An Anatomy of the International ICT Digital Divide

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Abstract

Advanced information and telecommunications technologies (ICT) are reaching different parts of the world at different rates and in different embodiments. The disparity is having an increasingly differential effect on nations, people and cultures. While the topic has been extensively discussed under the title "digital divide," perception has made the discussion gravitate around the penetration of the Internet (1), which is a related issue, but not "the" problem. In this paper we present a much broader view of the digital divide, based on current thinking (2). Our presentation is not exhaustive, excluding impact on economic development (3). Education, as the pivotal focus of concern for developing nations is discussed with respect to an international perspective and the taxonomy of technology solutions available to address this aspect of the International ICT Digital Divide.

Introduction

Widespread access to advanced ICT is considered the key to participation in the world's knowledge-based economy. At the turn of the new century, The Lisbon Council proposed to turn the European Union of nations into the world's leading knowledge-based economy by adopting a strategy (4) based on a two-pronged philosophy of access to a) the information society and b) to ICT. This strategy begins to dissect the parameters of exclusion that establish the boundaries of the international digital divide:

1. Poverty, social exclusion and personal factors such as age, gender or disability
2. Education and skills gap in ICT and lack of digital literacy
3. Poor or no access to the Internet in remote areas or regions

These factors are universal characteristics of the internal physical structure of the digital divide that provide a frame of reference for understanding the problem. Once we are able to understand and characterize the problem, we will be able to correctly apply the taxonomy of solutions available to remedy the situation. Furthermore, characterization of these factors helps us to understand the complex, implicit interrelationship of the issues involved: human, social, economic, commercial, political, religious, educational, technical, and more. By adopting a basis for classification of the issues, we can come to understand the problem better. The Lisbon strategy presents an interested new start to comprehension, with possibly universal implications. It would certainly be easier to address only the ICT problem as the central "lack of structure" causing the international digital divide, or to hope that by enhancing the conquering the ICT

infrastructure problem somehow all the other issues will resolved themselves. That, however, would put at risk hard to obtain resources that should be carefully and wisely invested. We have extensively seen documented regional and local efforts to bridge various forms of the digital by addressing access and connectivity with limited and poorly understood results. Case in point, in the U.S., at the end of President Clinton's administration only fourteen percent of poor and minority classrooms were connected to the Internet (5 & 6). In spite of dedicated and unparalleled focus, the nation and the administration were not able to conquer the digital divide.

In fact, massive efforts to connect to the Internet result in the proliferation of the digital divide syndrome. In essence the digital divide is an obvious and standard by-product of Internet connectivity. But, unlike other systems with similar interrelationships of issues, where proliferation exacerbates disparities among people, the digital divide has the potential of impacting on the differences among countries more than on the differences among people within a country. This level of impact on the world makes the international digital divide perhaps the most powerful obstacle to understanding among nations. And, in turn, addressing the problem could become the most powerful means by which to unite nations and promote understanding.

An Overview of Advanced ICT

Before we launch into understanding of the digital divide, it is important to outline the make-up of the international ICT. For the purposes of this analysis, we view the ICT as an international infrastructure, developed along dimensions of intelligence and flexibility and exhibit characteristics inherently attributed to human systems, wherein its embodiment is a function of information and telecommunications technologies. Adventurous research will take the ICT further into dimensions that we cannot yet even imagine. We at least know that some of these developments are already in evolution.

Following is a set of dimension mapped to the characteristics that that they infuse the ICT with.

NATURAL:	Collaboration & Conversation
INTELLIGENT:	Knowledge
EASY:	Seamless Integration
EVERYWHERE:	Ubiquitous Access
TRUSTED:	Security & Authentication
ALWAYS ON:	Reliability & scalability

In addition these characteristics of the ICT have created technology trends such as:

- ✓ Dramatically cheaper, faster networks
- ✓ Better security and reliability
- ✓ Lower latency
- ✓ Differentiated Quality of service
- ✓ Better Caching/Replication
- ✓ Pervasive computing
- ✓ Advanced searching, data mining and knowledge discovery

With those possibilities becoming not only realities but also technological trends, we can expect the ICT infrastructure of the future to be able to support extremely comprehensive and

challenging areas of human knowledge and practice. From the human perspective specific technical enhancements will be perceived as enhancing the quality of the interaction with the technology, and translate into comfortable adaptation to living with the ICT, as for example:

- ✓ Broadband distribution of broadcast quality video
- ✓ Completely integrated interactive collaboration environments
- ✓ New and seamless integration of disparate applications
- ✓ Enhanced network access that results in "always on" feeling
- ✓ Pervasive services and computational power
- ✓ Policy based application area capabilities

Some application areas that we already know about include:

- ✓ Remote medical diagnosis, consultation and surgery
- ✓ e-learning & t-learning
- ✓ Intelligent e-commerce
- ✓ Intelligent financial management
- ✓ Integrated, interactive collaboration
- ✓ Remote depositions and arraignments
- ✓ Remote design, manufacturing & apprenticeship
- ✓ Interactive video-based customer care centers
- ✓ Interactive vs. passive entertainment
- ✓ Remote scientific instrumentation
- ✓ Distributed terabyte data mining
- ✓ Remote child care monitoring
- ✓ "Tellerless" retail checkout
- ✓ Other…

The rationale for adopting these trends consists of a complex set of considerations that have one thing in common: growth. Some of the statistics that were collected by the turn of the new century help us to understand the force of the evolutionary ICT infrastructure in terms of its growth. The ICT has exhibited growth faster than the rate of growth of the TV, the VCR, and the cell-phone, and this growth has been driven by personalization and the emergence of content and functionality specific to applications organized by means of Web Portals.

Growth of the Internet & Users:	Doubling every 18 months
Content:	Doubling every 12 months
Growth of Opportunity & e-business:	Doubling every 6 months
Bandwidth:	Doubling every 4 months

More specific trends, already known by the turn of the new century, forecast an abyss of disparity in the digital divide. Incredible bandwidth rates:

- ✓ Million times increase in Internet core and 100 - 1,000 times improvement in last mile
- ✓ Fiber Optic Infrastructure costs falling dramatically
- ✓ Dense wave division multiplexing (DWDM) dramatically increasing capacity per fiber
- ✓ Speeds quadrupling every 18 months
    - o Networks that run at OC-12 (622 Mbps)

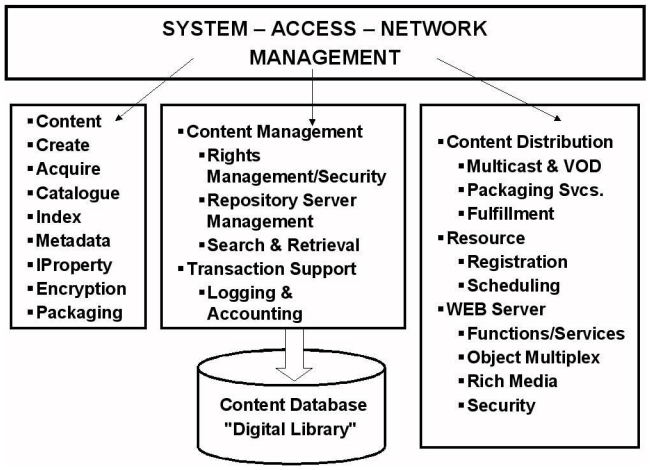
- Most networks run at OC-48 (2.4 Gbps)
- Next generation at OC-192 (10 Gbps)
- SONET maximum of OC-768 (40 Gbps)

✓ Many last mile solutions
- DSL
- Cable modems
- Wireless

These new connectivity advantages couple to the privileges of enhanced services will make it very difficult desirable to further commercialize the ICT infrastructure. Core technology building blocks no longer target e-commerce and e-learning but e-nabling, exemplified by richness of media, high quality video and audio experiences, multiple levels of services offerings, platforms integration for collaboration, content management, security, advanced use support, in short, comfortably living with ICT.

The e-nabling of the ICT includes the assumption that not only content assets abound, but also that content technologies continue to evolve in interesting and highly sophisticated directions. Video streaming becomes not a solution but a tool for creating interactive video programming, video shows and designer video applications. CD audio quality becomes secure audio and a plurality of services that for individualizing applications within different language and cultural context. Content assets management, knowledge discovery, content creation and reorganization and customized presentations, as part of the digital library trend, creating perhaps a deeper divide than caused by lack of connectivity.

The architecture of the ICT



In general, the ICT is a large, complex, interconnected system. Useful content, as well as trained users are components of this system. Technology is only component of the system. The complexity of the system and the complexity of the growth of the system are part of its dynamics. In addition, the ICT centers its users on the Web and the abilities to e-mail and surf. A fundamental need to increase quality and quantity of ICT services then became part of those activities.

To overcome these issues it is important to reflect on the validity of the model and architecture. It is important that we device a plurality of solutions to impart the same classes of services and accomplish the same social, economic and business goals. The more the ICT advances, the more this digital divide will leave behind developing nations and their citizens, and overall lower the standard of living for most of the world.

