The Evolving Global Public Inclusive Infrastructure (GPII)

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Abstract. We are facing a perfect storm where, just as access to ICT is becoming mandatory for meaningful participation, independence, and self sustenance, we find that we not only are nowhere near providing access to everyone who needs it, but we are actually losing ground due to reasons such as technical proliferation across platforms, increasing product churn (breaking existing solutions), decreasing social resources to address it, and an inability to effectively serve the tails of these populations because of the higher cost to do so. At the same time the incidence of disabilities is increasing as our population ages. This paper describes the Cloud4all and Prosperity4All projects and progress in building the Global Public Inclusive Infrastructure, an infrastructure based on cloud, web and platform technologies that can increase dissemination and international localization while lowering the cost to develop, deploy, market, and support a broad range of access solutions.

Keywords: Universal Design, Inclusive Design, Digital Divide, Cloud computing.

1 Introduction

Over 2 billion people worldwide have different types, degrees, or combinations of disability, literacy, digital literacy or aging related barriers that impede or prevent use of ICT. Not long ago you could live without access to ICT quite well. However today access to ICT is required for most education, employment, and commerce, and is increasingly required for travel, health, safety, daily living and participation in most of our society. Yet we currently only reach 3 to 15% of these - in developed countries. We cannot socially, economically or politically afford to have this cumulatively large percentage of our society offline going forward. Yet there is no way to reach them with our current model.

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There is a pressing need for a paradigm shift in access to ICT by people with disabilities and elderly. The current model and system are not serving the majority of those how need it and the challenge is only becoming greater and the consequences more severe.

Access to information and communication technologies and services is increasingly becoming essential for everyone, leaving those who cannot effectively access and use these technologies at risk of exclusion from education, employment, commerce, health information, and almost every other aspect of daily living and civic participation. Those at risk include those who cannot use ICT and services due to **disability, low literacy, low digital-literacy or aging related barriers.**

In the past those who could not access these technologies could get by, avoiding technology entirely. However, ICT is now becoming so engrained in all aspects of society that this is no longer an option. If we don't / can't provide access to these groups they soon will be unable to participate in education, employment, commerce, our health system, transportation, or even daily independent living. This need to ensure that everyone is able to access and use ICT however is occurring at the same time we are facing something of a perfect storm in accessibility; where a number of factors are all coming together at the same time to create a fatal combination.

1. **Fewer resources:** The new economic realities mean that <u>we will have less, not more, resources</u> to address the needs of this much larger population. It is impractical to think that we can solve the problem by sharply increasing expenditures on this. Is also impractical to believe that we can serve this much larger population with decreased resources by approaching the problem the same way we have done in the past.

2. **Many small groups – together large:** <u>The problem is broader than just disability</u> and includes people facing barriers to ICT from <u>disabilities</u>, <u>literacy</u>, <u>digital literacy</u>, and <u>aging</u>. All of these groups are threatened with an inability to participate, be productive, live independently, or participate as we continually '*technify*' everything around them. Although it is many many small groups, they are cumulatively large, around 2 billion[1] worldwide.

3. **We never were reaching a reasonable fraction:** We must recognize that, even before the financial crisis, <u>in the developed countries,</u> we were <u>never reaching more than a small fraction of those who needed</u> special access technologies or features in order to effectively use ICT. There are no solid data, but AT manufacturers estimates of their market penetration, although varying widely, all fall in the very low range of between 3% and 15% of those that need assistive technologies being reached, cumulatively.

4. **Focus on the "mainstream" disabilities leaving the tails unaddressed:** <u>Current solutions tend to focus on the larger populations</u> or <u>mainstream disabilities,</u> with

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[1] There are an estimated 1 billion+ people with types, degrees, and combinations of disability who face substantial barriers in daily lives [1] an unknown portion of which need special features or capabilities to use ICT; about 800 million people with literacy levels that prevent them from employment and other social participation [2] about 870 million (and rapidly increasing) people aged above 60 at risk of digital divide [3]. Even accounting for overlap on the fact that only some elders have problems, when you combine these with those who are not digitally literate the number is in the neighborhood of 2 billion+.

fewer or no solutions for individuals at the tails of each disability distribution; for low incidence groups. And with all the types, degrees, and combinations of disability, literacy, digital literacy, and aging, a large portion of threatened group falls outside of the large/mainstream/single-limitation category where all of the current focus lies, and it one of the many 'tails or 'tails of the tails.

