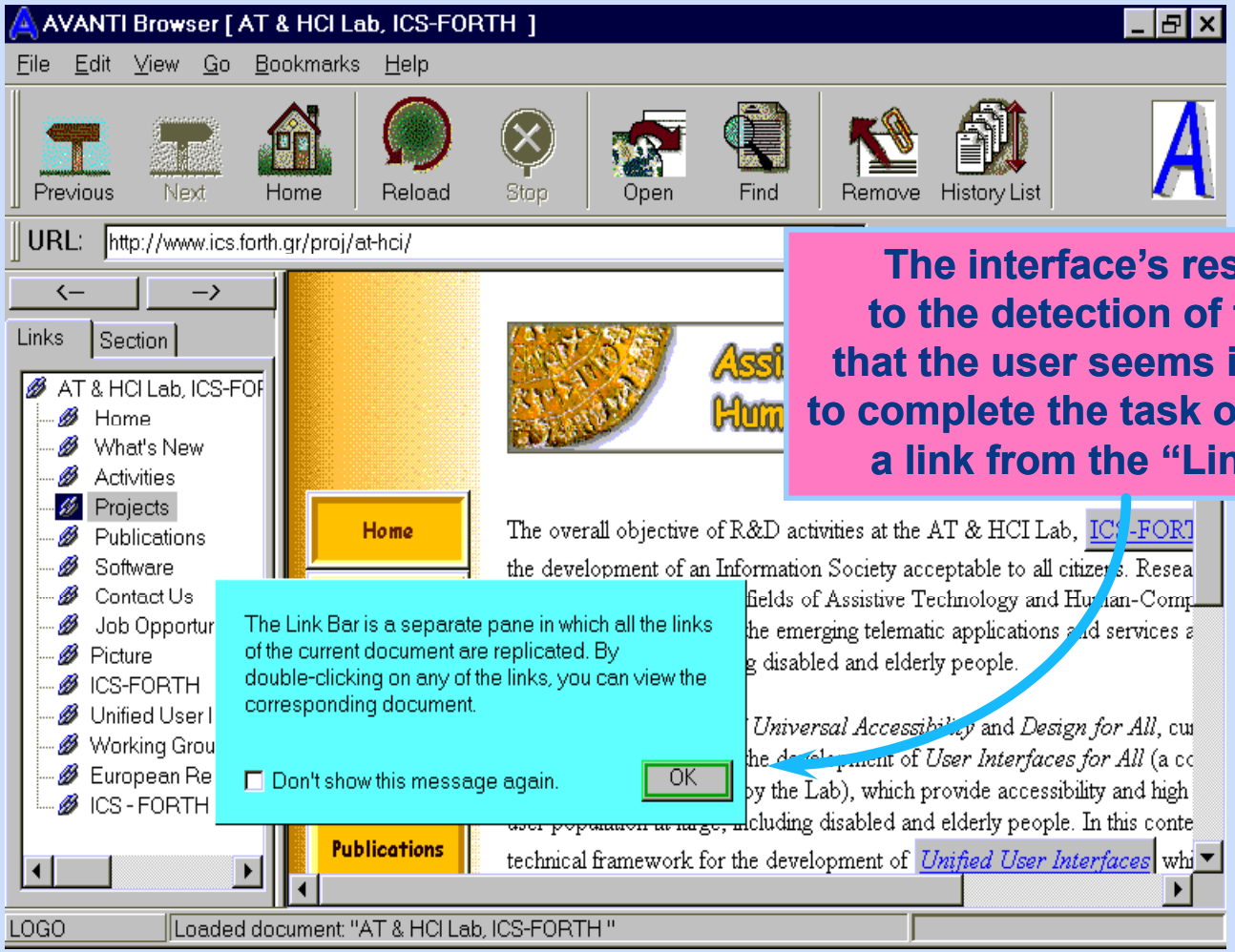


Adaptability – examples (4/4)



