



D12.8 Accessibility and Inclusion of FutureID

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Abstract

At the beginning of the FutureID project, project partners drafted a set of requirements for all parts of FutureID. This work was part of WP 22. One of the activities was defining requirements so that as many people as possible can use FutureID. These requirements were documented in D22.7. Here, we create a summary of the accessibility and inclusion evaluation work in the project, with a focus on the FutureID client. We provide three different evaluations of FutureID: at the architecture level, at the development level, and at the pilot level. The current work satisfies the requirements, but future evaluations will be needed to ensure that the client keeps its commitment to working with accessibility and inclusion. The requirements should serve future implementers well.

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1 Project Description

The FutureID project builds a comprehensive, flexible, privacy-aware and ubiquitously usable identity management infrastructure for Europe, which integrates existing eID technology and trust infrastructures, emerging federated identity management services and modern credential technologies to provide a user-centric system for the trustworthy and accountable management of identity claims.

The FutureID infrastructure will provide great benefits to all stakeholders involved in the eID value chain. Users will benefit from the availability of a ubiquitously usable open source eID client that is capable of running on arbitrary desktop PCs, tablets and modern smart phones. FutureID will allow application and service providers to easily integrate their existing services with the FutureID infrastructure, providing them with the benefits from the strong security offered by eIDs without requiring them to make substantial investments.

This will enable service providers to offer this technology to users as an alternative to username/password based systems, providing them with a choice for a more trustworthy, usable and innovative technology. For existing and emerging trust service providers and card issuers FutureID will provide an integrative framework, which eases using their authentication and signature related products across Europe and beyond.

To demonstrate the applicability of the developed technologies and the feasibility of the overall approach FutureID will develop two pilot applications and is open for additional application services that want to use the innovative FutureID technology

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2 Overall Evaluation Approach

The FutureID Evaluation approach uses a Design Science Methodology framework to organize and harmonize the multiple disciplinary evaluation approaches for all three artifacts: Reference Architecture, Implementation, and Pilots.

To provide a closer look, FutureID has simplified its evaluation process into three easy steps. First, we **identify** each of the artifacts, two pilots, a reference architecture, and implementation. Second, we **clarify** what each interdisciplinary team considers as the artifacts and develop requirements regarding their disciplinary. FutureID has interdisciplinary teams that cover of spectrum of important perspectives regarding; technical merit, security, privacy, usability, accessibility, socio-economic, and legal. This step is ranked regarding importance and is utilized by using the Evaluation Wiki Tool. Lastly, we **reevaluate**, which is when each requirement identified will be reevaluated on whether they should be really implemented or initiated in each artifact. Of course, with the complexity of some of the artifacts a noble evaluation could not be sufficiently executed with just this process, therefore, FutureID has used extra evaluation steps to properly consider specific needs of some of the artifacts. For example, there are testbeds used to better grasp the outlook of the pilots.

The Evaluation Wiki tool is a quality control mechanism that has been used for the core evaluation of FutureID's results. The Evaluation Wiki tool has a variety of different beneficial functions that lead to a practical and more optimal evaluation method. On the practical side, it presents an easy to read, adjustable and comprehensive solution for documentation of the evaluation requirements needed for each artifact. Each artifact can be sub categorized into viewing each of the importance levels of requirements (must, should, may, not applicable) on the main page of the Evaluation Wiki tool. The Evaluation Wiki tool classifies each requirement, its origin (interdisciplinary team), its rank of importance, and includes a comments section.

Collaborating with multiple disciplines, harmonizing, and consolidating a wide spectrum of requirements proved difficult and resulted in major conflicts. To solve this problem, FutureID included another addition to the Evaluation Wiki tool and to the Evaluation work package. The additions was an added deliverable that focused on the clarification of which requirements are either similar to, relates to, or conflicts with other requirements. This is a necessary task that all large-scale interdisciplinary projects should have to harmonize requirements in evaluations. This task provided insight on how all of the requirements can cooperate and be applied all together.

In addition to these processes, the testbed has proven to be a great technical method in testing the implementation and pilot applications. It is built of three different levels of testing; unit testing, integration testing, and system testing. The implementation artifact is tested using the unit, integration, and system testing. While, the pilots are tested on all the system level testing, the form of evaluation methods between different artifacts obviously

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varies. However, the Design Science Evaluation methods are broad enough to cover a wide range of techniques.

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3 Evaluation

We carried out the accessibility and inclusion evaluation in three stages and used the requirements that were defined in D22.7 (Schulz, Fritsch, Schlehahn, Hansen, & Zwingelberg, 2013). Although each stage may have consisted of multiple tests and evaluations, we present the final results for each stage below. This arrangement does repeat a lot of information, but it maintains consistency between other deliverables in WP 12 and should make it easy to focus on the results for a single stage of the evaluation.

The requirements are presented in a tabular format, taken from the Evaluation Wiki:

Requirement number from D22.7	Requirement Title
Description	Description of requirement from D22.7
Classification for...	The requirement level defined for the architecture, implementation, or pilot stage, based on the RFC 2119 (Bradner, 1997). Possible values: May, Should, Must, Not applicable
How it has been tested?	Manually or Automatically
Result	Passed, Failed, or Not yet

Items that have been marked as *Not applicable* do not have the rows for how the requirement was tested or its result since these rows would not make sense. The classification of the requirements varied depending on the type of evaluation (Figure 1).

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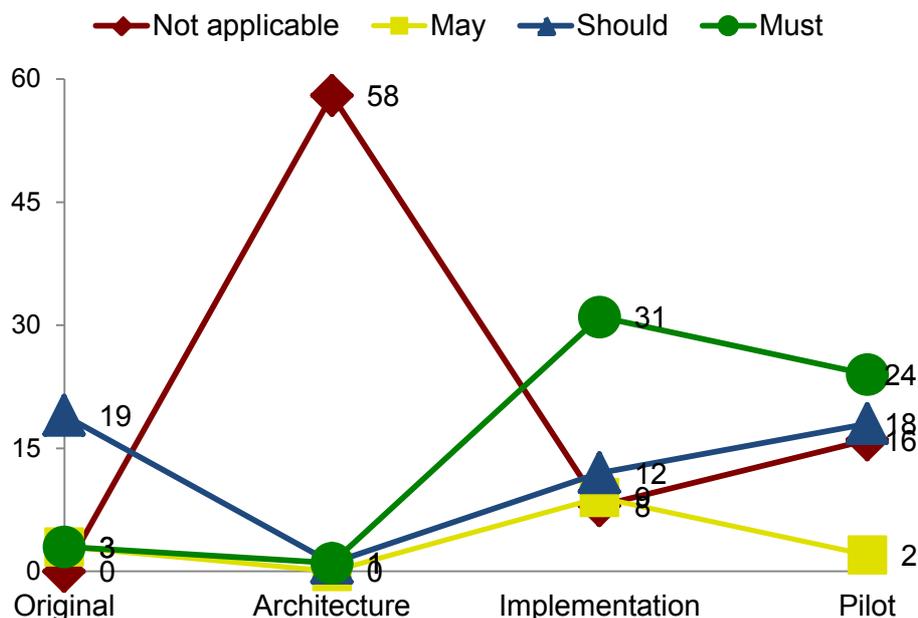


Figure 1 Graph of requirement level changes during FutureID.

3.1 Reference Architecture

We evaluated the reference architecture as found in D21.4 during autumn 2014. Most of the items in the reference architecture do not document how the user interface of the client should work. This should be expected since the reference architecture documents how things should work at a high-level and not the details of user interaction. The upshot of this is that most of the requirements, which are concerned about these details, are not applicable at this stage of the evaluation (Figure 1). Despite most of the requirements here not being applicable (Table 1), accessibility and inclusion issues were kept in mind when designing the architecture.

Table 1 Accessibility and inclusion results for architecture evaluation.

AIR-01	Accessibility and inclusion for all FutureID services
Description	All FutureID services SHOULD take into account the following accessibility and inclusion requirements. The provision of any accessibility and inclusion functionalities for the FutureID services SHOULD be possible either directly or by open interfaces enabling adequate add-on services by third parties.
Classification for Architecture	Should
How has it been tested?	Manually

Result Passed

AIR-02 **Ensure content in the client is accessible to the largest audience**

Description All content MUST conform to the Level AAA of the WCAG 2.0. Many of the items are repeated here, but check the guidelines for more information.

Classification for Architecture Not applicable

AIR-02.1 **Color contrast for text and background**

Description Text MUST have an acceptable contrast to be read by the largest amount of people.

Classification for Architecture Not applicable

AIR-02.1.1 **Minimum color contrast for large text and background**

Description Text larger than 4.9 mm MUST have a color contrast ratio of at least 4.5:1.

Classification for Architecture Not applicable

AIR-02.1.2 **Minimum color contrast for smaller text and background**

Description Text smaller than 4.9 mm MUST have a color contrast ratio of at least 7:1.

Classification for Architecture Not applicable

AIR-02.1.3 **Contrast exceptions for incidental text and logos**

Description Incidental text or logos MAY ignore the contrast ratio requirements.

