Users with disabilities

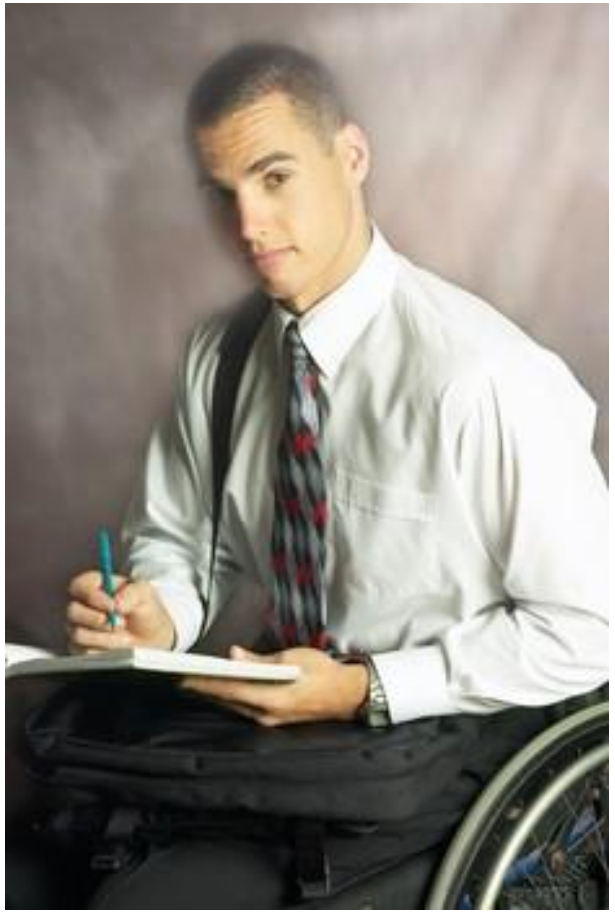
Disabled people using computers

People with special needs should have access to computers so that they are not discrimnated.

Some users can be disabled or elderly so the design of the interface should consider these factors.

Blind people could have help by using a ‘talking computer’ or using Voice Interfaces to input data into the computer. Blind people can use Braille keyboards to type in information.

Text can be increased in size to help visually impaired people,



Impairments

- Sensory
  - Full or partial loss of: sight, hearing, touch, smell, taste
- Mobility and co-ordination
  - Weakened or nonexistant: limbs, back, neck, breathing, dexterity
- Cognitive
  - Memory (short or long term), dyslexia/dyspraxia, behavioural
- And they can interact.

Users with disabilities

- visual impairment
  - screen readers, SonicFinder
- hearing impairment
  - text communication, gesture, captions
- physical impairment
  - speech I/O, eyegaze, gesture, predictive systems (e.g. Reactive keyboard)
- speech impairment
  - speech synthesis, text communication
- dyslexia
  - speech input, output
- autism
  - communication, education

… plus …

- age groups
  - older people e.g. disability aids, memory aids, communication tools to prevent social isolation
  - children e.g. appropriate input/output devices, involvement in design process
- cultural differences
  - influence of nationality, generation, gender, race, sexuality, class, religion, political persuasion etc. on interpretation of interface features
  - e.g. interpretation and acceptability of language, cultural symbols, gesture and colour

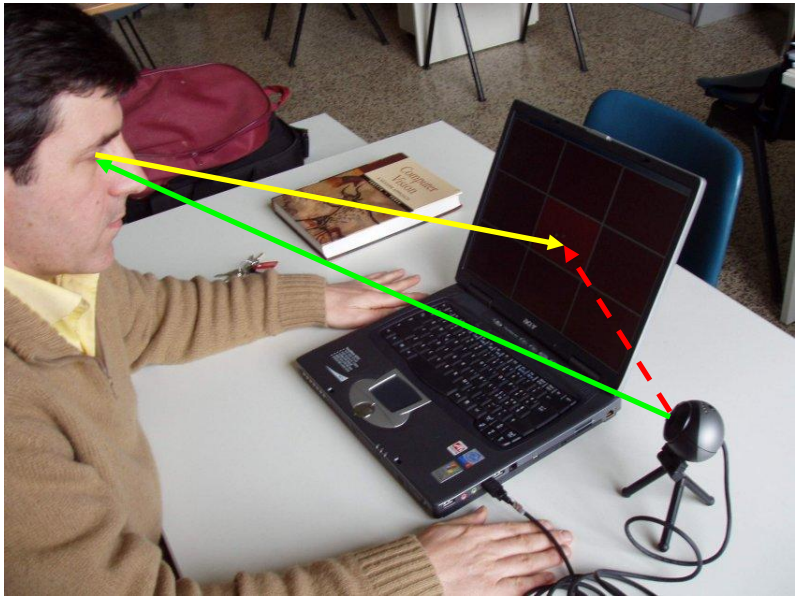
Text Input to Handheld Devices for People with Physical Disabilities