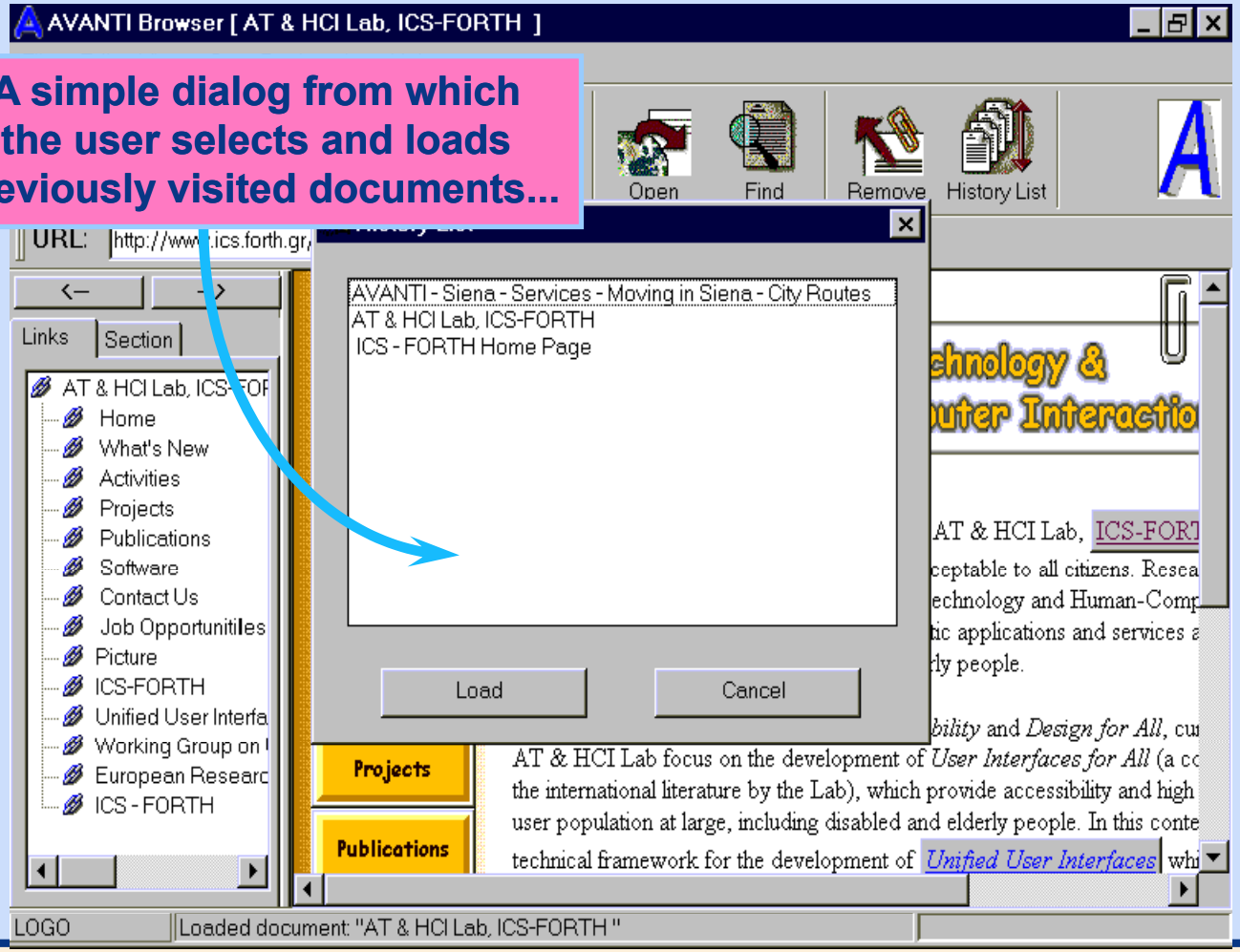
Adapting to the context of use: kiosk mode operation

Adaptivity – examples (1/3)