Classification for Architecture Not applicable

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AIR-02.2	Typefaces and fonts
Description	Bizarre and indistinct typefaces SHOULD be avoided. Most typefaces in common use are legible.
Classification for Architecture	Not applicable
AIR-02.3	Default text size
Description	Text MUST respect the default sizes of the operating system, but MAY be larger.
Classification for Architecture	Not applicable
AIR-02.4	Adjustable text size
Description	Text SHOULD be adjustable to larger or smaller size, either through the operating system, assistive technology, or via mechanisms in the program itself.
Classification for Architecture	Not applicable
AIR-02.5	Block text readability
Description	Blocks of text MUST be readable by the largest amount of people.
Classification for Architecture	Not applicable
AIR-02.5.1	Line spacing (leading)
Description	The height of the line SHOULD be at least one and a half times the point size of the typeface being used. It MUST be larger than one and one quarter times the point size. It MUST NOT be more than one and three quarters times the point size.
Classification for Architecture	Not applicable
AIR-02.5.2	Paragraph Spacing
Description	Spacing between paragraphs SHOULD be at least one and a half times larger than the line spacing. It MUST NOT be smaller than half the point size of the typeface.
Classification for Architecture	Not applicable

AIR-02.5.3		Line Width	
Description		The line width in a block of text SHOULD NOT exceed 70 characters. It MUST NOT exceed 100 characters.	
Classification for Architecture		Not applicable	
AIR-02.5.4		Text Alignment	
Description		Blocks of text MUST NOT be fully justified. It MUST be either aligned to the left or right margin. Centered text is also allowed, but SHOULD be used sparingly.	
Classification for Architecture		Not applicable	
AIR-02.6		Internationalization and localization support	
Description		The client MUST be able to be translated into multiple languages.	
Classification for Architecture		Not applicable	
AIR-02.6.1		Example translations	
Description		Translations of the client SHOULD be provided for in at least three languages (e.g., English, German, and Spanish) to prove that translation is possible.	
Classification for Architecture		Not applicable	
AIR-02.6.2		Alternate languages	
Description		Translations of the client MAY be provided in French, Italian, or other languages that are in use among the project partners.	
Classification for Architecture		Not applicable	
AIR-02.7		Text alternatives for non-textual content	
Description		All non-textual content (e.g., images) MUST have alternative text to describe them.	
Classification for Architecture		Not applicable	

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AIR-02.7.1 **Non-textual decoration, formatting, and invisible content**

Description

Non-textual content that is used only as decoration, to format items visually, or is invisible to the user **MUST** be implemented in a way that it is ignored by assistive technology.

Classification for Architecture Not applicable

AIR-02.7.2 **Non-textual controls**

Description

Non-text controls **MUST** have a name that describes their purposes. See D22.7, § 8.5 for more information about controls.

Classification for Architecture Not applicable

AIR-02.7.3 **Non-textual tests**

Description

Non-text content tests that would be invalid if given a text alternative **MUST** have descriptive identifying text instead.

Classification for Architecture Not applicable

AIR-02.8 **Multiple cues to convey important information**

Description

Important information **SHOULD** be conveyed by more than one type of cue (e.g., not only color, not only text, or not only sound). Use additional information, such as position, or animation, to help convey the information.

Classification for Architecture Not applicable

AIR-02.9 **Time-based media accessibility**

Description

Time-based media (e.g., video and audio) **MUST** conform to the AAA Level in the WCAG 2.0.

Classification for Architecture Not applicable

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AIR-02.9.1

Prerecorded audio accessibility

Description

Prerecorded audio tracks **MUST** be captioned and provide a sign language interpretation.

Classification for Architecture

Not applicable

AIR-02.9.2

Prerecorded video accessibility

Description

Prerecorded video tracks **MUST** provide an audio description and an extended audio description where there are not significant pauses to provide normal audio description.

Classification for Architecture

Not applicable

AIR-02.9.3

Alternative media

Description

Alternative media **MUST** be provided prerecorded synchronized media or prerecorded video-only (i.e., video, but no audio) content, and live audio-only content.

Classification for Architecture

Not applicable

AIR-03

Compatibility with Assistive Technology

Description

The client **MUST** be usable with different types of assistive technology.

Classification for Architecture

Not applicable

AIR-03.1

Compatibility with screen readers

Description

The client **MUST** be compatible with at least two of the following screen readers: Talkback, VoiceOver, NVDA, Jaws, Windows Eyes, SuperNova, Orca, ZoomText, or any other equivalent screen reader software.

Classification for Architecture

Not applicable

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AIR-03.2

Compatibility with screen magnifiers

Description

The client **MUST** be compatible with the at least two of the following screen magnifiers: SuperNova, Virtual Magnifying Glass, ZoomText, any of the operating system specific magnifying tools, or other equivalent screen magnifying software.

Classification for Architecture

Not applicable

AIR-03.3

Compatibility with onscreen keyboards

Description

The client **MUST** be compatible with the at least two of the following onscreen keyboards: KeyStrokes, Florence Virtual Keyboard, SofType, Magic Cursor 2000, Click-N-Type, any of the operating system specific onscreen keyboards, or other equivalent onscreen keyboard software.

Classification for Architecture

Not applicable

AIR-04

Keyboard Control

Description

All tasks in the client **MUST** have equivalent ways they can be accomplished by only using the keyboard, without requiring specific timings for specific keystrokes.

Classification for Architecture

Not applicable

AIR-04.1

Logical navigation via keyboard

Description

Navigation using only the keyboard **SHOULD** be logical. That is, the navigation should follow the logical layout of the client.

Classification for Architecture

Not applicable

AIR-04.2

Shortcuts for keyboard navigation

Description

Shortcuts to aid navigation **MAY** be implemented.

Classification for Architecture

Not applicable

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AIR-05

No Timing of essential events or activities

Description

Any activity in the client that is essential, i.e., if removed would fundamentally change information or functionality and cannot be achieved in another way, **MUST NOT** be timed. Exceptions exist for non-interactive synchronized media, events that happen in real-time, and lifetime of tokens and sessions.

Classification for Architecture

Must

AIR-06

Postponing Interruptions

Description

It **MUST** be possible to postpone interruptions unless the interruption involves an emergency.

Classification for Architecture

Not applicable

AIR-07

Compliance with legal requirements for accessibility and inclusion

Description

The provision of accessibility and inclusion features within FutureID services **MUST** be in compliance with the applicable European legislation relevant for accessibility and inclusion matters. The provision of accessibility and inclusion functionalities within FutureID services **SHOULD** be in compliance with the UN Convention on the Rights of Persons with Disabilities and its Optional Protocol.

Classification for Architecture

Not applicable

AIR-07.1

Data processing legally compliant with European Data Protection Legislation

Description

If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, it **MUST** be in accordance with the provisions of the European data protection law, in particular the European Data Protection Directive 95/46 EC and the e-Privacy Directive 2002/58/EC and its amending Directive 2009/136/EC (see also D22.6 for details).

Classification for Architecture

Not applicable

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AIR-07.1.6

Appropriate safeguards for user data

Description

If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, appropriate safeguards **MUST** be implemented to protect that data (technical and organizational measures). Moreover, this data **SHOULD** be stored under the control of the user (e.g., locally on the user's device).

Classification for Architecture

Not applicable

AIR-07.2

Realize transparency and user control

Description

Sufficient transparency and appropriate ways for users to exercise control **MUST** be provided, while these **SHOULD** take into account specific accessibility and inclusion needs of users. Each legal ground for the collection and processing of personal data for the purpose of providing accessibility and inclusion functionalities **MUST** be made available for the user at any time, while different levels of user abilities regarding perception and understanding of all information relevant to them **SHOULD** be taken into account. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modus of processing, and the implemented technical and organizational measures **MUST** be given at an utmost early stage of the interaction in accessible formats. The information of the user **SHOULD** comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Architecture

Not applicable

AIR-07.2.1

Enable information on user side

Description

Accessibility and inclusion functionalities **MUST** include functionality for the user to learn all relevant information concerning the user at any time, e.g., the price of the service, legal protection, which data is collected, processed and stored. Also, each legal ground for the col-

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AIR-07.2.1

Enable information on user side

lection and processing of personal data for the purpose of providing accessibility and inclusion ties **MUST** be made available for the user at any time, taking into account different levels of user abilities regarding perception and understanding of all information relevant to them. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modi of processing, and the implemented technical and organizational measures **MUST** be given at an utmost early stage of the interaction in accessible formats. The information of the user **SHOULD** comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Architecture Not applicable

AIR-07.2.2

Enable control on user side

Description

Accessibility and inclusion functionalities of FutureID services **MUST** include functionality for the user to exercise control about her data by exerting influence or by decisions, e.g., through controls built into the UI so the user can act if information is false or the user wants it deleted.