- Provide text entry for people with physical disabilities
- For handheld devices like Palm Pilots
  - Also called Personal Digital Assistants (PDAs)
- Also use Palm Pilots as interface to desktop computers

“EyeMouse”: An interaction device for severely motor-disabled people

EyeMouse

- Human-machine interaction system replacing the mouse with eye movements

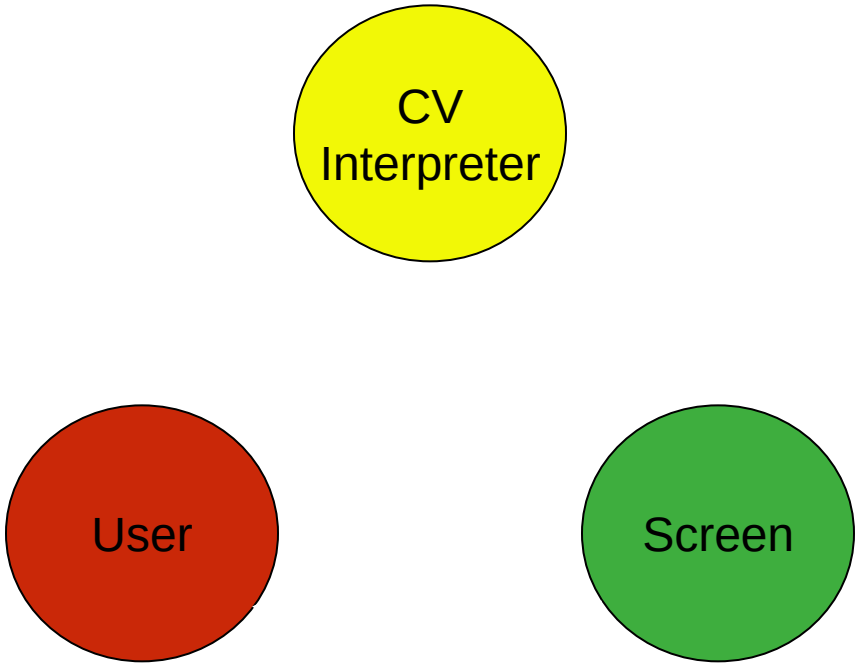


- Designed to exploit the residual mobility of severely motor-disabled people (e.g. multiple sclerosis)

Interaction

- User eye movements **are** captured through computer vision…

- …and then transformed into commands for the on-screen PC interface



Eye capture

- External eye and iris are captured by elastic template matching (*snakes*)

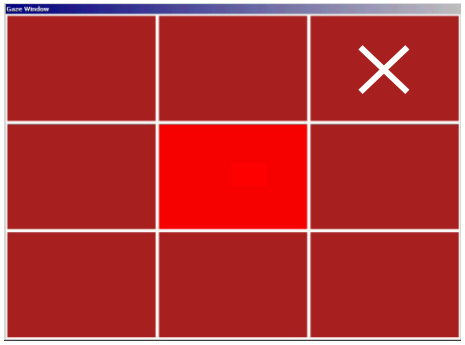
Snake template

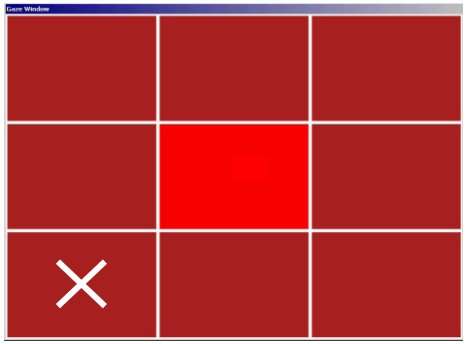
Eye remapping

- The iris position in the image is remapped onto the screen plane
- The image-to-screen map is calibrated at startup

Image plane

Screen plane





Mouse functionalities

- Navigation: eye movements
- Selection: eye persistence, eye blinks

- *Interface feedback compensates for slight remapping errors*


OLYMPUS

Scenario 1

- Female old age pensioner with
  - bad eyesight, but not tunnel or peripheral vision
  - some short term memory problems
  - some but not disabling arthritis
  - extremely polite, and unwilling to question.
- One to one teaching situation with you
  - learning keyboard skills, leading to learning email
  - keeps making mistakes
  - you discover on observation that it is mostly due to missing the return key about 15% of the time.
- We need a solution.

