INTERNET IN A BOX: THE eGRANARY DIGITAL LIBRARY SERVES SCHOLARS LACKING INTERNET BANDWIDTH

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The eGranary Digital Library uses innovative off-line storage technology to deliver millions of digital documents to schools, clinics, hospitals, and homes in the developing world with little or no Internet connectivity.
Providing patrons with instant access to a broad range of Web pages, audio, video, and multimedia resources from within the institution's local area network (LAN), the eGranary Digital Library demonstrates a new, low-cost way to deliver knowledge to the world's information poor.

Introduction

Over the past five years, staff and volunteers at the University of Iowa's WiderNet Project (www.widernet.org/) have developed an innovative way to deliver millions of digital documents to schools, clinics, hospitals, and homes in the developing world. This program, the eGranary Digital Library, is a practical solution for those with little or no Internet connectivity. It delivers a wealth of knowledge without requiring a wealth of investment.

The eGranary Digital Library (www.widernet.org/digitalLibrary/) is an open-source, collaborative effort to garner and deliver a massive collection of digital information to the world's information poor. It provides instant access to an entire range of Web pages, audio, video, and multimedia software from within the institution's local area network (LAN) and requires no Internet connectivity. It also provides subscribers with a publishing platform from which they can share their own digital content with scholars around the world.

The WiderNet Project is a not-for-profit research and service program of the University of Iowa's International Programs that, since 1999, has focused on improving educational technology systems in the developing world, especially Africa, by training thousands of university faculty, staff, and students in ICT skills and furnishing them with refurbished computers and networking equipment. The eGranary Digital Library grew organically from the WiderNet Project's ongoing collaborations with over a dozen African universities, and is now spreading to other areas of the developing world.

Defining the Problem

The Internet and the World Wide Web have, in a few short years, become some of the world's premier intellectual resources, hosting billions of pages of

information and providing unparalleled communication and collaboration opportunities to online academics. In terms of information access, these technologies hold forth a historically unique chance for schools and clinics in developing countries to gain a more equal footing with their sister institutions in technologically advanced countries.

Yet most institutions in developing countries are many years, possibly decades, away from reliable, robust ICT capacity and adequate Internet connectivity. The global trend towards electronic dissemination of scholarship presents both promises and difficulties for scholars in the developing world.

There are dozens of groups involved in resource creation, access, and management for developing countries. Some of these programs provide institutions in developing countries with free, subsidized, or discounted access to an increasing array of core scholarly material. Yet most of these efforts are significantly hampered by a lack of Internet bandwidth at their target institutions. Their clients are invited to 'come and get it' over the Internet. Yet the 'come and get it' part is particularly onerous for their clients because it presupposes a great deal of expensive bandwidth, as well as generations of human and capital infrastructure.

Scholars in economically advanced countries are so awash in Internet bandwidth that it is easy to miss the fact that only one in seven people in this world have access to the Internet. For most people in developing countries, the World Wide Web is still known as the 'World Wide Wait'; either because it may take generations for the benefits of the Internet to trickle out to poor, rural communities, or because what little bandwidth they now have limits the Internet's usefulness and dramatically saps their budgets.

A recent report by the Partnership for Higher Education in Africa (2004) has shown that an African university pays, on average, nearly 50 times what an American university pays for the same amount of bandwidth. Given the pressing needs for improvements throughout most schools and health services in the developing world, it is unlikely that they will be able to pay for increasing Internet access.

For example, the 30,000 students and researchers at the University of Iowa enjoy two 1 Gbit/sec connections to the Internet, giving them the capacity to collectively transmit and receive 2 billion bits of information per second. Meanwhile, at one of the better connected universities in Nigeria, the University of Jos, 13,000 students share a single satellite connection that provides 256 Kbits/sec – or 256 thousand bits of information per second. This latter connection is equal to four telephone modems and represents 0.01% of the bandwidth of the University of Iowa. Sadly, Jos' Internet connectivity – which is a fraction of what most US homes purchase for around US$45 – costs them US$48,000 a year. Taken in context, US$48,000 a year will barely pay for one full-time professor in the US, while the same amount of money at a typical African university might pay for as many as 12 full-time professors.

The average US university spends 4–6% of its entire institutional budget on ICT (Smallen and Leach nd, 2004). This works out to be about US$1700 per full-time equivalent (FTE) student (Hawkins et al. 2004). There are no reliable figures for ICT budgets at African universities, although it is safe to say that many African universities have yet to reach the 1% mark.