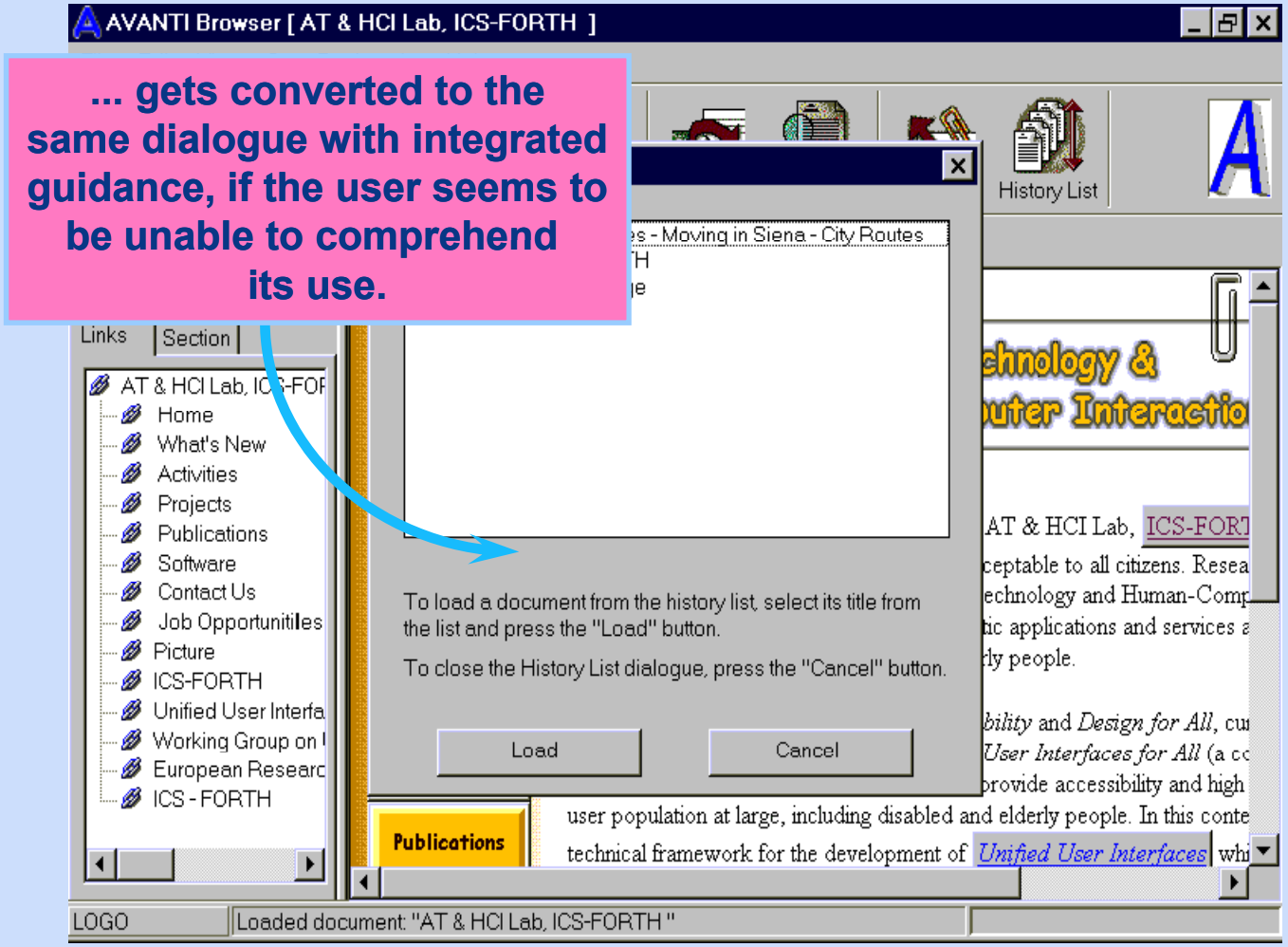


The interface's response to the detection of the fact that the user seems incapable to complete the task of selecting a link from the "Link Bar"

Adaptivity – examples (2/3)



Adaptivity – examples (3/3)