Solutions

1. Build a specialist keyboard for her.
2. Consider voice input.
3. … grid input, switch input, helper

4. Remap keyboard – (almost) all operating systems have a key to character table.
   - the cost is zero plus some time.
   - it is intrinsically generalizable.

Scenario 2

- Young man whose only stable movement is with his eyes. No speech
  - may be some cognitive damage
- Requirement – browsing and environmental control.
- You have tried head movement, switches on various body parts, joystick, all failed.
  - What do we mean by failed?

A Solution

- ***Mytobii*** eye following kit, http://www.smartboxat.com/mytobii.html
  - at £12k, moves curser, and blink is click.
- No good for text input.
- Add ***The Grid*** software, http://www.inclusive.co.uk/catalogue/acatalog/The_Grid_2.html
  - at ~£300, uses multiple mappable grids, so generalizable.
  - can be grid of characters, words, links, environmental commands….
  - browser links are handled directly (not through The Grid).

Scenario 3

- A skilled machinist loses strength and some dexterity, wishes to continue in his job.
- Numerical control (NC) machines are available.
- Solution
  - mapping of NC code to the appropriate HCI.
  - a ***The Grid***-like interface; later, voice control
  - training the machinist in the macro system so that she can write her own.

Scenario 4

- A personal assistant acquires a heavily wasting disease. After trying many interface mechanisms, a tracker ball under the chin is chosen.
- Two clamps, some wood and velcro solve the problem, along with a ***The Grid***-like on-screen keyboard. Cost: £8.50
- She retains her job.

Scenario 4 failures

- Voice input: voice too weak and variable.
- multiple buttons: hand or foot fatigue.
- ***Quadjoy*** http://www.quadjoy.com/ mouth operated joystick, suck is left click, blow is right click:
  - intrinsic hygiene problems
  - very important: personal perception of own disability
  - tools that appear technically to liberate may badly effect ones perception of oneself

Scenario 5 and 6

- Student with only peripheral vision
  - puts nose on the screen, and scans with eyes
  - can work for 10 minutes, then exhausted
  - **Solution. put screen on arm, move screen to nose. Cost, £40**.
- Wheelchair user in laboratory
  - had very expensive ramp built to get chair safely to lab bench height.
  - **Solution. put lab kit on ordinary desk**.
- These are examples of the KISS rule.

Scenario 7

- Blind person
  - no mobility problems
  - no keyboard skills
  - wishes full use of a computer
- Solution – specialist software
  - Use specialist audio feedback teaching software to learn keyboard
  - ***Jaws*** or others as screenreader at £700

Specialist software failures

- Most specialist software needs to catch characters “on the way” to the screen.
  - This means embedding a trap in the interrupt chain of the OS.
  - Think now of needing two specialist apps. Installation can be difficult.
- Reading presentation software cannot cope with pictures
  - Flash (unless specially edited), pdf, etc. cannot be easily read.
  - mathematics is a problem.

Button Failures

- A button is just an electrical contact.
- Athetoid (shaky) powerful person breaks “disability” buttons - £20 each few days.
- £350 industrial control button lasts 8 months.
- 53p micro-switch and two pieces of wood last about a year, and then micro-switch is replaced.

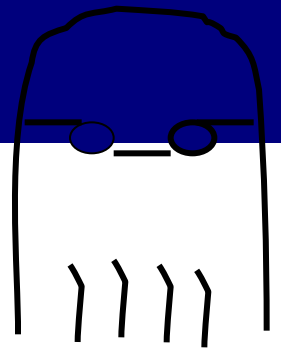
Button Successes

- Take an ordinary keyboard, and provide external contacts from keypad 8, 4, 6, 2
- Connect switches to computer via game port or other interface
- Use for any digital purpose.