With very fast and reliable connectivity, Western cybersearchers have developed complex information literacy through lots of practice. The typical cybersearcher in poorly connected countries simply does not have the kind of bandwidth required to efficiently compare and contrast hundreds of documents in a day. In addition, there are many infrastructural impediments to Internet connectivity in developing countries: power failures, equipment failures, reg-ulatory restriction of communication technologies, unreliable telecommunication technologies, and lack of foreign exchange with which to pay for connectivity. For many institutions in developing countries, their first years on the Internet may involve only occasional, unreliable connections with long periods of being off-line, waiting for broken components or broken budgets to be repaired.

Such infrastructure and bandwidth constraints make it difficult to plan for locally appropriate, sustainable uses of ICTs in research and teaching. A teacher, for example, cannot reliably plan on her students using an online tutorial or encyclopedia if she cannot be sure that the Internet connection will be functioning and that the bandwidth would be adequate to the task. So, while the Internet and the World Wide Web are often talked about as a panacea for deficiencies in scholarly information access in the developing world, there are daunting economic and capacity issues to be overcome before significant numbers of scholars can use on-line resources reliably and effectively.

The eGranary Digital Library – Replacing Bandwidth with Storewidth

While institutions in developing countries have limited Internet connectiv-ity, there remain other ways to provide them access to some of the billions of digitized documents on the Internet.

The eGranary Digital Library provides an information delivery system that is economically and technologically appropriate for developing nations. The eGranary Digital Library 'stores the seeds of knowledge' by moving a massive assortment of digital educational materials – many readily available on the Internet in developed countries – onto the LANs of subscriber institutions. This arrangement makes information – text, audio, video, animations – available to everyone within the institution, freely and instantly, even when the Internet connection is malfunctioning or non-existent.

Those using resources from the eGranary Digital Library over their institution's 100 Mbit LAN will experience file transfer speeds three times faster than the average Internet user at a US university. Video files that might have

taken days to download over a slim Internet connection open within seconds over the LAN.

The eGranary Digital Library can come in several forms:

- Most subscribing institutions already have a server and a LAN in place, so they simply add the eGranary Digital Library hard drive (the size of a paperback book) to their existing server. Thus, for a one-time cost (approximately US$350 for a 250 Gb disk drive) the problems of adequate and reliable Internet bandwidth – especially for institutions with no Internet connection – are significantly mitigated.
- For those institutions without a server or adequate ICT staff, the WiderNet Project has developed a US$2,500 eGranary Appliance, a plug-and-play server that provides proxy and search services for the eGranary Digital Library, as well as many other basic local area network services (including space for local content creation).
- For some institutions, the WiderNet Project can provide an eGranary appliance, a dozen refurbished computers, and all the miscellaneous networking devices and training required to deploy a library resource center.

Most importantly, the WiderNet Project is training technicians at partner institutions in developing countries to make their own eGranary appliances using common open-source and/or commercial software and local equipment.

Progress to-Date

There are over 75 installations of the eGranary Digital Library in sub-Saharan Africa, Bangladesh, Indonesia, and Haiti. Because of poor intercampus connectivity, some institutions sport two or even three installations.[1]

The eGranary Digital Library currently holds more then 3 million digital resources, including Web pages, books, journals, databases, videos, radio programs, CDs, multimedia tutorials, and software. Its contents are grouped into subject categories which include Agriculture, American Studies, Computer Science, Education, Engineering, English Literature, General/Multi-Subject Collections, Geography, Information and Communications Technology (ICT), International Development, Language, Library Science, Mathematics, Medicine, Music, Public Health, Sciences, Social Science, and Water Resources.

These subject collections are developed and maintained by content editors, mostly volunteers, who seek out academically rich Web resources in their areas of expertise and then, if necessary, attempt to secure permission from the authors and publishers to distribute the materials. Some of the many authors and publishers who have granted permission to distribute their works via the eGranary include: US Centers for Disease Control, Columbia University, Cornell University, MIT Press, UNESCO, World Bank, WHO, and INASP.[2]

About 10% of the content in the eGranary Digital Library is not found on the public Internet. These materials, donated by their authors or publishers, are

usually found on password protected intranets, fee-based sites, or are proprietary content not found on the World Wide Web. In some cases, third parties have funded the inclusion of a few commercial items, like the World Book Encyclopedia.

Copyright issues are handled in the following manner. The eGranary Digital Library contains many materials in the public domain or covered under one or more open content initiatives like Creative Commons, GNU Free Documentation License, or General Public License. Other materials are secured by contacting the authors or publishers for distribution permission. Authors and publishers, who in most cases have already reconciled themselves to sharing their information for free with the entire Internet-connected world, are simply extending their reach by allowing their materials to be placed into the eGranary Digital Library.