5. **Existing solutions focus on biggest few platforms:** <u>A majority of the solutions that we have tend to be for one or two major platforms</u>. Yet industry, consumers, and public entities (schools, employment, transportation, etc.) are moving to a wide variety of platforms (operating systems, browsers, mobile technologies, etc.). Assistive technology vendors had great difficulty keeping up with even the one or two platforms they were supporting since these platforms were continually being advanced and upgraded, continually breaking the AT in the process. With the rapid proliferation of platforms vendors are completely unable to address all of these (disability, literacy, digital literacy, and aging) groups, across all of the devices and platforms that these groups are encountering in daily life (education, travel, etc.).

  To make things worse for a key vendors, <u>the advent of inexpensive mobile platforms</u> (iOS, android, Windows phone, etc.) <u>has dropped the bottom out of the AT pricing</u>, making it harder for AT vendors to profitably market solutions for any group other the largest user groups -- and any platforms other the most popular platforms. And as accessibility features that are being built into mainstream products eat away at the bulk of AT vendor's easier to serve customers, we risk losing the only group (AT vendors) that is capable of addressing those with more severe-, complicated- or mixed- disability/literacy/digital-literacy/aging problems.   And although all of these "tail" groups are small and each requires different solutions, they cumulatively represent a significant population that must be served.

6. **Not just devices, also e-documents, media, and services.** <u>The problem extends beyond devices, and also includes document and media access</u>. Access to documents and media have always been critical to education and work but access to any and all documents and media, including locked electronic documents are also essential for participation in most types/areas of society, legal papers, and health records. As we shift to an increasingly all digital society, document and media access issues are becoming increasingly acute.

7. **It is not just vendors and consumers that are feeling the impact.** The rapid proliferation of platforms, devices, and solutions is leaving <u>those who must deliver accessibility</u> (clinicians, educators, libraries, public access points, government funding agencies, etc.) confused, perpetually behind, and unable to track or understand what is available, much less which solutions would be best or even effective for their different clients/patrons/citizens.

So we have a perfect storm; where just as access to ICT is becoming mandatory for meaningful participation, independence, and self sustenance, -- we find that we not only are nowhere near providing access to everyone who needs it, but we are actually losing ground -- due to technical proliferation across platforms, - increasing product churn (breaking existing solutions), - decreasing social resources to address it, - and an inability to effectively serve the tails of these populations because of the higher cost to do so (due both to the diversity the tails represent and the inability of

AT vendors to generate sufficient revenues to support serving these groups with our current infrastructure and assistive technology ecosystem).

2   The Role and Limitations of Research

We have applied science to the problem and it has given us some powerful new technologies for addressing some specialized and some general disabilities. However this alone cannot address the issues described above, and the lack of a good mechanism for moving these research results through to commercial and clinical availability leaves many of these developments in laboratories or journals rather than reaching the market and consumers/users who need them. They also are too few and often focus on technical innovation rather than on innovation that would result in more cost-effective ways to address the needs of the large population of underserved and un-served people who face barriers to ICT due to disability, literacy, digital literacy, and aging. We are left with:

- solutions for only for some of the different types, degrees and combinations of limitations, and only on some devices/operating systems,
- solutions that are available in only some languages, in some countries, and acceptable to only some cultures,
- solutions that are not reaching even those who can use what is available and can afford them, (which further increases the costs due to unnecessarily low sales),
- a development and delivery ecosystem that costs too much to allow us to develop for and serve even a fraction of those who need special access techniques or technologies,
- vendors (especially small to medium vendors) who are financially strapped, limiting their ability to innovate, develop for new platforms, develop for low incidence disabilities etc.,
- new techniques and technologies coming out of research but not making it beyond project review and publication -- no mechanism to commercially harden them or get them to market,
- disability solutions that don't really fit individuals with literacy, digital literacy and sometimes aging related barriers,
- solutions that are technology driven, or based on what sells most or what designers believe, rather than what users need/want,
- assistive technology vendors who are in trouble and narrowing their product line focusing on sweet spots in disability to be healthy,
- lack of involvement of most researchers outside of a small group that is dedicated to accessibility research;
- Poor awareness of what does exist, resulting in poor market reach and penetration which hurts both consumers and vendors;
- schools, companies, governments who find it difficult or impossible to ensure that students, employees, customers, patrons etc. with disabilities etc. are able to access all of the media and materials they generate and distribute;

…and no option except to find some new way to provide access to all these groups - if this cumulatively large and growing portion of our population is to be able to participate in education, employment etc.

Research can tell us about these problems. It can give us new tools. But it can't deliver solutions and provide all of the innovation – especially **user level innovation. For this we need the entire "AT – Mainstream – Provider – Funder" ecosystem**. Yet our current ecosystem can't serve but a fraction, focuses on "majority disabilities", can't address the tails, and is losing ground as technology accelerates and proliferates, etc.

3   Elements of the Solution

These problems are emerging despite the attempts of researchers, companies and policy makers to address them. But the problems have not been addressable using the model we have been using to date no matter how much effort is expended. The model has worked well for about 15% market penetration [2] with a stable technology landscape. But 15% penetration is not sufficient when access to technology is no long optional, and we no longer have a stable technology landscape.

3.1   Addressing Industry Needs

Industry is key to solving this, yet industry (mainstream and AT) has faced barriers in its attempts to address and grow the market. Any solution must therefore facilitate the private commercial sector efforts; help them reduce costs and grow their markets to cover as much as possible, while ensuring that those they cannot reach have access as well.

Any new approach must address the underlying problems commercial problems, such as:

- limited market penetration,
- the high cost for marketing, distributing and supporting assistive technologies,
- the high cost for development of new approaches,
- the high cost of just keeping existing technologies working with ever-changing ICT and web technologies,
- the difficulties faced by new innovators in developing alternate and innovative solutions and getting them to market, etc.

3.2   Addressing User Needs

The new approach also needs to make it much easier for users to:

- discover there are solutions to their problems,
- determine what types of access features or technologies would address their particular problems,
- locate specific solutions, and
- get these solutions delivered and set up   on their computer(s).

Moreover, it needs to allow them to access and use these solutions not just on a single computer, or maybe two, but on all of the different computers and ICT that they must use (in different classrooms and laboratories, at home, at work, and the community, when traveling, etc.).

4   The Global Public Inclusive Infrastructure (GPII) Initiative

To address these issues, an international coalition of organizations and individuals is coming together and proposed the development of a global public inclusive infrastructure (GPII).

The goal of the GPII is to create the *infrastructure* from which *a new ecosystem can grow over time* that can address these problems. This work began with the FP7 project *Cloud4all*.   The ongoing Cloud4all project is building the initial pieces of the infrastructure necessary to allow *instant auto-personalization* of software, devices, media, materials, and services *based on user needs and preferences* (stored in the cloud or on a personal device). See Figure 1. This infrastructure allows assistive-technology and mainstream-product manufacturers (software, hardware, media materials and services) to create products that can automatically change their interface or format to accommodate the needs of each individual as the individual encounters them. The long-term result can be a world in which each of us would find that essentially every device we approach would instantly and automatically change into a form that we are able to understand and use.

The GPII consists of enhancements to platform and network technologies to create an infrastructure that would simplify the development, delivery and support of access technologies and provide users with a way to instantly apply the access techniques and technologies they need, automatically, on any computers or other ICT they encounter.