Voice Failures

- Modern voice recognition software requires training in a voice.
- Voices can change over the course of a day's work through fatigue, for example.
- Multiple scenaria solves this.
- If you get angry with it, or have timing problems, it can fail.

Making Web Pages Accessible



Cute, but not much good for blind people

Assumptions

- You know why you want a web site
- You know who your audience is
- You know what you want to say
- You have prioritised the information you are trying to convey
- You have thought out how you wish the viewers to traverse that information

WHO WHAT WHEN WHERE WHY → HOW

Navigating

- Tension between
  - little or no scrolling
  - shallow hierarchy
- In-band and out-of-band navigation
  - navigation in the main body - maintenance problems
  - navigation in side or top bar - frame problems
- E-commerce sites need to control some navigational aims.

Who needs access?

- People with visual disabilities
- People with aural disabilities
- People with cognitive disabilities such as dyslexia
- People

Vision problems

- Need the fonts and colours adjustable
- Keep it simple
  - no frames, or simple use of frames
  - tables only for tabular information
  - simple (and often) navigation
  - ensure that there is an `ALT` text or alternative textual description for purely

-- use simple backgrounds, fonts and sizes.

Aural Problems

- What can I say?

•Don’t rely on sound.

Cognitive problems

- Use language correctly and simply
  - It is not a bad idea not to use double negatives
- Get your navigation right.
- Problem
  - for most people, fonts with serifs are best, for long texts.

The Big Tension

HTTP was designed to allow the user (the browser) control over the appearance, as opposed to the content, of a web page. Can be good for disability access.

Corporate users want total control over what and how the user sees and hears the material. Can be bad for disability access.

Note that this slide is bad for colour blind people.

Political Correctness

- Think that - if someone is offended by your work, then you have been offensive. Not always true, but…
- Where are the limits?
  - Saying nasty things about my religion
  - selling exotic things like truffles. Who knows, some day they may be sold to a soldier. Soldiers are bad, therefore truffles are bad.

To learn more..

There is a very good tool that will lead to further information. It is “Cynthia says athttp://www.contentquality.com/

It will not only actually check your site for you for accessibility, cross-browser compatibility, and speed of access,

“The source” is http://www.w3.org/WAI/GL/

A Simple Test

- Unplug the mouse.
- If the site works well from the keyboard you are successful in making an accessible sight.

..and more..

- One of the best studies of pathological HCI is Edwards, D.N., ed., Extra-*Ordinary Human Computer Interaction*, CUP 1995
- A commercial designer (of many) with the right idea
  - http://dreamink.com/design/
- For an entry into the psychology, try
  - http://kpope.com/
  - http://www.internettg.org/newsletter/dec98/banner_blindness.html - old but useful.

What is Web Accessibility

- Web accessibility means that people with disabilities can use the Web
- Disabilities including
  - Visual
  - Auditory
  - Physical
  - Speech
  - Cognitive
  - Neurological
  - Aging-related conditions

How People with Disabilities Using the Web

- Alternative keyboards or switches
- Braille and refreshable braille
- Scanning software
- Screen magnifiers
- Screen readers video
- Speech recognition

How People with Disabilities Using the Web (cont)

- Speech synthesis
- Tabbing through structural elements
- Text browsers
- Visual notification
- Voice browsers

Examples

- Blind – Audio description of a video
- Deaf – Captions accompanying audio
- Deaf & Blind – Text description of the audio and video to refreshable braille display
- Physical disability & Low vision – Speech input and speech output, and precise indicators of location and navigation.

Essential Components of Web Accessibility (cont)

- **users**' knowledge, experiences, and in some cases, adaptive strategies using the Web
- **developers** - designers, coders, authors, etc., including developers with disabilities and users who contribute content
- **authoring tools** - software that creates Web sites
- **evaluation tools** - Web accessibility evaluation tools, HTML validators, CSS validators, etc.

How the Components Relate

- Web **developers** usually use **authoring tools** and evaluation tools to create Web **content**.
- **People** ("**users**") use Web **browsers, media players, assistive technologies,** or other "**user agents**" to get and interact with the **content**.

Interdependencies Between Components

- There are significant interdependencies between the components; that is, the components must work together in order for the Web to be accessible.
- When accessibility features are effectively implemented in one component, the other components are more likely to implement them.

