Towards Open Access Accessibility Everywhere: The ÆGIS Concept

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Abstract. The current paper presents the concept of ÆGIS Integrating Project (Grant Agreement: 224348), which aims to embed support for accessibility into every aspect of ICT-including the pre-built user-interface components, developer's tools, software applications and the run-time environment, and via embeddable assistive technologies. ÆGIS is a 3,5 years project, aiming to constitute a breakthrough in the eInclusion area, through the development of an Open Accessibility Framework, upon which open source accessibility interfaces and applications for the users as well as accessibility toolkits for the developers will be built. Three mainstream markets are targeted, namely the desktop, rich Internet applications and mobile devices/applications market segments.

Keywords: accessibility, open source, mainstream ICT, Open Accessibility Framework, design, development, assessment, desktop, rich web applications, Java-based mobile devices.

1 Introduction

With the recent emergence of a 3rd generation accessibility approach[1], mainstream (Information and Communication Technologies) ICT companies and the regulatory bodies that address ICT accessibility have now begun to recognize the importance of a formal division of responsibilities in ICT accessibility: tasks done by the ICT "platform", tasks done by ICT "applications", and tasks done by AT. This 3rd generation approach is also in service of a shift towards Universal Design. Still, this early emergence fails short from this goal, due to the lack of appropriate developer toolkits and methodologies/tools for embedding accessibility within mainstream products in a cost effective way. ÆGIS is an Integrating Project that comes to bridge this gap, by developing an Open Accessibility Framework (OAF) and open

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[1] The first generation of ICT accessibility emerged in the 1960s with access to character-based systems to people with vision impairments. The second generation emerged in the 1980s with access to the graphical desktop via complex, reverse-engineering on the part of AT. This third generation began to emerge at the end of the 20th century, and is now actively being pursued in the desktop realm but not yet at all in rich Internet applications or for mobile devices.

source accessible interfaces and applications for the users and accessibility toolkits for the developers. This is performed in three interconnected and high value mainstream markets, those of the:

- desktop,
- rich Internet applications, and
- mobile devices / applications, also taking into account the recent Information Technology (IT) convergence trend bringing together / combining these sectors into common applications (i.e. web applications on the desktop, cell phones that are browsers and play videos, etc.).

Therefore, ÆGIS does not seek to develop yet another accessible application(s) for the people with disabilities and/or elderly. It targets the very "heart of the problem", i.e. the "building blocks" of all applications offered through mainstream ICT to all people (whether with impairments or not). The project will produce major new open source results (and expand upon existing open source efforts) that are expected to:

- Bring key contribution to a collective mindset change towards placing users and their needs, such as utility, accessibility, simplicity and learnability, at the centre of all ICT developments.
- Focus on providing new solutions for embedding accessibility in current and future mass-market ICT-based products and services. ÆGIS solutions shall be open, plug & play, personalized & configurable, realistic and applicable in various contexts.
- Offer significant support to ICT developers, in order to encourage and empower them to contribute towards the inclusive ICT vision. The heart of this support is in the open source developer tools and user-interface building blocks into which accessibility support will be built. This support also support includes, but is not limited to, the delivery of standards and design guidance, know-how transfer through training and other means, in order to enable developers to verify and optimize the accessibility of their prototypes at all development stages.
- Facilitate the development of simple, cost-effective, useful, accessible, usable, and ultimately, adoptable ICT. Particular attention is paid to solutions and approaches that will extend the current population of ICT beneficiaries representing, nowadays, roughly 30% of the European population (a production force, and concurrently a market share, highly unexploited today). Thus, ÆGIS aims at mainstreaming and radically improving the user experience with ICT, by advancing the current paradigms of accessibility and usability for people with functional limitations, people lacking digital competence, and marginalized young and elder people [1].

2   What Is ÆGIS?

The ÆGIS project (Open Accessibility Everywhere: Groundwork, Infrastructure, Standards ; http://www.aegis-project.eu) seeks to determine whether 3rd generation access techniques will provide a more accessible, more exploitable and deeply embeddable approach in mainstream ICT (desktop, rich Internet and mobile applications). This approach is developed and explored with the Open Accessibility Framework (OAF) through which aspects of the design, development and deployment of accessible main-

stream ICT are addressed. The OAF provides embedded and built-in accessibility solutions, as well as toolkits for developers, for "engraving" accessibility in existing and emerging mass-market ICT-based products, thus making accessibility open, plug & play, personalized & configurable, realistic & applicable in various contexts; ÆGIS is placing users and their needs at the centre of all ICT developments. Based on a holistic UCD, ÆGIS identifies user needs and interaction models for several user groups, (users with visual, hearing, motion, speech and cognitive impairments as well as application developers) and develops open source based generalized accessibility support into mainstream ICT devices/applications:

- desktop,
- rich web applications, and,
- Java-based mobile devices.