Classification for Architecture Not applicable

AIR-07.2.3

Allow alternative output

Description

Accessibility and inclusion functionalities **SHOULD** allow alternative outputs other than just a user computer. This output **SHOULD** include alternate devices (e. g. tablets and smartphones) as well as output channels to assistants of the user (e. g. delegates, caring persons, and other authorized third parties). More examples are: Accessibility and inclusion functionalities **SHOULD** allow alternative access systems to just screen (e. g. ASCII-export for text-to-voice readers). Accessibility and inclusion functionalities **SHOULD** allow the semantically equivalent and lossless processing of alternative ac-

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cess systems (e. g. checking or creating signature components), especially if they are used to exercise legally binding or else highly relevant decisions.

Classification for Architecture Not applicable

AIR-07.2.4 Implement feedback and help channels

Description

Accessibility and inclusion functionalities **MUST** include the implementation of assistive feedback and help channels (multiple channels) to enable the user to handle an error message or other accessibility dysfunction. This includes a contact channel to an external support person on the side of the entity providing the accessibility services.

Classification for Architecture Not applicable

AIR-07.2.5 Logging of processing operations

Description

Any changes to the data set (collection, modification, backup, deletion, etc.), as well as read-only accesses **MAY** be logged and stored under the control of the user (e.g., locally on the user device powered by the user client). Accessibility and inclusion functionalities then **MUST** include functionality for the user to have reading access to these logs.

Classification for Architecture Not applicable

AIR-07.3 Support of service providers offering accessibility functionalities

Description

Service Providers **SHOULD** be supported in choosing eID services that fulfill accessibility and inclusion requirements (e.g. by providing information such as “accessibility & inclusion seals” within the FutureID infrastructure). Such support **MAY** be realized by holding this information in the trust repository.

Classification for Architecture Not applicable

AIR-08 Testing the accessibility of the client

Description

The accessibility of the client **MUST** be tested.

Classification for Architecture Not applicable

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AIR-08.1	Expert testing of accessibility of the client
Description	The client accessibility SHOULD be tested by experts in accessibility who understand how assistive technology is used and how the client will be used.
Classification for Architecture	Not applicable
AIR-08.2	User testing of accessibility of the client
Description	The accessibility of the client MUST be tested by users with disabilities.
Classification for Architecture	Not applicable
AIR-08.2.1	Testing of client with people with vision impairment
Description	The client SHOULD be tested by users that have vision impairment.
Classification for Architecture	Not applicable
AIR-08.2.2	Testing of client by people with motor impairments
Description	The client SHOULD be tested by users that have vision impairment.
Classification for Architecture	Not applicable
AIR-08.2.3	Testing of client by people with hearing impairment
Description	The client SHOULD be tested by users with hearing impairment.
Classification for Architecture	Not applicable
AIR-08.2.4	Testing of client with people with dyslexia
Description	The client SHOULD be tested by users that have dyslexia.
Classification for Architecture	Not applicable
AIR-08.2.5	Testing of client with people with other cognitive impairments
Description	The client SHOULD be tested by users with other cognitive impairments, such as memory problems or mental retardation.
Classification for Architecture	Not applicable

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AIR-09	Client help and support material accessibility
Description	Online help material—such as web pages, digital manuals, or local on the machine running the client— MUST be accessible as per AIR-02 — Ensure content in the client is accessible to the largest audience.
Classification for Architecture	Not applicable

AIR-10	Alternative help and support
Description	Alternate help and support systems for the client (e.g., call centers, learning centers) SHOULD take accessibility and universal design into account.
Classification for Architecture	Not applicable

3.2 Implementation

The implementation evaluation consisted mostly of expert evaluations of the client. This also involved a bit of development work as well. The general pattern would be to select some of the requirements and test them against the latest version of FutureID client. We primarily looked at the authentication task because it was the most complete and self-contained. This would uncover issues that had to be addressed. Most of the issues were addressed by changing either the styling or fixing the markup for the interface. These changes were then incorporated into the other interfaces.

Most of the testing happened on OS X 10.10 with Safari and VoiceOver screen reader using the main HTML interface. In later processes, a built-in browser was also used. Unfortunately, this browser is based on the JavaFX framework and it currently has no support for assistive technology. This means that the built-in browser cannot be used with a screen reader. However, technologies like onscreen keyboards and screen zooming did seem to work OK, probably because they do not depend on the same sort of interfaces a screen reader needs.

The tests were performed manually (Table 2). Though most of these items would have options for automation in the testbeds presented in WP 37. But, when the tests were being run, it wasn't easy to automate the client use. As the FutureID is integrated into more systems, it should be straightforward to automate many of the tests, especially in AIR-02.*.

Regarding the AIR-7.* requirements, it is only partially possible to evaluate the client as well as the pilots since a complete and final implementation must be taken into account for a coherent analysis. Since neither the client nor the pilots at the time of the evaluation provide any indication that personal information about a user's physical or cognitive condition is collected and processed, it is not yet possible to definitely determine how they meet the AIR-7.* requirements. The same applies for related functionalities that would then be required once such data exists. This is the reason why some of the data protection re-

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requirements are labelled as *not applicable*. However, at this current stage, it is assumed that the technology developed so far has the potential to adequately meet these requirements in a final deployment. Therefore, the requirements for user information and control are labelled as *not yet*, because the user interface leaves room to implement such features.

Table 2 Accessibility and inclusion results for implementation evaluation.

AIR-01	Accessibility and inclusion for all FutureID services
Description	All FutureID services SHOULD take into account the following accessibility and inclusion requirements. The provision of any accessibility and inclusion functionalities for the FutureID services SHOULD be possible either directly or by open interfaces enabling adequate add-on services by third parties.
Classification for Implementation	Should
How has it been tested?	Manual
Result	Passed
AIR-02	Ensure content in the client is accessible to the largest audience
Description	All content MUST conform to the Level AAA of the WCAG 2.0. Many of the items are repeated here, but check the guidelines for more information.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.1	Color contrast for text and background
Description	Text MUST have an acceptable contrast to be read by the largest amount of people.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.1.1	Minimum color contrast for large text and background
Description	Text larger than 4.9 mm MUST have a color contrast ratio of at least 4.5:1.

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Classification for Implementation Must
How has it been tested? Manual
Result Passed

AIR-02.1.2 **Minimum color contrast for smaller text and background**

Description Text smaller than 4.9 mm MUST have a color contrast ratio of at least 7:1.
Classification for Implementation Must
How has it been tested? Manual
Result Passed

AIR-02.1.3 **Contrast exceptions for incidental text and logos**

Description Incidental text or logos MAY ignore the contrast ratio requirements.
Classification for Implementation May
How has it been tested? Manual
Result Passed

AIR-02.2 **Typefaces and fonts**

Description Bizarre and indistinct typefaces SHOULD be avoided. Most typefaces in common use are legible.
Classification for Implementation Should
How has it been tested? Manual
Result Passed

AIR-02.3 **Default text size**

Description Text MUST respect the default sizes of the operating system, but MAY be larger.
Classification for Implementation Must
How has it been tested? Manual
Result Passed

AIR-02.4 **Adjustable text size**

Description Text SHOULD be adjustable to larger or smaller size, either through the operating system, assistive

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technology, or via mechanisms in the program itself.

Classification for Implementation Should

How has it been tested? Manual

Result Passed

AIR-02.5 **Block text readability**

Description Blocks of text **MUST** be readable by the largest amount of people.

Classification for Implementation Must

How has it been tested? Manual

Result Passed

AIR-02.5.1 **Line spacing (leading)**

Description The height of the line **SHOULD** be at least one and a half times the point size of the typeface being used. It **MUST** be larger than one and one quarter times the point size. It **MUST NOT** be more than one and three quarters times the point size.

Classification for Implementation Should

How has it been tested? Automated

Result Passed

AIR-02.5.2 **Paragraph Spacing**

Description Spacing between paragraphs **SHOULD** be at least one and a half times larger than the line spacing. It **MUST NOT** be smaller than half the point size of the typeface.

Classification for Implementation Should

How has it been tested? Automated

Result Passed

AIR-02.5.3 **Line Width**

Description The line width in a block of text **SHOULD NOT** exceed 70 characters. It **MUST NOT** exceed 100 characters.

Classification for Implementation Must

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How has it been tested? Automated

Result Passed

AIR-02.5.4 **Text Alignment**

Description

Blocks of text **MUST NOT** be fully justified. It **MUST** be either aligned to the left or right margin. Centered text is also allowed, but **SHOULD** be used sparingly.

Classification for Implementation Must

How has it been tested? Manual

Result Passed

AIR-02.6 **Internationalization and localization support**

Description

The client **MUST** be able to be translated into multiple languages.

Classification for Implementation Must

How has it been tested? Automated

Result Passed

AIR-02.6.1 **Example translations**

Description

Translations of the client **SHOULD** be provided for in at least three languages (e.g., English, German, and Spanish) to prove that translation is possible.

Classification for Implementation Should

How has it been tested? Automated

Result Passed

AIR-02.6.2 **Alternate languages**

Description

Translations of the client **MAY** be provided in French, Italian, or other languages that are in use among the project partners.