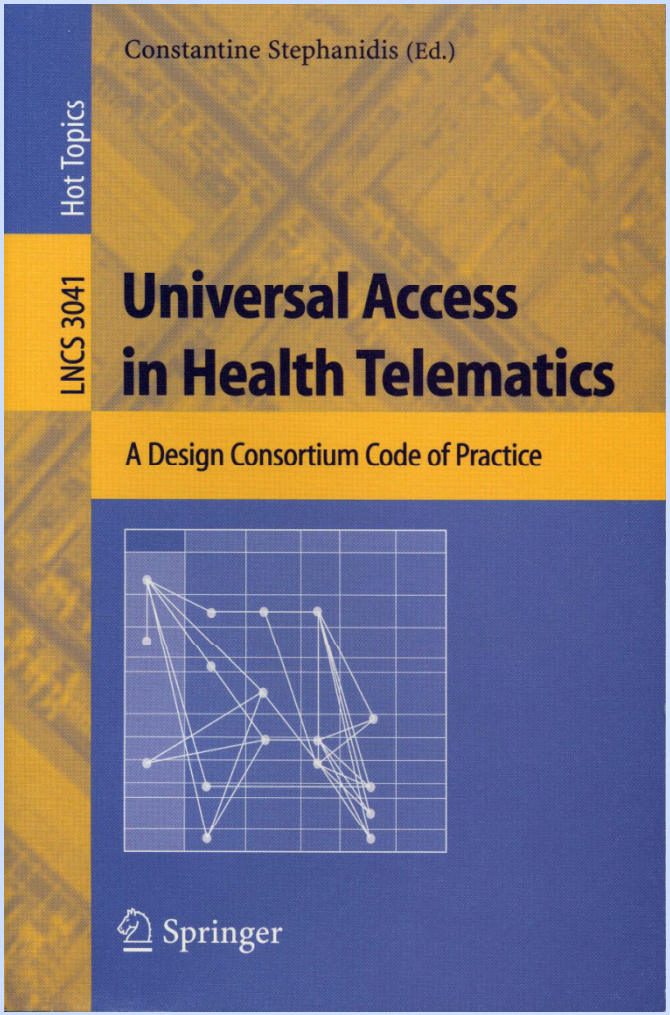


Thematic Network IS4ALL

Information Society for All – IST

- **Objectives**
  - **Development of the basic concepts of universal design (design for all)**
  - **Transfer of corresponding concepts in a new application environment**
    - **From accessibility of people with disabilities**
    - **To hospital information system**
  - **Duration: 2001 - 2003**

Thematic Network IS4ALL



ISTAG scenarios 1/2

- Scenarios for Ambient Intelligence in 2010 (ISTAG – Information Society Technology Advisory Group)
  - Views of a potential future, based on the developments in technologies, society, the economy and networks which are necessary for implementing an environment in which the scenarios could actually become a reality

Functional specifications

- The ambient intelligence environment must be
  - personalized (i.e. it can recognize the user, and its behaviour can be tailored to the user's needs)
  - adaptive (i.e. its behaviour can change in response to a person's actions and environment)
  - unobtrusive (i.e. many distributed devices are embedded in the environment, and do not intrude into our consciousness unless we need them)
  - anticipatory (i.e. it anticipates a person's desires and environment as much as possible without the need for mediation)
- Emphasis on greater user-friendliness, more efficient support of services, user-empowerment, and support for human interaction and group cooperation

Position of the problem

- Analysis, through the ISTAG scenarios, of the potential impact and consequences of AmI for people with activity limitations (for example if they cannot see, hear, move independently, and manipulate objects or they do not have the required cognitive abilities) with respect to a "typical" user.

- The analysis is based on the following assumption

  - All the scenarios are considered as "true", that is, it is taken for granted that the technology and services are available with the foreseen characteristics.
  - The AmI environment is considered as available everywhere
  - The AmI environment is considered as continuously available (without faults)

Methodology

- The ISTAG scenarios are divided into activities, and some user groups having activity limitations are “virtually observed” while performing the corresponding necessary tasks

- User groups
  - People who cannot see at all
  - People who cannot hear at all
  - People with mild or moderate cognitive limitations: memory, language, orientation and problem solving problems that normally do not impede their independent living, suitably supported
  - People with manipulation problems, fixation problems and/or difficulties in expressing themselves using voice
  - People moving in a wheelchair, dealing only with their problems of access to information and interpersonal communication