All developments will be iteratively tested with a significant number of end users, developers and experts in 3 phases and 4 Pilot sites Europe wide (in Belgium, Spain, Sweden and the UK).

The project includes strong industrial and end user participation (the participating industries are among the market leaders in the corresponding mainstream ICT markets). The project results' uptake is promoted by strong standardization activities, as well as the fact that much of the technology results will be either new open source applications or will be built into existing and already widely adopted open source ICT.

3 ÆGIS Users, Stakeholders and Domains

ÆGIS efforts occur in the following important domains:

- Desktop and mobile user agents and web browsers
- "Web 2.0" applications - rich Internet applications built with technologies like AJAX, DHTML, JavaScript, and JavaFX
- Mobile applications and devices (e.g. smart phones, PDAs, etc.)
- Developer's tools
- Document authoring applications
- Communications products
- In this context, ÆGIS addresses 2 main categories of end users:
- Developers of ICT infrastructure, applications and services –referred to hereinafter as "developers"
- People with disabilities –referred to hereinafter as "end users"– who experience one or more of the following mild to severe impairments:

    o   Blind and low-vision users
    o   Motor impairment users
    o   Cognitive impairment users
    o   Hearing impairment users
    o   Speech impairment users

It is worth noting that the target end user groups include also the elderly, given that the vast majority of elderly people experiences one or more of the above impairments.

These people have the competence, in most cases, to lead independent and active lives, but, are at risk of exclusion due to the impairment(s) that they are experiencing, as well as the complexity and lack of utility, accessibility and usability of ICT. It is worth noting that people with disabilities represent at least 16% of the overall EU working age population, but only 40% of persons with disabilities are employed compared to 64.2% of non disabled persons. This gap often exists because of a lack of properly adapted working environments (both in terms of hardware or software).

People with disabilities included in the main ÆGIS end user group are supported through a multitude of stakeholders that are duly considered and supported by the ÆGIS Open Accessibility Framework, such as:

- ICT providers (industrial players and SMEs)
- National, local and regional authorities
- Teachers / tutors / trainers/ formal informal care-givers
- Disability groups, forums and Associations
- Family members
- Mobile service providers
- Public / private Social security service providers and insurance companies
- Web service providers
- Health care and emergency support service providers
- Policy makers / standardization bodies

Individual end users (people with disabilities), who will actively participate in the project's User Centered Approach and iterative evaluations will be recruited through Partner networks and contacts of the end user representatives in the Consortium (RNIB, FONCE, EPR, ACE, SUDART) and key individual specialists working with people with disabilities.

Based on the ÆGIS User Centered Approach, the above end users will be involved throughout the project in all of its phases, as well as various other stakeholders such as accessibility assessors and developers, service providers, and where applicable relevant accessibility units within public bodies. In addition, ÆGIS addresses indirectly all stakeholders who are engaged with the well being of people with disabilities, such as formal / informal care-givers, teachers / tutors/ trainers, family members, public / private social security service providers, insurance companies, health care and emergency support service providers, etc. Their views are represented in the ÆGIS Consortium either directly (e.g. FONCE incorporates FIAPAS, the Spanish Federation of Associations of Parents and Friends of the Deaf), or indirectly (through partners' contacts).