Classification for Implementation May

How has it been tested? Automated

Result Passed

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AIR-02.7	Text alternatives for non-textual content
Description	All non-textual content (e.g., images) MUST have alternative text to describe them.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.7.1	Non-textual decoration, formatting, and invisible content
Description	Non-textual content that is used only as decoration, to format items visually, or is invisible to the user MUST be implemented in a way that it is ignored by assistive technology.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.7.2	Non-textual controls
Description	Non-text controls MUST have a name that describes their purposes. See D22.7 § 8.5 for more information about controls.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.7.3	Non-textual tests
Description	Non-text content tests that would be invalid if given a text alternative MUST have descriptive identifying text instead.
Classification for Implementation	Must
How has it been tested?	Manual
Result	Passed
AIR-02.8	Multiple cues to convey important information
Description	Important information SHOULD be conveyed by more than one type of cue (e.g., not only color, not only text, or not only sound). Use additional infor-

mation, such as position, or animation, to help convey the information.

Classification for Implementation Should
How has it been tested? Manual
Result Passed

AIR-02.9 **Time-based media accessibility**

Description Time-based media (e.g., video and audio) MUST conform to the AAA Level in the WCAG 2.0.
Classification for Implementation Must
How has it been tested? Manual
Result passed

AIR-02.9.1 **Prerecorded audio accessibility**

Description Prerecorded audio tracks MUST be captioned and provide a sign language interpretation.
Classification for Implementation Must
How has it been tested? Manual
Result Passed

AIR-02.9.2 **Prerecorded video accessibility**

Description Prerecorded video tracks MUST provide an audio description and an extended audio description where there are not significant pauses to provide normal audio description.
Classification for Implementation Must
How has it been tested? Automated
Result Passed

AIR-02.9.3 **Alternative media**

Description Alternative media MUST be provided prerecorded synchronized media or prerecorded video-only (i.e., video, but no audio) content, and live audio-only content.
Classification for Implementation Must
How has it been tested? Manual

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Result Passed

AIR-03 **Compatibility with Assistive Technology**

Description The client MUST be usable with different types of assistive technology.

Classification for Implementation Must

How has it been tested? Manual

Result Passed

AIR-03.1 **Compatibility with screen readers**

Description The client MUST be compatible with at least two of the following screen readers: Talkback, VoiceOver, NVDA, Jaws, Windows Eyes, SuperNova, Orca, ZoomText, or any other equivalent screen reader software.

Classification for Implementation Must

How has it been tested? Manual

Result Passed

AIR-03.2 **Compatibility with screen magnifiers**

Description The client MUST be compatible with the at least two of the following screen magnifiers: SuperNova, Virtual Magnifying Glass, ZoomText, any of the operating system specific magnifying tools, or other equivalent screen magnifying software.

Classification for Implementation Must

How has it been tested? Automated

Result Passed

AIR-03.3 **Compatibility with onscreen keyboards**

Description The client MUST be compatible with the at least two of the following onscreen keyboards: KeyStrokes, Florence Virtual Keyboard, SofType, Magic Cursor 2000, Click-N-Type, any of the operating system specific onscreen keyboards, or other equivalent onscreen keyboard software.

Classification for Implementation Must

How has it been tested? Manual

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Result Passed

AIR-04 Keyboard Control

Description All tasks in the client MUST have equivalent ways they can be accomplished by only using the keyboard, without requiring specific timings for specific keystrokes.

Classification for Implementation Must

How has it been tested? Automated

Result Passed

AIR-04.1 Logical navigation via keyboard

Description Navigation using only the keyboard SHOULD be logical. That is, the navigation should follow the logical layout of the client.

Classification for Implementation Should

How has it been tested? Automated

Result Passed

AIR-04.2 Shortcuts for keyboard navigation

Description Shortcuts to aid navigation MAY be implemented.

Classification for Implementation May

How has it been tested? Manual

Result Passed

AIR-05 No Timing of essential events or activities

Description Any activity in the client that is essential, i.e., if removed would fundamentally change information or functionality and cannot be achieved in another way, MUST NOT be timed. Exceptions exist for non-interactive synchronized media, events that happen in real-time, and lifetime of tokens and sessions.

Classification for Implementation Must

How has it been tested? Automated

Result Passed

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AIR-06

Postponing Interruptions

Description

It **MUST** be possible to postpone interruptions unless the interruption involves an emergency.

Classification for Implementation

Must

How has it been tested?

Automated

Result

Passed

AIR-07

Compliance with legal requirements for accessibility and inclusion

Description

The provision of accessibility and inclusion features within FutureID services **MUST** be in compliance with the applicable European legislation relevant for accessibility and inclusion matters. The provision of accessibility and inclusion functionalities within FutureID services **SHOULD** be in compliance with the UN Convention on the Rights of Persons with Disabilities and its Optional Protocol.

Classification for Implementation

Must

How has it been tested?

Manual

Result

Not yet

AIR-07.1

Data processing legally compliant with European Data Protection Legislation

Description

If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, it **MUST** be in accordance with the provisions of the European data protection law, in particular the European Data Protection Directive 95/46 EC and the e-Privacy Directive 2002/58/EC and its amending Directive 2009/136/EC (see also D22.6 for details).

Classification for Implementation

Not applicable

AIR-07.1.1

Avoid the collection and processing of user data

Description

If possible, accessible and inclusion functionalities **SHOULD NOT** by default require the collection of personal data of the user.

Classification for Implementation

Should

How has it been tested?

Manual

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Result Passed

AIR-07.1.2 Have legal ground for processing personal data

Description If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, a valid legal ground in accordance with Article 7 European Data Protection Directive 95/46/EC MUST exist (e.g., valid consent, contract).

Classification for Implementation Not applicable

AIR-07.1.3 Data collection & processing only as far as a necessary

Description If an independent third party entity offers the accessibility and inclusion functionalities and this requires information about the user's physical or cognitive condition, the service provider MUST NOT obtain this information.

Classification for Implementation Not applicable

AIR-07.1.4 Purpose-bound processing

Description Personal data collected for the provision of accessibility and inclusion functionalities MUST NOT be used for other purposes without legal ground.

Classification for Implementation Not applicable

AIR-07.1.5 Deletion of user data if no longer necessary

Description If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, the personal data about the user MUST be deleted once it is no longer necessary for this purpose.

Classification for Implementation Not applicable

AIR-07.1.6 Appropriate safeguards for user data

Description If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, appropriate safeguards MUST be implemented to protect that data (technical and organizational measures). Moreover, this data SHOULD be stored under the control of the user (e.g., locally on

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the user's device).

Classification for Implementation Not applicable

AIR-07.2

Realize transparency and user control

Description

Sufficient transparency and appropriate ways for users to exercise control **MUST** be provided, while these **SHOULD** take into account specific accessibility and inclusion needs of users. Each legal ground for the collection and processing of personal data for the purpose of providing accessibility and inclusion functionalities **MUST** be made available for the user at any time, while different levels of user abilities regarding perception and understanding of all information relevant to them **SHOULD** be taken into account. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modus of processing, and the implemented technical and organizational measures **MUST** be given at an utmost early stage of the interaction in accessible formats. The information of the user **SHOULD** comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Implementation Must

How has it been tested? Manual

Result Not yet

AIR-07.2.1

Enable information on user side

Description

Accessibility and inclusion functionalities **MUST** include functionality for the user to learn all relevant information concerning the user at any time, e.g., the price of the service, legal protection, which data is collected, processed and stored. Also, each legal ground for the collection and processing of personal data for the purpose of providing accessibility and inclusion functionalities **MUST** be made available for the user at any time, taking into account different levels of user abilities regarding perception and un-

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derstanding of all information relevant to them. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modi of processing, and the implemented technical and organizational measures **MUST** be given at an utmost early stage of the interaction in accessible formats. The information of the user **SHOULD** comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Implementation Must
How has it been tested? Manual
Result Not yet

AIR-07.2.2

Enable control on user side

Description

Accessibility and inclusion functionalities of FutureID services **MUST** include functionality for the user to exercise control about her data by exerting influence or by decisions, e.g., through controls built into the UI so the user can act if information is false or the user wants it deleted.

Classification for Implementation Must
How has it been tested? Automated
Result Not yet

AIR-07.2.3

Allow alternative output

Description

Accessibility and inclusion functionalities **SHOULD** allow alternative outputs other than just a user computer. This output **SHOULD** include alternate devices (e. g. tablets and smartphones) as well as output channels to assistants of the user (e. g. delegates, caring persons, and other authorized third parties). More examples are: Accessibility and inclusion functionalities **SHOULD** allow alternative access systems to just screen (e. g. ASCII-export for text-to-voice readers). Accessibility and inclusion functionalities **SHOULD** allow the semantically equivalent and lossless processing of alternative access systems

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(e. g. checking or creating signature components), especially if they are used to exercise legally binding or else highly relevant decisions.