Existing ICT Solutions

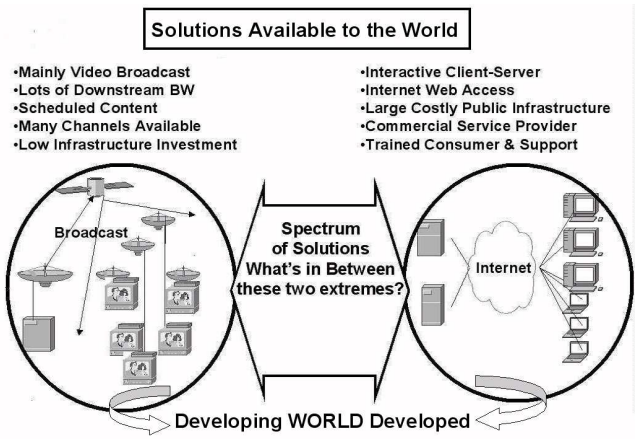
While there is no single solution to this problem, it is clear that any solution has to be comprehensive and specifically tailored to the needs of a region, and its populations. At the same time, we speculate that the Internet and the Web are part of the solution, but in reality, they are just one manifestation of a technology evolution that presents useful de-facto and global standards for information dissemination, an architecture that is modifiable and replicable in a diversity of technical embodiments.

The key to the solutions is in the dissemination of information and knowledge using the same standards but without requiring that whole countries or regions become infrastructure ready overnight nor that they follow the same business model of the developed world (e.g. massive monthly consumer subscription outlays for infrastructure or information utility access; highly commercialized content; and ever evolving PC hardware platforms, PC software, and networking options). The solution has to have some very fundamental elements: be able to leapfrog the infrastructure problem; provide its own locally originated and developed content; stimulate its own local economy by participation of the pubic and private sectors; and create a self-reinforcing replicating cycle.

The parts of the known solutions, as exemplified by the ICT architecture, are today:

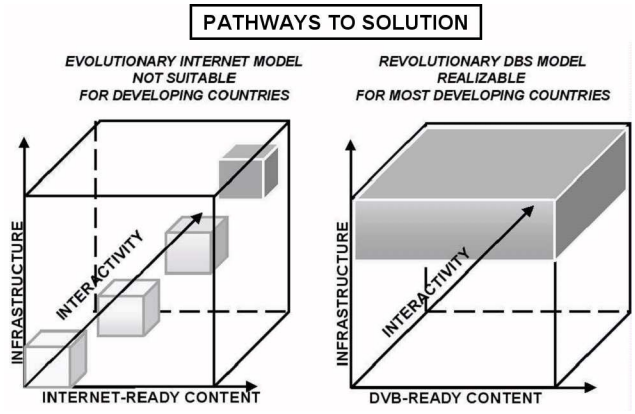
1. A digital library of “websites” content developed in a particular style using any website development tool.
2. A content transformation tool provided to turn any form of content into UCT-ready media. .
3. A server scheduler to deliver the content through the ICT.
4. A delivery system to impart this content in such a way that it continues to flow through the ICT, unbounded by physical limitations created by lack of access.
5. Receiver appliances in the form of connected tools, potentially free from the limitations imposed by arbitrary controls and security dangers.

To deploy the ICT within those components of the known solution, there exist two major embodiments that serve the developing and developed well with great disparity and unevenness the Internet and broadcast television.



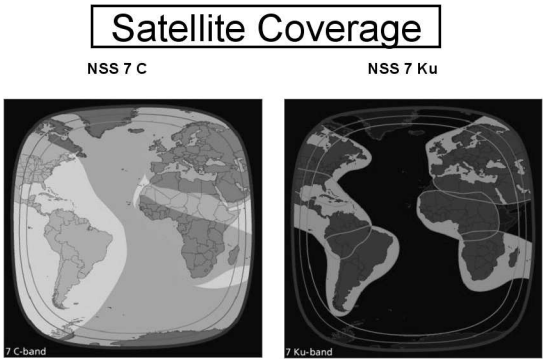
All the solutions available to the world can be categorized within these two major embodiments. The question is, what lies between these extremes? If a middle ground solution can even the technology landscape, then what is the embodiment of that solution? One obvious possibility is to severely simplify the components of the architecture. Another is to rethink its goals and engineer with a different approach.