4   ÆGIS Concept and Objectives

4.1   The ÆGIS Concept

ÆGIS aims, through user research and prototype development with current and next-generation ICT, to develop and validate the necessary infrastructure and accessibility

frameworks needed for deeply embedding accessibility into the desktop, for mobile devices, and rich Internet applications; with a focus on the needs of users with mild, severe or complex disabilities served via assistive technologies; and, where appropriate, to propose these results to the appropriate standards organizations for review and potential adoption, as well as to make them available through open source as much as possible. In realizing this aim, the following cornerstones of the approach are highlighted:

- ÆGIS is addressing the entire "accessibility value delivery chain" in this new, 3rd generation ("built-in") approach to accessibility and support for assistive technologies - where programmatic accessibility mechanisms are defined, built into the building blocks of software applications, supported by developer tools, and exposed on the user's platform and web browser - thus creating a welcoming environment for AT on those platforms.
- As the participating industries and especially the Technical Coordinator (Sun Microsystems) have key technology in all aspects of this "value delivery chain", ÆGIS is in an ideal position to develop ÆGIS support "everywhere" (the "E" in ÆGIS). Furthermore, the Partners' technology is itself deeply embedded in the mobile space (80% of cell phones sold have Java-based technology in them) and for rich Internet applications, thus ÆGIS Consortium is the best positioned organization to bring "built-in accessibility" to these devices.
- The vast majority of work undertaken by ÆGIS will be on open source technologies, available for all to use under open source (and royalty-free) licenses, so there will be (for example) 5 assistive technology prototypes that will be all open source, and built-in DAISY and Braille support in a major office suite that is open source, etc.

The software development that will be undertaken in this respect follows a predictable path as illustrated in the figure below. Using user interface elements from a component set, (1) the software developer composes them in a developer's tool (2) in order to build a rich Internet application (3), or a desktop application (4), or a mobile application (5) for a PDA or cell phone. The rich Internet application requires a web browser (6) that knows how to expose it to an assistive technology running on the desktop (7). Likewise, the more typical desktop application is accessible because of an assistive technology running on the desktop. Mobile applications are accessible because of the work done by an assistive technology (8) on the cell phone or PDA.

4.2 ÆGIS Objectives

The big ÆGIS innovation lies in the fact that, while there have been limited and rather isolated attempts at addressing a few specific pieces of this ICT development process, never has such a comprehensive and holistic approach been taken, and never on so large a scale (encompassing rich Internet applications and mobile devices, in addition to the desktop). The fundamental scientific objectives of the ÆGIS Open Accessibility Framework, towards the achievement of which the project will steer the Consortium's research are:

1. to demonstrate and prove that use of 3rd generation access techniques results in equal or better end-user access experiences as compared to the existing, 2nd generation approaches;
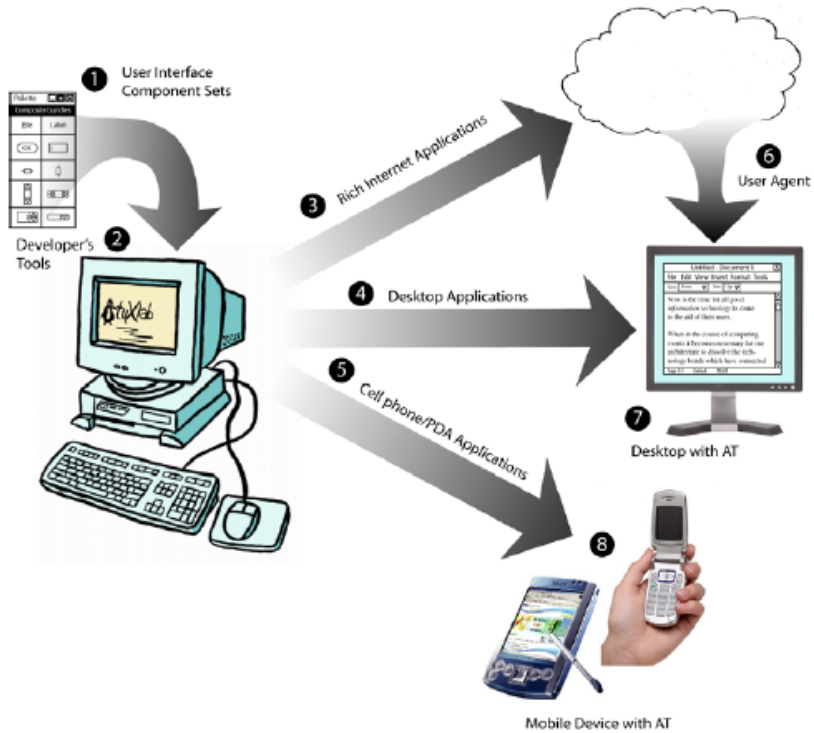
Fig. 1. The ÆGIS software development path

2. to identify and develop the right combination of developer's tools aiding in creating accessible applications which leverage sets of pre-built and accessibility enabled user interface components for desktop, mobile, and rich Internet applications; which together allow developers to comfortably and easily create accessible applications;
3. to develop a set of embeddable assistive technologies for mobile devices that fit into this framework and deliver a satisfying experience to people with disabilities;
4. to develop a set of user agents for desktop and mobile devices which leverage and translate a cross-platform accessibility API from the 3rd generation access techniques of the web, to the desktop and mobile accessibility APIs – in such a fashion as to give users with disabilities the same utility and accessibility with rich Internet applications as they have with accessible desktop applications.