Guidelines for Different Components

The World Wide Web Consortium (W3C) Web Accessibility Initiative (WAI) develops **Web accessibility guidelines** for the different components.

Guidelines for Different Components (cont)

- Authoring Tool Accessibility Guidelines (**ATAG**) addresses authoring tools
- Web Content Accessibility Guidelines (**WCAG**) addresses Web content, and is used by developers, authoring tools, and accessibility evaluation tools
- User Agent Accessibility Guidelines (**UAAG**) addresses Web browsers and media players, including some aspects of assistive technologies

Accessibility Policy

- Guidelines
- Learn by examples

Quick Tips

1. **Images & animations:** Use the **alt** attribute to describe the function of each visual.
2. **Image maps.** Use the client-side **map** and text for hotspots.
3. **Multimedia.** Provide captioning and transcripts of audio, and descriptions of video.

Quick Tips (cont)

4. **Hypertext links.** Use text that makes sense when read out of context. For example, avoid "click here."
5. **Page organization.** Use headings, lists, and consistent structure. Use **CSS** for layout and style where possible.
6. **Graphs & charts.** Summarize or use the **longdesc** attribute.

10 Quick Tips (cont)

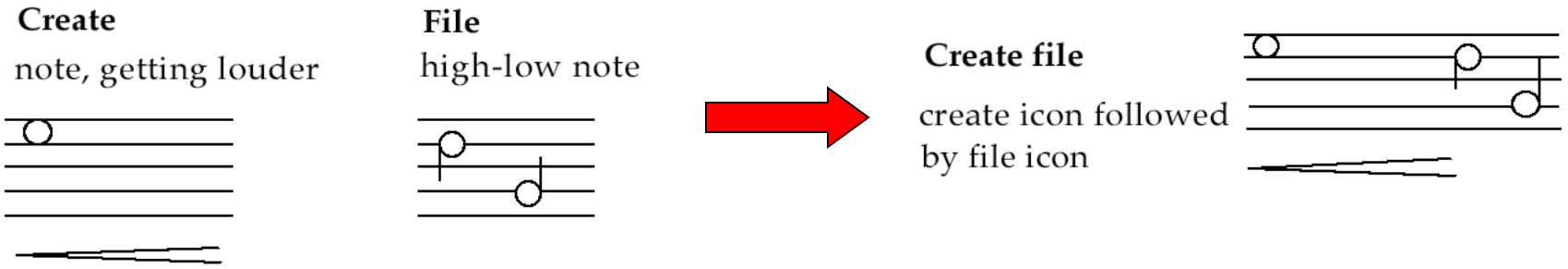
6. **Scripts, applets, & plug-ins.** Provide alternative content in case active features are inaccessible or unsupported.
7. **Frames.** Use the **noframes** element and meaningful titles.
8. **Tables.** Make line-by-line reading sensible. Summarize.
9. **Check your work.** Validate. Use tools, checklist, and guidelines at http://www.w3.org/TR/WCAG

References

- Web Accessibility Initiative (WAI)
- www.WebAIM.org
- www.cew.wisc.edu/accessibility

Earcons

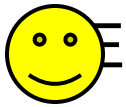
- Synthetic sounds used to convey information
- Structured combinations of notes (motives) represent actions and objects
- Motives combined to provide rich information
  - compound earcons
  - multiple motives combined to make one more complicated earcon



Earcons (ctd)

- family earcons

  similar types of earcons represent similar classes of action or similar objects: the family of “errors” would contain syntax and operating system errors



Earcons easily grouped and refined due to compositional and hierarchical nature

Harder to associate with the interface task since there is no natural mapping

What are the advantages of using sound in interfaces?

- sound is a natural means of presentation
- vision and hearing are interdependent
- the use of sound would reduce the load on the visual senses
- sound is attention grabbing
- most computers have facilities for the use of sound (which is generally underused)

Who might benefit from the use of sound in interfaces?

- users of graphical interfaces. Sound can provide extra information not displayed on the screen
- visually disabled people can be guided by the use of sound
- users of telephone-based interfaces; these users are totally dependent on sound
- users of interfaces where eyes are busy
- portable computer users, where sound can

What is the difference between Auditory Icons and Earcons?