About 60% of authors and publishers approached have agreed to distribute their materials through the eGranary Digital Library upon the first request. Another 10% agree to do so after due consideration. Except for the removal of Website traffic counters and links to advertisement servers, the donated materials are not altered in any way and still sport their original copyright notices and disclaimers.

Subscribing institutions sign license agreements that, among a host of housekeeping matters, stipulate that they will provide the information free of charge to their patrons and will only make the content available over their local intranet. (The latter stipulation only makes sense for subscribing institutions, as they cannot afford to use their precious bandwidth to serve someone else's content.)

Thanks to a grant from USAID's Leland Initiative, the WiderNet Project has recently developed an update mechanism for the eGranary Digital Library. This new Internet protocol allows subscribers to receive updates anytime via any transport mechanism. Original Websites are monitored for changes. The changes are inspected, indexed, categorized, and packaged for delivery. Subscribers can then use any transport mechanism at their disposal – a full Internet connection, an occasional Internet connection, digital radio broadcast, CD-ROM, DVD, or USB memory stick – to transfer the updates from one computer to another. For example, Computers for Africa, a non-profit group setting up computer labs in secondary schools in Uganda, plans to download updates via the Internet in the capital city, Kampala, and then circulate the updates using CD-ROMs to hundreds of schools in the rural areas.

Beyond simply delivering millions of information objects, the WiderNet Project is collaborating with partners to turn portions of the eGranary Digital Library into deliverable course curriculum.

We have yet to begin our formal evaluation, but early feedback is generally positive:

> The eGranary Digital Library has helped our students and lecturers in accessing academic materials which were not easily accessible due to limited bandwidth.

The concept is very good for those with limited or no bandwidth and should be supported. It has become part and parcel of our e-learning platform.

Nyaga Gacheru
Network Administrator
Jomo Kenyatta University of Agriculture and Technology
Kenya

The eGranary Digital Library has been a great bridge in the digital divide for us in the University of Jos in Nigeria. It has served the purpose of bringing the Internet to our doorsteps. We have it up and running on our intranet with no bandwidth cost and it's accessible at the speed of lightning! What better motivation for academics! The eGranary holds great promise for developing economies where bandwidth and the cost of Internet access are high.

Stephen Akintunde
Deputy University Librarian
University of Jos, Nigeria

Increasing Original African Content on the Internet

One perennial issue is that of digitizing African resources: little of the information that is currently available on the Internet is produced in Africa. Yet African research is of great interest to other African scholars, who oftentimes must travel to the West to get access to African materials.

For many African scholars interested in collaborating with other African colleagues, there is little incentive to publish in a digital format since few of their colleagues have Internet access. There is a widespread perception that digitized materials are the domain of the West and that time spent digitizing materials benefits Western, more than African, scholars. All too often the output of digital preservation projects winds up served from computers in Europe and America, requiring African scholars to pay per minute Internet connectivity fees to view materials scanned from their own archives.

The eGranary Digital Library provides subscriber universities with a publishing platform, similar to that of the World Wide Web, which freely delivers digital content to scholars on their LANs. Since all subscribers are given the opportunity to mirror their institution's Website in the eGranary Digital Library, their materials can also be made available at no cost to other subscribers in the developing world.

Conclusion

Digitized information promises to strengthen scholarly efforts in developing countries, yet a daunting host of economic, infrastructural, and human capacity challenges face those who seek ICT solutions that address the needs of the information poor.

The sheer expense of bandwidth severely restricts the ability of scholars in developing countries to take full advantage of free or subsidized resources, as

well as to disseminate their research within their own institutions and the rest of the developing world.

Internet connectivity remains only one of many pieces that need to be fitted into a larger, appropriate, and holistic solution.

The eGranary Digital Library provides those working in this field with one more piece to this puzzle. It represents an inexpensive and practical solution for the bandwidth conundrums faced by many who work in and around libraries in the developing world. The eGranary Digital Library delivers millions of documents in a familiar Web format and can save a subscriber tens of thousands of dollars every year in Internet connectivity costs. It has the capacity to make resource digitization more meaningful for African institutions and provide even those at unconnected institutions a 'near-Web' experience, along with the opportunity to develop contemporary search, usage, and content creation skills.

Notes

1. See http://www.widernet.org/digitalLibrary/currentstatus.asp for the most current list of eGranary Digital Library installations. At the time of this writing, there are installations in Kenya, Nigeria, Bangladesh, Mozambique, Tanzania, Uganda, The Gambia, Indonesia, Niger, Zambia, Ghana, Haiti, and Guinea.
2. See http://www.widernet.org/digitallibrary/permissionsreport.asp for a list of 600+ authors and publishers who have given permission to have their materials included in the eGranary Digital Library.

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