In addition to this overarching, framework approach to providing generalised access to mainstream ICT, ÆGIS will also address two of the key purposes for which people use ICT – for creating accessible documents and information, and for communicating with other people in an accessible manner. For document and information creation, the project will bring the latest research into assistance for people with cognitive impairments into use with a popular, open source office suite. Further, ÆGIS addresses the issues of accessibility document creation by building direct support for DAISY

digital talking books and Braille and large print to that office suite – so that ÆGIS aids not just developers, but also document authors – in the ÆGIS project. To aid the deaf and hard of hearing community in communicating with one another and with people outside of that community – and also with emergency services – the project will build into mainstream ICT communication software the ability to communicate using real-time-text. Our objective is to demonstrate how mainstream ICT communication applications can utilize these techniques to integrate and support real-time-text within their existing communication product. For people with speech impairments, ÆGIS will develop and demonstrate affordable – and open source – AAC applications that can be embedded into future mobile devices and desktop systems.

The final, core objective of ÆGIS is to address the major economic barriers to e-Inclusion. The project takes the traditional approach of involving key industrial partners in the consortium, and then goes a step further by developing all of infrastructure, developer's tools, our prototypes assistive technologies under an open source software license. This will allow mobile device manufacturers to extend, complete, and embed these assistive technologies into their products cost effectively. It will also allow desktop systems to include real-time-text communications systems – that interoperate with those on cell phones and PDAs – cost effectively. It will enable developers to obtain the developer's tools and user interface component sets to create accessible applications at no cost. And it will allow the translation and customization of these access solutions to the languages and needs of every EU Member State.

5   ÆGIS Overall Strategy and Innovation

In the holistic approach to accessibility that is taken within ÆGIS, the project directly supports developers, to dramatically reduce their burden on making applications
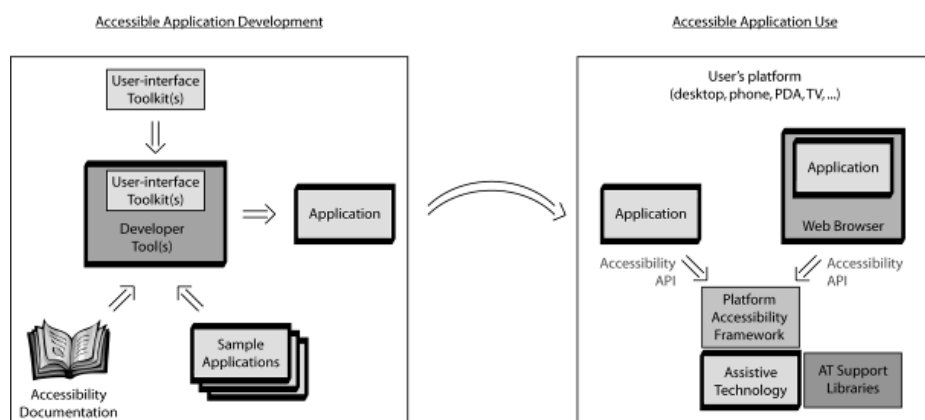

Fig. 2. The ÆGIS approach

accessible. While a number of the ideas and techniques used aren't new (the basic concept of UI component sets is well established, and the project technical coordinator Sun was one of the first to apply this in service of accessibility), nobody before ÆGIS has woven them into a complete, holistic approach to accessibility, called the "Open Accessibility Framework" of ÆGIS.

ÆGIS will establish a set of user interface components supporting accessibility one step further – by making it a cross-platform set of components designed for rich Internet applications. To fully prove the technique, the project will implement the emerging WAI ARIA specification on several different user interface component sets, and on several particular complex user interface components. In this fashion, the project may discover some limitations of the WAI ARIA specification and engage with the W3C Standardization effort to change and improve the standard based on our discoveries. ÆGIS will also transfer the Java Accessibility API to the more complex world of highly visual/animated web user interfaces – these are user interfaces created not with typical user interface component sets, but rather with animated bitmap and vector graphics drawing primitives.