Levels of analysis

- Three different levels
  - The basic technologies necessary for the deployment of AmI environments
  - The integration of the basic technologies in applications and services
  - The way users will interact with the AmI environment

Basic technologies

- Multimodal interactions and alternative input-output systems
- Automatic translation (real-time conversation between people speaking different languages)
- Special vibrating materials for alerting people
- GPS and other localisation systems
- Smart tag
- Gesture recognition
- Intelligent agents

AmI as a general facilitator

- Environmental control systems as an integral part of the living environment
- Relay services available by default in the Ambient Intelligence environment
- Pervasive and very sophisticated alarm and support/control systems
- Intelligence in the environment – E.g. if people have cognitive limitations (e.g., at home), AmI is able to guide them through the required actions:
  - Mild cognitive problems: AmI can remind and provide suggestions, just like a friend in the house
  - More severe problems: AmI can completely control the situation
- Emphasis on group cooperative activities

Interaction with the environment

- User in an AmI environment
  - User not able to see - audio messages
  - User not able to speak at all – use of gesture recognition or text
  - User not able to speak perfectly - voice recognition system trained to match the characteristics of the audio signal
  - Output be given in any modality matching to the capabilities of the user.

- Radical changes in the way in which interaction is accomplished
  - Shift of interaction from an explicit paradigm, in which the users' attention is on pre-defined tasks, towards an implicit paradigm, in which interfaces themselves proactively drive human attention when required toward heir inferred goals
  - Execution of single tasks will be left to intelligent computing units in the environment (task delegation) alleviating both the physical and the cognitive efforts required for interaction

Challenges

- Intelligence in the emerging environment
- Identification of how interaction will affect individual perceptive and cognitive spaces
- Complexity of the emerging environment from both a sensorial and cognitive perspective
- Clarification of the people's ability to cope with possible hyper-stimulation and the corresponding cognitive load
- Identification of the abilities of people, in order to balance the distribution of tasks between the user and the AmI environment itself
- Identification of the relevant social factors (e.g. privacy ad security)

Cost 219ter book

The EDeAN network

- European Design for All e-Accessibility Network
  - Established in 2002, in accordance with one of the specific goals of the eEurope 2002 Action Plan
- Mission
  - To help achieve the European accessibility objectives and to stimulate activities in Europe within the area of Design for All, with particular focus on ICT and e-Accessibility
  - To collaborate and liaise with various relevant national, regional, European and international networks, organisations and projects
  - To cooperate with the European Commission and all EU member states to achieve the above mentioned mission goals

EDeAN organisation

- Network of centres of excellence selected on the basis of common application criteria and selection procedures throughout Europe

- Composed of
  - NCCs (National Contact Centres)
  - Members (organised in national networks)
  - Observers (organised in mailing lists)

- Managed by a Steering Committee (NCCs)

DfA@eInclusion" Coordination Action

- Coordinator : Italian National Research Council
- Partners: The National Coordination Centres of the EDeAN Network
- Mission
  - To contribute towards the advancement of eInclusion in Europe through fostering design for all, by continuing, extending and enhancing previous efforts targeted to the creation of a sound Design for All (DfA) interdisciplinary theoretical framework of reference and a set of proven engineering practices

"DfA@eInclusion" Coordination Action

- **Strategic objectives**
  - **To support existing European initiatives to promote Design for All and in particular the European Design for All eAccessibility Network (EDeAN)**
  - **To enhance existing partnerships between academic, research, user, and industrial communities to promote e-inclusion through adopting and promoting effective DfA practices**
  - **To facilitate DfA knowledge spillovers across industry sectors and communities**
  - **To support the mainstreaming of accessibility in IST products and services through a series of dissemination activities**

Conclusions

- The Information Society is emerging as an AmI environment
- eInclusion is an important socio-economic goal of the developments of ICT in Europe
- Design for All is an important approach toward eInclusion
- The developments in the information society are toward cooperative activities, made possible by broadband network connections
- The emergence of the Information society as an AmI environment has the potentiality to favour integration of all if it is designed taking into account the capabilities, needs, requirements and preferences of all citizens (design for all)