In specific, GPII aims to:

- Simplify accessibility for users, schools, public access points, organizations, companies, governments, etc.
- Increase built-in accessibility in those places where it is practical and effective, to provide ubiquitous access that is natural, doesn't have a stigma, and doesn't 'tax' individuals with disabilities by causing them to pay more to access the same ICT as their peers.
- Grow the market for assistive technologies and services, in order to serve more people, lower costs, and increase motivation to innovate and invest in accessibility.
- Facilitate international, public-private, private-private and cross sector collaboration in order to lower costs, to reduce duplication and to accelerate innovation.
- Increase the number of new ideas and products that make it to market – and make it easier and much less expensive to market them internationally.

4.1   Origin and Support for the GPII

The GPII initiative is a synthesis of ideas and efforts from many people and programs in the US, Canada, Europe and other countries.   It is a concept that grew out of the Raising the Floor initiative, which is now coordinating the international efforts on GPII.   Raising the Floor, a non-profit association based in Switzerland, is a coalition of academics, ICT industry (IBM, Microsoft, etc.), AT companies, practitioners and of course consumers (individual and in all of the above). There are currently about 80 programmers, designers, researchers, practitioners working on the GPII and it's components -- and the participation is continuously growing.

Initial funding for the development of the GPII concept and components is coming so far from the US National Institute On Disability and Rehabilitation Research (NIDRR), the William and Flora Hewlett Foundation, the Canadian government, the Adobe foundation and the funders of the other participants in Raising the Floor.

The major components of the GPII Concept as it is currently conceived are shown below with highlighting on the areas on which Cloud4All will work.

Overview of the GPII. Figure 1 shows an overview of the Global Public Inclusive Infrastructure (GPII). The Infrastructure has three major functions, each with five major subcomponents.

The three major functions of the GPII are:

1. To provide the infrastructure - to make it easy for individuals who have difficulty in using ICT (for any reason) to be able to discover what features or technologies they need in order to make ICT usable for them.   This information is then stored in the cloud or in a personal device.
2. To provide the infrastructure - to allow users to use their needs&preference sets to cause any software/devices/media/ebooks/edocuments/services to automatically change (or be changed) into a form that they can use - instantly - and without their understanding how to do it.
3. To provide the infrastructure - that can make it easier, less expensive, and faster to innovate and then move these innovations through development and to markets internationally; - as well as to enable the development of entirely new types of accessibility solutions and delivery systems.

Each of the rows in figure 1 represents components in the infrastructure needed to achieve the one of three major functions. *Cloud4all* focuses on the key components needed to enable auto-personalization from user (needs and) preferences a PFP).   The lower row(s), focus on building the infrastructure needed to grow a new ecosystem that is capable of addressing the key factors preventing us from being able to create solutions for all the need them – and to reach them in a manner that is affordable to users, schools, libraries, companies and society.
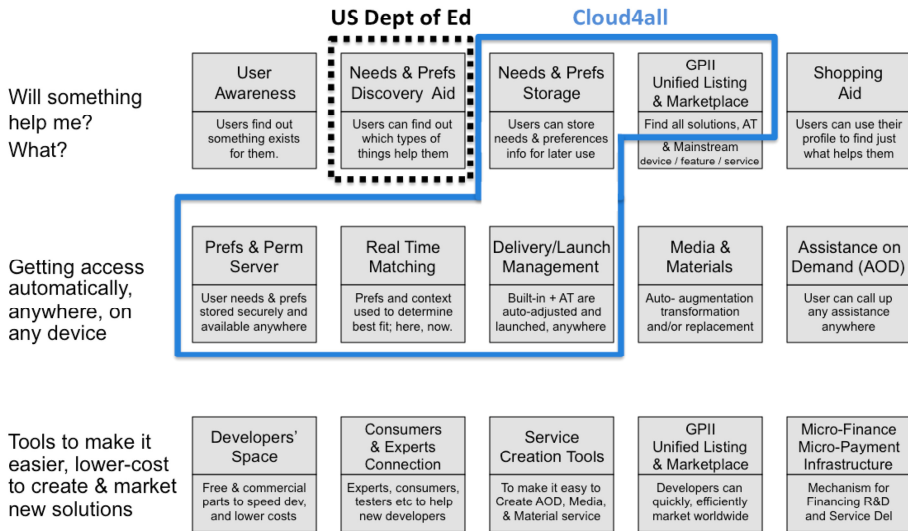
Major Components of GPII

Fig. 1. The Global Public Inclusive Infrastructure and its relation to Cloud4All

Status

The ***Cloud4all*** project is well underway with mainstream and AT companies already demonstrating their products being auto-configured to user preference sets, that are retrieved from the cloud or a personal key-token (a USB stick, or an NFC tag or ring worn on the hand, facial recognition in the home, etc.).