Further, ÆGIS will apply these cross-platform accessibility APIs to a pair of cross platform user agents – a web browser and a Java run-time environment. These user agents, in turn, translate the cross-platform accessibility APIs into their native platform accessibility APIs, so that assistive technologies need not support both the platform accessibility API and the rich Internet accessibility API; the user agent mediates that information for the AT.

While parts of the ÆGIS approach – third generation access and user interface components implementing accessibility support – have been realized by some of ÆGIS consortium participants on desktop systems, they have never been attempted on mobile devices, like cell phones and PDAs. Access on those devices is still mired in the second generation approach to accessibility. ÆGIS will take the holistic approach in building out on the desktop and web, and apply it to mobile devices. This means ÆGIS will define accessibility APIs for the mobile space, define user interface component sets and prototype built-in support for the accessibility APIs on those component sets, create developer tool support to help developers create accessible mobile applications, prototype the necessary platform accessibility services to support assistive technologies (including text-to-speech services), and then go on to develop a set of prototype assistive technologies as well. While this is a large undertaking that breaks new ground in many areas, the history the ÆGIS partners have in developing many of these components for the desktop provides confidence it can be accomplished.

All of this implementation work is for nothing if it doesn't result in a satisfying experience for users with disabilities. For that reason this project is undertaken in close collaboration with expert disability user organizations, with a strong focus on User Centered Design. These user organizations bring a strong mixture of experienced technology users (expert in the use of second generation access solutions) and novice users, for whom much of this technology will be brand new. This combination will allow us to build prototype solutions that are proven to meet a broad range of new as well as experienced technology users. Such a thorough and comprehensive design approach is novel in the field of assistive technology development.

Particularly innovative is the development, hand-in-hand, of the mainstream consumer products and the assistive technology solutions for them, all with the close consultation and collaboration of disability organizations and users.

Finally, ÆGIS brings critical innovation to the problem of the major economic burden access solutions can impose – especially on the high percentage of unemployed among people with disabilities, and among those in the less wealthy EU Member states who lack government programs that provide expensive access solutions. ÆGIS addresses this issue through the use of open source solutions throughout all aspects of the accessibility value delivery chain. First, ÆGIS will develop most of the user interface component sets under open source licenses, so that they may be used free of license or royalty charge in applications. Second, ÆGIS will build accessibility support into existing and newly created open source developer's tools, so that developers need not make a single software purchase in order to develop an accessible application. Next, to the greatest extent possible, the project will choose open source end user platforms to make accessible – including open source UNIX and GNU/Linux desktops, open source user agents and web browsers, and open source mobile device platforms – in addition to working with the major existing commercial desktop and mobile platforms. This greatly lowers the purchase price of these platforms (for example, all schools in Extremadura and Andalusia in Spain use open source GNU/Linux desktops in all classrooms, because they are much more affordable that commercial alternatives, like Windows). Finally, ÆGIS will prototype five open source assistive technology prototypes that will run on these platforms. Assistive technologies are often the most expensive piece of an accessible solution. By developing these under an open source license, the project dramatically lowers the cost of accessible technology – a cost that the significantly unemployed set of Europeans with disabilities can little afford.

Open source is also key to the ÆGIS plan for dissemination and exploitation. Today, desktop solutions cost several thousand Euros, and in addition supporting assistive technologies such as screen readers and screen embossers would need to be acquired as they are default not built in, again costing at least thousand Euros. The total package is obviously out of reach of people with disabilities who often lack financial means. But if the desktop solutions and the supporting assistive technology solutions were open source and free, ÆGIS will have removed the single greatest barrier to their inclusion, and their subsequent adoption by users who need them.

The final benefit of note to the innovation of an open source accessibility framework, across the overall delivery value chain – and that also significantly aids in exploitation – is the fact that every link in the chain can be directly modified by a company that wishes to exploit it – directly tailored to suit the specific needs of the environment it will be used and exploited in. This ability to modify open source technologies – and to use them free of charge – is a key reason for the widespread adoption of GNU/Linux in mobile devices. ÆGIS' innovation is to apply that same technique to accessibility.

Reference

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