- An Auditory Icon makes use of natural everyday sounds in order to represent objects and actions on the interface. For example, as a file is dragged across the screen the noise of paper scraping can be heard.
- An Earcon is a structured audio message based on musical sounds which conveys to the user information about the tasks being carried out. For example, while scrolling up and down a page the user gains information on their place in the document. At the top of the document the pitch of the note given is high; as the user scrolls down the pitch decreases.

Auditory **learning**

- Auditory **learning** is a **learning** style in which a person learns through listening. An auditory **learner** depends on hearing and speaking as a main way of **learning**.

- **Example S14.1: An Earcon representing a paint file.**
  An Earcon representing a paint file, played with a brass timbre.
- **download:** SHB-S14.1 (mp3, 43k)
  source: Brewster, Wright and Edwards (1994)
- **Example S14.2: An Earcon representing the “open” operation.**
  An earcons representing an “open” operation, played with a piano timbre.
- **download:** SHB-S14.2 (mp3, 38k)
  source: Brewster, Wright and Edwards (1994)

Characteristics of Auditory Learners

- . Auditory learners like to be read to.
- Auditory learners sit where they can hear.

. Auditory learners are most likely to read aloud or subvocalize when they read.

- Auditory learners enjoy music.
- Auditory learners acquire information primarily through sound.
- Auditory learners are easily distracted by noises.
- Auditory learners may not coordinate colors or clothes, but can explain what they are wearing and why.
- Auditory learners enjoy listening activities.
- Auditory learners enjoy talking.
- Auditory learners hum or talk to themselves or others when bored.

Why Focus on Mobile?

- Most widely available ICT device worldwide –
  7 billion SIM cards in service
- Everything digital ends up interfacing with mobile phones, tablets or wearable wireless devices
- Internet of Things: from 4.5 billion connected devices today to 50 billion connections in 2020 (Gartner Group)
- Mobile devices by virtue of their embedded accessibility features are the best way for persons with disabilities to interact with their environment

Smartphones all carry accessibility features and more intuitive interfaces for easier usage by persons with disabilities

- Visual
  - **Text-to-Speech**
- Hearing
  - **Video Relay Service with sign language**
- Speech
  - **Peer-to-peer video for sign language**
- Dexterity
  - **Voice recognition for controls and input**
- Cognition
  - **Icon interface**

Accessibility Innovation and Lower Costs Are Driven by Global Market Scale

Mobility + Networks Bandwidth + Processing Power + Memory + GPS + NFC + Camera + Gyroscope + Microphone + Biometrics + Kinetics +Miniaturization

=

Unprecedented Accessibility and Assistive Solutions Available to Persons with Disabilities

Anywhere, Anytime

HOW CAN CITY GOVERNMENTS LEVERAGE THE MOBILE OPPORTUNITY FOR PERSONS WITH DISABILITIES?

Step One: Making Existing e-Government Apps and Services Accessible to All

- Persons with disabilities should have unrestricted access to the same services provided electronically to all citizens
- Mobile is the most used device to access e-government services around the world
- City governments must:
  - Ensure that existing e-government web sites are compliant with W3C mobile *and* accessibility guidelines (80% overlap)
  - When developing mobile apps, ensure that they are accessible and use the embedded accessibility features of the main mobile operating systems (iOS, Android, Windows)
  - Check everything digital in the city for accessibility, preferably with a dedicated organization

Step 2: Ensure the Accessibility of Critical Mobile Services for Independent Living

- Examples:
  - Public transportation systems

    Bus schedules and positioning systems are available via accessible mobile apps

  - Emergency response centers

    Accept, acknowledge and respond to SMS sent by deaf callers

Good Practice: City of Istanbul ICT Accessibility Commission

- Constituted to guide the City in promoting the accessibility of all its e-services
- Meets weekly, chaired by government official
- All 7 members are IT engineers with disabilities knowledgeable on ICT accessibility, on loan by their companies
- Examine web sites, apps, transportation systems, social services, emergency response
- Proposes and promotes solutions

Step 3: Engage Civil Society in Deploying Mobile Services for Persons with Disabilities

- Mobile operators: Can offer Smart Spaces technology with path finding apps and beacon technology
- At home care services: Can leverage IoT technologies and remote monitoring with sensor technology to optimize safety and services
- Banks: Can leverage mobile banking to better serve customers with disabilities
- Grassroots organizations: Can provide disability specific crowd sourced information for physically accessible services (toilets, restaurants etc.)