Classification for Implementation Should
How has it been tested? Manual
Result Not yet

AIR-07.2.4 Implement feedback and help channels

Description Accessibility and inclusion functionalities **MUST** include the implementation of assistive feedback and help channels (multiple channels) to enable the user to handle an error message or other accessibility dysfunction. This includes a contact channel to an external support person on the side of the entity providing the accessibility services.

Classification for Implementation Must
How has it been tested? Manual
Result Not yet

AIR-07.2.5 Logging of processing operations

Description Any changes to the data set (collection, modification, backup, deletion, etc.), as well as read-only accesses **MAY** be logged and stored under the control of the user (e.g., locally on the user device powered by the user client). Accessibility and inclusion functionalities then **MUST** include functionality for the user to have reading access to these logs.

Classification for Implementation Must
How has it been tested? Manual
Result Not yet

AIR-07.3 Support of service providers offering accessibility functionalities

Description Service Providers **SHOULD** be supported in choosing eID services that fulfill accessibility and inclusion requirements (e.g. by providing information such as “accessibility & inclusion seals” within the FutureID infrastructure). Such support **MAY** be realized by holding this information in the trust repository.

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Classification for Implementation Should
How has it been tested? Manual
Result Not yet

AIR-08 **Testing the accessibility of the client**

Description The accessibility of the client **MUST** be tested.
Classification for Implementation Must
How has it been tested? Automated
Result Passed

AIR-08.1 **Expert testing of accessibility of the client**

Description The client accessibility **SHOULD** be tested by experts in accessibility who understand how assistive technology is used and how the client will be used.
Classification for Implementation Should
How has it been tested? Manual
Result Passed

AIR-08.2 **User testing of accessibility of the client**

Description The accessibility of the client **MUST** be tested by users with disabilities.
Classification for Implementation May
How has it been tested? Manual
Result Passed

AIR-08.2.1 **Testing of client with people with vision impairment**

Description The client **SHOULD** be tested by users that have vision impairment.
Classification for Implementation May
How has it been tested? Manual
Result Passed

AIR-08.2.2 **Testing of client by people with motor impairments**

Description The client **SHOULD** be tested by users that have

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	vision impairment.
Classification for Implementation	May
How has it been tested?	Manual
Result	Passed
AIR-08.2.3	Testing of client by people with hearing impairment
Description	The client SHOULD be tested by users with hearing impairment.
Classification for Implementation	May
How has it been tested?	Manual
Result	Passed
AIR-08.2.4	Testing of client with people with dyslexia
Description	The client SHOULD be tested by users that have dyslexia.
Classification for Implementation	May
How has it been tested?	Manual
Result	Passed
AIR-08.2.5	Testing of client with people with other cognitive impairments
Description	The client SHOULD be tested by users with other cognitive impairments, such as memory problems or mental retardation.
Classification for Implementation	May
How has it been tested?	Manual
Result	Passed
AIR-09	Client help and support material accessibility
Description	Online help material—such as web pages, digital manuals, or local on the machine running the client—MUST be accessible as per AIR-02 — Ensure content in the client is accessible to the largest audience.
Classification for Implementation	Should

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How has it been tested? Automated

Result Passed

AIR-10 **Alternative help and support**

Description Alternate help and support systems for the client (e.g., call centers, learning centers) SHOULD take accessibility and universal design into account.

Classification for Implementation Not applicable

3.3 Pilots

The pilots were evaluated in late September and October. Since this was near the end of the project, we needed to go a different route than we had originally planned. The original plan was to recruit users that would represent different people with disabilities. This would allow us to get a result from real users that would have to use the accessibility bits that had been created during the project.

But, recruiting users takes time and we were unsure when the pilots would be ready for real testing. Instead we combined different methods with different strengths and weaknesses to get as broad coverage of accessibility issues as possible. We used several different methods, such as personas, disability simulation kit, and expert evaluation to get results for the evaluation. This kind of method triangulation is recommended in accessibility evaluations (Fuglerud, 2014). In addition, this allowed us to collect data and see how many issues were uncovered using each of the methods, what sort of issues overlapped, and which methods uncovered new issues. We are still looking at this data and will publish it in a future article on universal design. That activity is independent of this deliverable.

During the development, we only evaluated the client and its test communication. For the accessibility evaluation of the pilots, we felt it was necessary to put FutureID in context and look at the client and the surrounding workflow. That is, we looked at the initial pages (or sub-pages) of the web site that were needed to navigate to get to the FutureID functionality. Then, we looked at the steps that were performed when using FutureID, like using a smart card or choosing a certificate. We did not look any further steps. Our reasoning was that even if the FutureID client was accessible, it doesn't mean anything if a user cannot get to the login (or sign) button. To put it in a real world perspective, a door that is universally designed doesn't matter much when you need to take a long flight of stairs to get to it.

See Appendix A for more details of the pilot evaluation and the methods we used.

The upshot of this expanded evaluation is that the *current versions* of the pilots do not pass all the requirements. But, this does *not* mean that the pilots *inherently fail* to meet the requirements. The areas where the pilots do not meet the requirements are all fixable. Even better, they are straightforward to fix and do not require reworking of the pilots. If there was more time to develop the pilots, we would perform another iteration and fix all the issues. So, as in the AIR-07.* requirements, we have chosen to mark these elements

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as “Not Yet”. We feel that although the pilots could have addressed accessibility better in their current version, we should provide an opportunity to improve.

To avoid unnecessary duplication we will present the information here only once (Table 3) and not for each pilot. This is because the result for the requirement applied to both pilots.

Table 3 Accessibility and inclusion results for pilot evaluation.

AIR-01	Accessibility and inclusion for all FutureID services
Description	All FutureID services SHOULD take into account the following accessibility and inclusion requirements. The provision of any accessibility and inclusion functionalities for the FutureID services SHOULD be possible either directly or by open interfaces enabling adequate add-on services by third parties.
Classification for Pilots	Should
How has it been tested?	Manual
Result	Passed
AIR-02	Ensure content in the client is accessible to the largest audience
Description	All content MUST conform to the Level AAA of the WCAG 2.0. Many of the items are repeated here, but check the guidelines for more information.
Classification for Pilots	Must
How has it been tested?	Automated
Result	Not yet
AIR-02.1	Color contrast for text and background
Description	Text MUST have an acceptable contrast to be read by the largest amount of people.
Classification for Pilots	Must
How has it been tested?	Manual
Result	Not yet
AIR-02.1.1	Minimum color contrast for large text and background
Description	Text larger than 4.9 mm MUST have a color contrast ratio of at least 4.5:1.
Classification for Pilots	Must

How has it been tested? Automated

Result Passed

AIR-02.1.2 Minimum color contrast for smaller text and background

Description Text smaller than 4.9 mm MUST have a color contrast ratio of at least 7:1.

Classification for Pilots Must

How has it been tested? Automated

Result Not yet

AIR-02.1.3 Contrast exceptions for incidental text and logos

Description Incidental text or logos MAY ignore the contrast ratio requirements.

Classification for Pilots May

How has it been tested? Manual

Result Passed

AIR-02.2 Typefaces and fonts

Description Bizarre and indistinct typefaces SHOULD be avoided. Most typefaces in common use are legible.

Classification for Pilots Should

How has it been tested? Manual

Result Passed

AIR-02.3 Default text size

Description Text MUST respect the default sizes of the operating system, but MAY be larger.

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-02.4 Adjustable text size

Description Text SHOULD be adjustable to larger or smaller size, either through the operating system, assistive technology, or via mechanisms in the program itself.

Classification for Pilots Should

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AIR-02.5.4

Text Alignment

Description	Blocks of text MUST NOT be fully justified. It MUST be either aligned to the left or right margin. Centered text is also allowed, but SHOULD be used sparingly.
Classification for Pilots	Must
How has it been tested?	Automated
Result	Passed

AIR-02.6

Internationalization and localization support

Description	The client MUST be able to be translated into multiple languages.
Classification for Pilots	Must
How has it been tested?	Manual
Result	Passed

AIR-02.6.1

Example translations

Description	Translations of the client SHOULD be provided for in at least three languages (e.g., English, German, and Spanish) to prove that translation is possible.
Classification for Pilots	Should
How has it been tested?	Manual
Result	Passed

AIR-02.6.2

Alternate languages

Description	Translations of the client MAY be provided in French, Italian, or other languages that are in use among the project partners.
Classification for Pilots	May
How has it been tested?	Automated
Result	Passed

AIR-02.7

Text alternatives for non-textual content

Description	All non-textual content (e.g., images) MUST have alternative text to describe them.
Classification for Pilots	Must
How has it been tested?	Manual

Result Not yet

AIR-02.7.1 Non-textual decoration, formatting, and invisible content

Description Non-textual content that is used only as decoration, to format items visually, or is invisible to the user **MUST** be implemented in a way that it is ignored by assistive technology.

Classification for Pilots Must

How has it been tested? Manual

Result Passed

AIR-02.7.2 Non-textual controls

Description Non-text controls **MUST** have a name that describes their purposes. See D22.7 § 8.5 for more information about controls.