Table 1. Technology Implementations of Auto-personalization underway in Cloud4all

	Prototypes			
1	Linux/Gnome	11	SuperNova Suite of low vision and	
2	Microsoft Windows	12	Maavis (cognitive aid)	
3	Microsoft Internet Explorer	13	Mobile Accessibility (mobile phone AT)	
4	Mozilla Firefox	14	ReadWrite Gold & BrowseAloud	
5	Simple phone (JAVA)	15	Allan eC (communicaton system for deaf,)	
6	Smart phone	16	eKiosk	
7	WebAnywhere (Cloud/online based AT)	17	Microsoft PixelSense Platform ('surface' touch-based technology)	
8	SAToGo (run from server AT)	18	Smart-house	
9	Online banking web application	19	DTV(iTV)	
10	ASIT Social networking application			

This Cloud4all/GPII instant auto-personalization provides many advantages to consumers including making individualization of ICT possible in a quick and very simple fashion. However auto-personalization cannot address all of the problems cited above, such as the lack of solutions for all types of users, access features for all technology platforms encounter, cost, etc.

Next Steps

The next steps in building the GPII will focus on addressing building the development infrastructure that will allow a new ecosystem to develop where these solution problems can be addressed. A project titled Prosperity4All proposed to the European Commission under FP7 will build an infrastructure that is based around cross-platform development techniques and that employees modern techniques such as crowdsourcing and gamification to both enable new strategies for the delivery of accessibility services and to enable an entirely new approach to accessibility solution development; an approach that can increase the percentage of research that actually makes it into the hands of users, increases the number of different types of researchers (especially researchers focusing on basic science areas) to contribute and enable breakthrough solutions; increase the number and variety of individuals and skills which can be brought to bear on the problem; and broaden the development process out toward users so that users and those living with them, or working with them, can get more directly engaged in the development of solution for them (selves). Prosperity4all, focuses on developing the infrastructure to allow a new ecosystem to grow; one that is based on self-rewarding collaboration, that can reduce redundant development, lower costs, increase market reach and penetration internationally, and create the robust cross-platform spectrum of mainstream and assistive technology based access solutions required. This will be done through a process based on true value propositions for all stakeholders and resulting in a system that can profitably serve markets as small as one, at a personally and societally affordable cost. This infrastructure will use cloud, crowd, game and smart technologies, to bring new players with both low and high technical skills into the development and delivery ecosystem, introduce accessibility as a ubiquitous service, and combine auto-configured access features built into mainstream products with assistive technologies and services to create the rich spectrum of options needed to bring this diverse 'population of populations' into our digital future.

5   Conclusion

Society is facing a looming crisis where access to ICT is becoming required but we do not have access solutions for all nor do we have anyway to deliver solutions to all that need them in an affordable manner. In order to meet the demand we are going to need to eat all a new ecosystem that can develop deliver and support solutions to a much wider range of users at a much lower cost. A consortium has come together that is beginning to address this problem. However it is a very large problem and the most important part, that of providing the economic ecosystem for developers, has yet to be realized. Without this key piece, we may have a way of effectively delivering solutions, but we will not have the range of affordable solutions that is needed in order to be able to provide solutions to the full range of people who faced barriers to accessing ICT due to disability, literacy, digital literacy, and aging.

References

1. WHO, World report on disability. World Health Organization (2011)
2. UNESCO Institute for Statistics, Adult and Youth Literacy. 20 (2012)
3. United Nations, World Population Prospects: The 2010 Revision, Highlights and Advance Tables (2011)