The Evolutionary vs. Revolutionary Approach

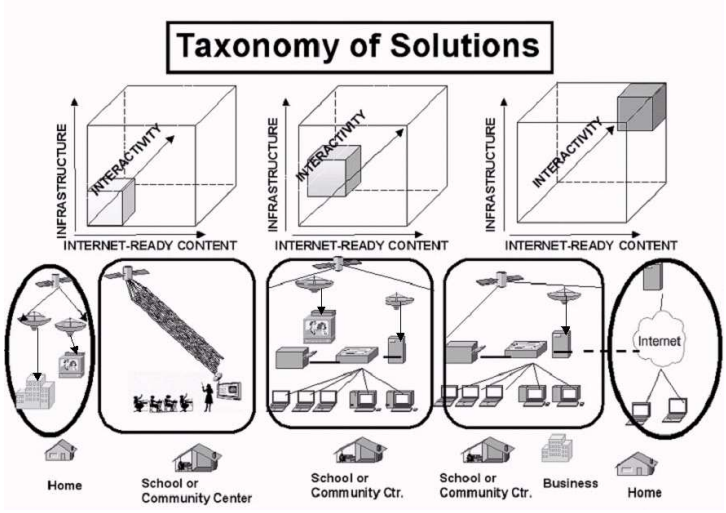


If we wait for the connectivity to find its way to the more remotes parts of the world, the evolution will become dependent on one factor, access. We already have enough satellite coverage around the work to solve that problem, but clearly, we are not using it to provide access to rich media interactive applications, we are using it to provide television programming in a limited realm of applications areas.

The access issue is no longer a problem. Technologies such as digital broadcast satellite (DBS) and digital data broadcast (DDB) have provided the solutions to the access problem. Advanced methodologies for enabling content create a complete set of components to build solutions based on the same architectures that gave us the Web, the Internet and digital libraries within the embodiments of a more ubiquitous infrastructure approach.

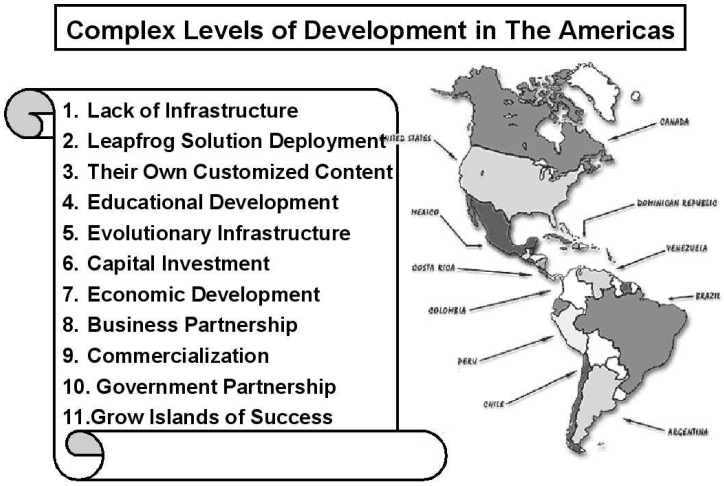


Taxonomy of Solutions from a Set of Architecture Components



There's a spectrum of solutions encompassing the possible components available to both developed and developing countries to provide the same classes of services in different ways. The progress can be opportunistic, opposed to evolutionary. This means massive deployments with wide satellite coverage using alternative solutions for content enablement and end-user appliances. It is important to understand that systems can be integrated using different components and different approaches to produce similar or the same functionality and deliver the same services.

Latin America Provides a Diversity of Exploratory Challenges



Latin America provides perhaps the best testbed for focusing on ICT research and development because it limits the sets of problems to the most fundamental: technical and economic. In the absence of the language barrier, it is possible to address the content enablement problem in its most simple form, by proliferation. The social and economic issues characteristic of the digital divide anywhere in the world are present in most of Latin America. Therefore, a confluence of limitations would bind the research to its most fundamental aspects.

Conclusion

For most people in the world, the television is the main source of information. Most people in the world lack the resources to support the minimum requirements for Internet-based e-learning, information and knowledge access: a high-powered personal computer (PC), a dedicated telephone line to access the Internet via a modem and the financial means to keep up with the latest version of the operating system and the repertoire of tools now needed to sustain a viable useful end-user environment. The most difficult barrier to conquer is content, limited by language, cultural and cost factors.

Unquestionably, the modern television environment, with its approaching universal penetration, ease of use and cultural appeal to all people, provides the level of access needed to build upon for creating a global and universal ICT infrastructure that is both accessible by the majority of people (global reach) and capable of providing the level of functionality needed to deliver all forms of content (universal medium). More importantly, the existing satellite infrastructure provides the network of connectivity needed to perpetuate access and an ongoing supply of content. While empowering end-users with personal appliances, such as cell phones and thin clients, to approximate the services of the ICT, it is in the power of massive access and the unlimited supply of content where the answer lies for universal ICT.

While the Internet has been identified, here and oftentimes, as a highly differential tool for developing nations as well as any disadvantaged and minority groups, the Television continues to be the least common denominator for access and usage flexibility for all people. We recognize, however, that the many complex issues surrounding the development of functionality in the still evolving space of interactive digital television, make it difficult for the vision of an international equitable ICT infrastructure to become a reality based on the advancement of one solution alone. Neither the Internet nor the television infrastructure will solve the digital divide problem. In examining the anatomy of the problem and presenting taxonomy of solutions we hope to expand on the thinking and the potential of unexplored approaches.

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