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-02.7.3 Non-textual tests

Description Non-text content tests that would be invalid if given a text alternative **MUST** have descriptive identifying text instead.

Classification for Pilots Not applicable

AIR-02.8 Multiple cues to convey important information

Description Important information **SHOULD** be conveyed by more than one type of cue (e.g., not only color, not only text, or not only sound). Use additional information, such as position, or animation, to help convey the information.

Classification for Pilots Should

How has it been tested? Manual

Result Passed

AIR-02.9 Time-based media accessibility

Description Time-based media (e.g., video and audio) **MUST** conform to the AAA Level in the WCAG 2.0.

Classification for Pilots Not applicable

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AIR-02.9.1	Prerecorded audio accessibility
Description	Prerecorded audio tracks MUST be captioned and provide a sign language interpretation.
Classification for Pilots	Not applicable
AIR-02.9.2	Prerecorded video accessibility
Description	Prerecorded video tracks MUST provide an audio description and an extended audio description where there are not significant pauses to provide normal audio description.
Classification for Pilots	Not applicable
AIR-02.9.3	Alternative media
Description	Alternative media MUST be provided prerecorded synchronized media or prerecorded video-only (i.e., video, but no audio) content, and live audio-only content.
Classification for Pilots	Not applicable
AIR-03	Compatibility with Assistive Technology
Description	The client MUST be usable with different types of assistive technology.
Classification for Pilots	Must
How has it been tested?	Manual
Result	Not yet
AIR-03.1	Compatibility with screen readers
Description	The client MUST be compatible with at least two of the following screen readers: Talkback, VoiceOver, NVDA, Jaws, Windows Eyes, SuperNova, Orca, ZoomText, or any other equivalent screen reader software.
Classification for Pilots	Must
How has it been tested?	Manual
Result	Not yet
AIR-03.2	Compatibility with screen magnifiers
Description	The client MUST be compatible with the at least two of the following screen magnifiers: SuperNova, Virtual Magnifying Glass, ZoomText, any of the operating system specific mag-

nifying tools, or other equivalent screen magnifying software.

Classification for Pilots Must
How has it been tested? Manual
Result Passed

AIR-03.3 Compatibility with onscreen keyboards

Description The client MUST be compatible with the at least two of the following onscreen keyboards: KeyStrokes, Florence Virtual Keyboard, SofType, Magic Cursor 2000, Click-N-Type, any of the operating system specific onscreen keyboards, or other equivalent onscreen keyboard software.

Classification for Pilots Must
How has it been tested? Manual
Result Passed

AIR-04 Keyboard Control

Description All tasks in the client MUST have equivalent ways they can be accomplished by only using the keyboard, without requiring specific timings for specific keystrokes.

Classification for Pilots Must
How has it been tested? Manual
Result Passed

AIR-04.1 Logical navigation via keyboard

Description Navigation using only the keyboard SHOULD be logical. That is, the navigation should follow the logical layout of the client.

Classification for Pilots Should
How has it been tested? Automated
Result Passed

AIR-04.2 Shortcuts for keyboard navigation

Description Shortcuts to aid navigation MAY be implemented.
Classification for Pilots Not applicable

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AIR-05 **No Timing of essential events or activities**

Description Any activity in the client that is essential, i.e., if removed would fundamentally change information or functionality and cannot be achieved in another way, **MUST NOT** be timed. Exceptions exist for non-interactive synchronized media, events that happen in real-time, and lifetime of tokens and sessions.

Classification for Pilots Not applicable

AIR-06 **Postponing Interruptions**

Description It **MUST** be possible to postpone interruptions unless the interruption involves an emergency.

Classification for Pilots Not applicable

AIR-07 **Compliance with legal requirements for accessibility and inclusion**

Description The provision of accessibility and inclusion features within FutureID services **MUST** be in compliance with the applicable European legislation relevant for accessibility and inclusion matters. The provision of accessibility and inclusion functionalities within FutureID services **SHOULD** be in compliance with the UN Convention on the Rights of Persons with Disabilities and its Optional Protocol.

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-07.1 **Data processing legally compliant with European Data Protection Legislation**

Description If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, it **MUST** be in accordance with the provisions of the European data protection law, in particular the European Data Protection Directive 95/46 EC and the e-Privacy Directive 2002/58/EC and its amending Directive 2009/136/EC (see also D22.6 for details).

Classification for Pilots Not applicable

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AIR-07.1.1	Avoid the collection and processing of user data
Description	If possible, accessibility and inclusion functionalities SHOULD NOT by default require the collection of personal data of the user.
Classification for Pilots	Should
How has it been tested?	Manual
Result	Passed
AIR-07.1.2	Have legal ground for processing personal data
Description	If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, a valid legal ground in accordance with Article 7 European Data Protection Directive 95/46/EC MUST exist (e.g., valid consent, contract).
Classification for Pilots	Not applicable
AIR-07.1.3	Data collection & processing only as far as necessary
Description	If an independent third party entity offers the accessibility and inclusion functionalities and this requires information about the user's physical or cognitive condition, the service provider MUST NOT obtain this information.
Classification for Pilots	Not applicable
AIR-07.1.4	Purpose-bound processing
Description	Personal data collected for the provision of accessibility and inclusion functionalities MUST NOT be used for other purposes without legal ground.
Classification for Pilots	Not applicable
AIR-07.1.5	Deletion of user data if no longer necessary
Description	If accessibility and inclusion functionalities require information about the user's physical or cognitive condition, the personal data about the user MUST be deleted once it is no longer necessary for this purpose.
Classification for Pilots	Not applicable
AIR-07.1.6	Appropriate safeguards for user data
Description	If accessibility and inclusion functionalities require infor-

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mation about the user's physical or cognitive condition, appropriate safeguards **MUST** be implemented to protect that data (technical and organizational measures). Moreover, this data **SHOULD** be stored under the control of the user (e.g., locally on the user's device).

Classification for Pilots Not applicable

AIR-07.2 Realize transparency and user control

Description

Sufficient transparency and appropriate ways for users to exercise control **MUST** be provided, while these **SHOULD** take into account specific accessibility and inclusion needs of users. Each legal ground for the collection and processing of personal data for the purpose of providing accessibility and inclusion functionalities **MUST** be made available for the user at any time, while different levels of user abilities regarding perception and understanding of all information relevant to them **SHOULD** be taken into account. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modus of processing, and the implemented technical and organizational measures **MUST** be given at an utmost early stage of the interaction in accessible formats. The information of the user **SHOULD** comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-07.2.1 Enable information on user side

Description

Accessibility and inclusion functionalities **MUST** include functionality for the user to learn all relevant information concerning the user at any time, e.g., the price of the service, legal protection, which data is collected, processed and stored. Also, each legal ground for the collection and processing of personal data for the purpose of providing accessibility and inclusion functionalities **MUST** be made available for the user at any time, taking into account different levels of user abilities regarding perception and understanding of

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all information relevant to them. For privacy-related requirements, an example is given as follows (see also D22.3): To enable impaired users for giving valid, informed and voluntary consent to the processing of their data, information about the nature of the service, the modi of processing, and the implemented technical and organizational measures MUST be given at an utmost early stage of the interaction in accessible formats. The information of the user SHOULD comply with the layered policy approach as proposed by the Article 29 Working Party in its Opinion 10/2004 on More Harmonised Information Provisions (WP100).

Classification for Pilots Must
How has it been tested? Manual
Result Not yet

AIR-07.2.2 Enable control on user side

Description

Accessibility and inclusion functionalities of FutureID services MUST include functionality for the user to exercise control about her data by exerting influence or by decisions, e.g., through controls built into the UI so the user can act if information is false or the user wants it deleted.

Classification for Pilots Must
How has it been tested? Manual
Result Not yet

AIR-07.2.3 Allow alternative output

Description

Accessibility and inclusion functionalities SHOULD allow alternative outputs other than just a user computer. This output SHOULD include alternate devices (e. g. tablets and smartphones) as well as output channels to assistants of the user (e. g. delegates, caring persons, and other authorized third parties). More examples are: Accessibility and inclusion functionalities SHOULD allow alternative access systems to just screen (e. g. ASCII-export for text-to-voice readers). Accessibility and inclusion functionalities SHOULD allow the semantically equivalent and lossless processing of alternative access systems (e. g. checking or creating signature components), especially if they are used to exercise legally binding or else highly relevant decisions.

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Classification for Pilots Should

How has it been tested? Manual

Result Not yet

AIR-07.2.4 Implement feedback and help channels

Description

Accessibility and inclusion functionalities **MUST** include the implementation of assistive feedback and help channels (multiple channels) to enable the user to handle an error message or other accessibility dysfunction. This includes a contact channel to an external support person on the side of the entity providing the accessibility services.

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-07.2.5 Logging of processing operations

Description

Any changes to the data set (collection, modification, back-up, deletion, etc.), as well as read-only accesses **MAY** be logged and stored under the control of the user (e.g., locally on the user device powered by the user client). Accessibility and inclusion functionalities then **MUST** include functionality for the user to have reading access to these logs.

Classification for Pilots Must

How has it been tested? Manual

Result Not yet

AIR-07.3 Support of service providers offering accessibility functionalities

Description

Service Providers **SHOULD** be supported in choosing eID services that fulfill accessibility and inclusion requirements (e.g. by providing information such as “accessibility & inclusion seals” within the FutureID infrastructure). Such support **MAY** be realized by holding this information in the trust repository.

Classification for Pilots Should

How has it been tested? Manual

Result Not yet

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AIR-08.2.3 Testing of client by people with hearing impairment

Description The client SHOULD be tested by users with hearing impairment.

Classification for Pilots Should

How has it been tested? Manual

Result Passed

AIR-08.2.4 Testing of client with people with dyslexia

Description The client SHOULD be tested by users that have dyslexia.

Classification for Pilots Should

How has it been tested? Manual

Result Passed

AIR-08.2.5 Testing of client with people with other cognitive impairments

Description The client SHOULD be tested by users with other cognitive impairments, such as memory problems or mental retardation.

Classification for Pilots Should

How has it been tested? Manual

Result Passed

AIR-09 Client help and support material accessibility

Description Online help material—such as web pages, digital manuals, or local on the machine running the client—MUST be accessible as per AIR-02 — Ensure content in the client is accessible to the largest audience.

Classification for Pilots Not applicable

AIR-10 Alternative help and support

Description Alternate help and support systems for the client (e.g., call centers, learning centers) SHOULD take accessibility and universal design into account.

Classification for Pilots Not applicable

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4 Conclusion

The accessibility and inclusion evaluation has been applied in three different areas: the architecture, the development client, and the pilots. These evaluations covered most of the original requirements from D22.7 (Schulz et al., 2013). Because of the limitations of the project, we did not have an opportunity to check some requirements (for example, many of the AIR-07.*, AIR-09 and AIR-10 are targeted more at a fully functioning system in use by users), but these requirements are still valid and worth checking in real world scenarios.

The evaluations show the benefit of focusing on accessibility and inclusion since the beginning of FutureID. Overall, the different evaluations found issues and allowed us to correct them. If we had not had these evaluations, we could have risked having a system that would not have been accessible to people with disabilities. This would have made FutureID not a valid choice in countries like Norway (Diskriminerings- og tilgjengelighetsloven (DTL), 2008) and Spain (Spanish Ministry of the Presidency, 2007).

In addition, some of the FutureID requirements are more stringent than the current requirements in these countries. That means that if implementers follow the accessibility and inclusion requirements for FutureID they can be reasonably sure that their solutions are accessible for as many people as possible.

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A Pilot evaluation methods and scenarios

A.1 Choice of evaluation methodologies

The aim of the accessibility evaluation is to evaluate whether the solutions will be accessible for a wide range of people, including people with various types of disabilities, such as blindness, partially sightedness, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement and speech disabilities.

Accessibility is sometimes divided into two main categories: technical accessibility and usable accessibility. Technical accessibility's main goal is to ensure that people with disabilities can perceive the information and operate the user interface of a solution. The main goal of usable accessibility is to ensure that the solution is usable for people with disabilities. Technical accessibility is a precondition for usable accessibility. An accessible solution needs to be both technical accessible and usable for people with disabilities.

Therefore, method triangulation is recommended (Fuglerud, 2014). That is, one should at least use a combination of methods from these two main categories. There are, however, many potential methods. In **Table 1**, we have listed a number of methods that can be used to evaluate accessibility, and roughly indicated whether the methods would be suitable to uncover technical or usable accessibility issues.

Table 4 Table of methods and whether they cover technical or usable accessibility.

Method	Technical	Usable
Automatic WCAG-testing	✓	
Manual WCAG-testing	✓	✓
WCAG-EM	✓	✓
Manual testing with different types of assistive technologies	✓	✓
Manual and automatic standards compliance testing, (CSS, HTML, etc.)	✓	
Inspection methods	✓	✓
Walkthrough-methods		✓
Personas walkthrough		✓
Cognitive walkthrough		✓
Using disability simulation kit	✓	✓
Using accessibility guidelines	✓	✓
Inquiry		✓
Interview/focus group		✓
Questionnaire		✓
Usability test	✓	✓

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In FutureID, a combination of several of these methods has been chosen for a thorough accessibility evaluation. Each of the methods has its strengths and weaknesses

A.2 Pilot activities and scenarios

There are two available pilots, E-Health Services for Citizens (epSOS) and E-Learning Services for Enterprises (Atos). Both have activities suitable for accessibility testing: registration, authentication and signing of documents.

A.2.1 Test scenarios

Both epSOS and Atos are using the same FutureID authentication technology. Since the epSOS pilot was more complete at the time we started the testing, we have focused on that pilot, with the following test scenario:

- Authentication and authorization for patient access through epSOS with FutureID

A user of epSOS can be authenticated using either a software certificate or an e-ID card. We had a FutureID certificate and an Estonian e-ID card available for testing. Based on the possible authentication methods, we created the following set of tasks from the chosen scenario:

1. Login with invalid certificate
2. Login with valid certificate
3. Login in with a wrong e-ID card
4. Login in with Estonia e-ID card using a wrong PIN
5. Login in with Estonia e-ID card using a correct PIN

In the first two tasks, the intention is to test if a user can login with a digital certificate. When the test is started we have not installed any certificate in the browser, and we expect the user to run into problems when he can't find a certificate. The purpose of this task is to investigate if a user understands which choices he has to make to use a certificate, that a certificate is missing, and that a certificate is required. Between the first and second task we will install a valid certificate for the user and ask the user to redo the test, but this time with the knowledge that there is a valid certificate.

For the last three tasks we want to investigate if the user can login to the pilot using an e-ID and a smartcard reader. In the third task we give the user a normal bankcard, but tell the user that the card should be a valid form of e-ID. We then ask the user to login using this card (and an imaginary pin code). For the fourth task we provide a valid e-ID card, but we give the user an incorrect pin code. In the last test we provide the user with a valid card and valid pin code. The purpose of these three tasks is to investigate if a user can find the correct e-ID in the list, if he can manage to login using a smartcard reader and if he can find the required information/help.

The tasks are ordered in a progressive manner with the intention of having the user experience as many situations as possible. It's also important to reveal as little as possible about the pilot from one task to the next, in order to keep the test person's view of the pilot

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as fresh as possible, and hence get as many immediate reactions from the test person as possible. The tasks were performed in this order through all the personas testing and the testing with simulated disabilities.

A.3 Methods and procedures

Due to time constraints, we could not recruit actual persons with sensory, physical and cognitive disabilities; we needed to simulate the behaviors of real users in order to get some indication of the accessibility of the pilots. This is, however, not a substitute for real user testing with disabled people and real impairments, but a tool for investigating and providing feedback to e.g. developers.

It requires a lot of effort to organize and execute accessibility testing. It's worth using some time ahead of a test to do some basic evaluation to discover the most basic flaws or problems for the various disabilities. It's a waste of time for the testers and the test users if a solution turns out to be technical inaccessible for people with disabilities already on the first page. For example if a blind user is not able to read the information on the page because it is not technical compatible with his or her screen reader.

One important step in accessibility testing is therefore to use various methods to uncover the most basic usability and accessibility flaws in advance. If allowing time for the developers to fix these issues before user testing with people with disabilities, then everyone benefits.

To cover a broad range of potential problems for disabled users, we have used various methods. The various methods cover the needs of the different types of disabilities to a varying degree. Therefore it is necessary to consciously select methods to cover as wide a range of user groups as possible. In addition we wanted to cover both technical and usable accessibility. Thus, first we have identified different disabilities in § A.3.1, before we describe the different methods and which type of disabilities they are likely to cover in § A.3.2. In the next sections we have described each method in detail.

A.3.1 Disabilities

There are many kinds of disabilities and we decided to try to cover a broad range of impairments. The most common categorization of impairments is along the sensory, physical and cognitive dimensions. These can be divided more specifically into visual, auditory, physical and cognitive impairments. While there are good guidelines and tools for evaluating sensory and physical accessibility, it is in general more difficult to address cognitive impairments. This may be because this group is extremely diverse, and that many types of cognitive impairments are poorly understood in terms of e-accessibility. We selected to focus on dyslexia and being old because the evaluators had ample experience with user testing with these two user groups. This is an advantage when doing expert evaluation, such as persona testing (Schulz & Fuglerud, 2012).

Sensory and physical impairments are easier to test, since it's possible to use tools in order to experience these types of disability. It's of course not a good replacement for a user

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with the actual disability, but it can give good indications of the most typical problems. It's also worth mentioning that using ICT with a sensory or a physical disability involve a certain element of cognitive load that is hard to simulate for a non-disabled user. For instance, a hearing impairment might involve a lot of frustration if critical information is only conveyed through audio, and a user with a hearing disability might give up sooner than a user that simulates hearing impairment (or vice versa). Moreover, using assistive technology introduces an extra level of technology that the user must learn and handle in combination with the solution in question.

Table 5: List over disabilities and methods used to simulate them.

Type of disability	Method	Materials
Dyslexia	Persona Testing	Jose Salazar
Being old	Persona Testing	Sam Wright
Reduced vision	Disability Simulation	Using Cambridge inclusive design glasses <ul style="list-style-type: none"> • The glasses simulate a general loss of the ability to see fine detail. The effects are representative of an inability to achieve the correct focus, reduced sensitivity of retinal cells, and problems with internal parts of the eye becoming cloudy. These effects typically occur with aging and the majority of eye conditions, as well as not wearing appropriate corrective glasses. • One pair of glasses simulates a mild loss of vision ability. More severe levels of impairment can be simulated by wearing multiple glasses on top of each other. The glasses have been designed to be thin and light-weight to enable this.
Reduced dexterity	Disability Simulation	Cambridge inclusive design gloves <ul style="list-style-type: none"> • The gloves simulate a reduction in the functional ability of the hands. Various conditions, such as arthritis, can cause effects like these.
One handed	Disability Simulation	A sling to simulating a broken arm.
Poor feeling in fingers	Disability Simulation	Latex gloves
Hearing loss	Disability Simulation	Earplugs
High contrast	VATLab	High contrast mode in windows + extension for chrome.
Blindness	VATLab	SuperNova and NVDA
Mult. disabilities	Expert walkthrough	WCAG 2.0 guidelines and VATLab checklist

The different methods and materials used are covered in the next section.

A.3.2 Methods

There are two kinds of methods that we have used: Task-based or checklist. Most of the testing has been task-based where a user is given a task (§ A.2.1), and should try to complete the task using either persona testing, disability simulation or with the VATLab lab. We have also done several checklists testing where an expert goes through a checklist and evaluate all parts of the solution.

A.3.2.1 Persona testing

In the persona walkthrough or persona testing approach (Schulz & Fuglerud, 2012), an expert simulates or play-acts a persona while carrying out typical tasks. In FutureID, there are two personas (Schulz et al., 2013), one with arthritis and one with dyslexia. For each persona there will be one expert play-acting the particular persona while performing the predefined test-scenarios. The more knowledge the expert has about the kind of challenges persons with the type of disability that the particular persona he or she is play-acting has, the easier it is to do a realistic and credible acting while testing the solution. This approach is informal and relatively quick to do, but is heavily dependent on the selected personas and the experience that the expert has with the particular type of disability that the personas has.

A.3.2.2 Disability Simulation

To simulate a physical disability, several materials and tools are needed. We have used the Cambridge inclusive design glasses for simulating reduced vision. It's possible to use one to five glasses in combination to simulate different reduced vision impairments. A normal user typically needs two glasses in order to simulate mild vision reduction. Three glasses will then typically simulate vision reduction that less than 1% of the population has (Goodman-Deane, Waller, Collins, & Clarkson, 2013).

We have also used the Cambridge inclusive design gloves to simulate dexterity reduction. These gloves are typically used when testing product and prototypes, but can also be used in software testing when a mouse or external device is involved. We have decided to include these gloves in our simulation since there is a smartcard reader involved.

To simulate hearing loss we can use earplugs or earmuffs to remove all sound. A sling can be used to simulate a broken arm, which is often overlooked when testing accessibility since it's a more temporary condition. However, it's important that all conditions and groups are included in a testing environment. Finally it's possible to use latex gloves or similar gloves in order to simulate poor feeling in the fingers.

A.3.2.3 VATLab

We have used a Virtual Assistive Technology Lab (VATLab) to test with Assistive Technology used by blind and partially sighted contrast impairments (Fuglerud, Halbach, & Skotkjerra, 2015). The VATLab contains two different screen readers; NVDA and SuperNova. Both of these tools are used by blind people, and give a good indication of how accessible the solution is for blind people.

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We have also used the built in high contrast mode in windows to simulate high contrast mode for persons that are light sensitive.

A.3.2.4 Expert walkthrough

The expert walkthrough should in theory cover multiple disabilities, and include vision problems, hearing problems, mobility problems etc. The de-facto guidelines for web pages, WCAG 2.0, have been evaluated. We have also used a VATLab checklist that has more specific points with regards to blindness and/or vision reduction. This checklist was developed to uncover accessibility problems for screen reader users.

A.3.2.5 WCAG 2.0 Guidelines

There is no complete and easy available automatic tool for WCAG-testing, hence we have chosen to do manual WCAG-testing, but with supportive use of available browser plugins to check for instance color contrast.

The WCAG 2.0 Guidelines was also evaluated for the Java application.

A.3.2.6 VATLab Checklist

The VATLab checklist (Fuglerud, Skotkjerra, & Halbach, 2015) is aimed towards checking how well a webpage works with a screen reader. The checklist was also evaluated on the Java application.

The following elements are evaluated in the pilots:

Links

1. Does the screen reader inform the user that there are links?
2. Is it possible to understand the link's target without knowing the context?
3. If the link opens a new window; is this apparent for the user?
4. Should the link, based on the visual layout, be a button instead?

Headings

5. Does the screen reader inform the user that there is a heading?
6. Does the heading level match the visual representation?

Images

7. Does the screen reader inform the user of the alternative text (alt text) for an image?
8. Does the user miss important information if the alternative text is not present?
9. Does the alternative text illustrate the image in a good manner?

Buttons

10. Does the screen reader inform the user that there is a button?
11. Does the screen reader inform the user about what the button does (is it the same text as seen on the screen or is it an alternative text for the icon or image)?

Tables

12. When a user moves across cells in a table, does the screen read inform the user about the column and/or row headings?

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13. Is it possible to understand the table based on what the screen read conveys?

Input fields

- 14. Does the screen reader inform the user that there is an input field?
- 15. Does the screen reader inform the user about what kind of information that is expected for the input field?
- 16. Does the screen reader inform the user about input suggestions (while writing)?

Checkboxes

- 17. Does the screen reader inform the user that there is a checkbox?
- 18. Does the screen reader inform the user what the checkbox is for?
- 19. Does the screen reader inform the user about the state of the checkbox (checked or unchecked)?

Radio buttons

- 20. Does the screen reader inform the user about a group of radio buttons (a heading for the collection of radio buttons)?
- 21. Is the description for each radio button conveyed to the user?
- 22. Does the screen reader inform the user of which radio button that is selected, both before and after a selection has been made by the user?

Custom input controller

- 23. Does the screen reader manage to inform the user about what kind of controller it has detected?
- 24. Does the user receive instructions on how to operate the controller?
- 25. Does the user receive feedback when the controller is manipulated?

If there are Internal frames (iframes):

- 26. Does the screen reader inform the user that an internal frame (iframe) is present?
- 27. Is there a descriptive name for the iframe?
- 28. Does the screen reader convey the context of the iframe correctly?

Regions and landmarks

If the webpage has landmarks or regions:

- 29. Do the landmarks or regions conveyed from the screen reader match the visual impression?
- 30. Does the screen reader inform the user about the contents of the different regions or landmarks?

Language

- 31. It's imperative that the language is always declared programmatically. The language should be declared, as a minimum, once per page. If a section of a page is in another language, it must be declared with the lang attribute for the section. The screen reader will then automatically switch to the correct syntactic voice for the given part of the page, assuming that the screen reader has an installed voice for the language.

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A.3.3 Lab environment and evaluation

All the task-based testing took place in the e-inclusion lab at the Norwegian Computing Center. The lab is equipped with a screen-based eye tracker and software for user experience testing. A person performing a task-based test would therefore start and end tasks through the testing software, and the person's eye-movements would be recorded, as well as the picture captured from a web-camera.

One or two observers were also present in the same room as the test person. The observers had to do some minor setup before some of the tasks, but would otherwise interfere as little as possible with the test scenario and the person performing the test. The observers were only observing and documenting the problems that occurred. The participants were encouraged to think loud and report everything they found difficult.

During the evaluation we decided to exclude certain disability simulations like one handed, poor feeling in fingers and hearing loss since experience and knowledge of the pilots indicated that these disability groups would not have much to add to the general knowledge. This was based on the fact that the pilots do not use audio or keyboard input. There is some interaction with the mouse and smartcard, but we argue that these cases are covered well enough with the reduced dexterity simulation and the VATLab.

In order to get a good sample size from various users, we evaluated the pilots with six different people for different disabilities. All methods were performed by at least three different people.

Before we started the evaluations, we also did two pilot evaluations to get input on the process, task description and order of tasks. The pilot helped us and we made adjustments to the scenarios that were defined.

A.4 Conclusion

Testing a solution with both expert walkthroughs and checklist on one hand, and task-based testing with test persons on the other hand is necessary for achieving a broad understanding of both the technical and the usable accessibility of the solution and uncovering the most issues. Measurable requirements are well suited for automatic testing or for expert walk-throughs, and the result of such testing gives, in a sense, a more objective view on the technical accessibility of the solution. The task-based testing, on the other hand, reveals both technical and usability accessibility issues experienced by the test persons and uncovered by the experts.

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