# Chapter 4
# Making the Global Convergence of ICT Available for Everyone

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## 4.1 Introduction

In 2011, the pace in the development of information and communication technology (ICT) seemed to peak, but the convergence phenomenon can still be described as a first-world trend. While the majority of citizens of North America, Australia, and Europe have Internet access, the world average is only every third person. In Africa, Internet penetration plunges as low as 11 %.[1]

While access to the Internet may not be as directly valuable as goals like eliminating hunger or curing disease, the converging applications in information and communication can accelerate the improvement of the human condition. Across the globe, agile protestors are overthrowing non-democratic governments by organizing via social media that uses ICT channels, and national legislations are facing empowered citizens while struggling with regulating the Internet. Inhabitants of the world grow together by means of digital communication and information and establish the first genuine digital democracies. Unrestricted information access supports and enables democratization, learning environments, and free speech, but this global convergence renders national regulation almost powerless. While, on one hand, this development routinely defies governmental censorship, it also imposes new kinds of threats that defy current law enforcement structures. Governments of leading countries in technological development criticize regimes that try to inhibit their citizens' communication connections and information access while also trying to establish similar censorship infrastructures under the cover of preserving intellectual property rights.

This outline demonstrates how the global convergence of information and communication affects a wide range of technological and social topics. This article

[1] http://www.internetworldstats.com/stats.htm.



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assesses the emerging themes in this area and the opportunities, threats, and challenges that these developments create.

The remainder of the article is structured as follows: first we describe our literature review approach. Then we discuss the emergent themes regarding global convergence. Finally, we propose a research agenda that could guide further research.

## 4.2 Literature Review

The Millennium Project is a report that identifies trends and issues that lead to global challenges. The present paper analyses how ICT can contribute to the challenge of making ICT available to everyone.

The framework (Fig. 4.1) explains the procedure that our research followed and shows the bridge between information and communication regarding the opportunities and threats of internet access and its availability to citizens. Moreover, it highlights which technological developments might help to close the gap and build an expedient bridge (Fig. 4.1).

A literature review seeks to uncover the sources relevant to a topic under study, so it makes a vital contribution to the relevance and rigor of research (vom Brocke et al. 2009). We searched among several databases: ACM Digital Library, Business source premier, EBSCOhost, Elsevier, JSTOR, and IEEE. The review can be characterized as focusing on research application, integrating various research areas, and having a neutral perspective and a target audience of general scholars (Cooper 1988). The literature review followed a procedure in which search results matching the respective topic ("hits") were saved to a project database; the hits were then analysed based on evaluation of their titles, abstracts, and summaries and, if

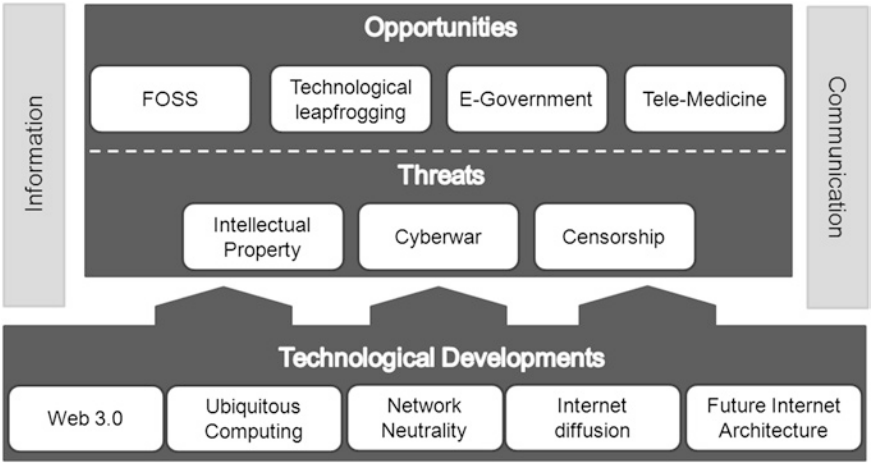


**Fig. 4.1** Conceptual framework

they were valuable for the purposes of this review, they were catalogued based on a tag-based taxonomy ("evaluated"); and articles that addressed the core research interest were synthesized and marked as "reviewed".

## 4.3 Results and Discussion

(**1**) ***Opportunities***. Developing countries set trends in applications, revenue models, and cost-saving approaches, especially for mobile networks (Khalil and Kenny 2008). ICT has immense potential to facilitate this development through, for example, *technological leapfrogging*, which bypasses some of the processes of accumulation of human capabilities and fixed investment in order to narrow the gaps in productivity and output that separate industrialized and developing nations (Steinmueller 2001). The developing world is well-equipped to use modern technologies or even to become the lone adopter of such products (Chen 1999) because of the unavailability of an established technology and the ambitions and aspirations of the developing world (Prakash 2005; Malairaja 2003). However, opinions vary concerning whether technological leapfrogging is possible beyond the mobile phone phenomenon and whether it is key to the successful development of countries that sometimes lack even basic sanitation facilities (Steinmueller 2001).

Digital government or *electronic government* (e-Government) has emerged as a new form of interaction between the state and the citizens with the purpose of improving government performance and processes (Andersen et al. 2010). The key principles of e-Government initiatives include transparency, participation, and collaboration. A certain level of trust in the electronic interaction with the government must underpin these key principles and requirements. The intention to use e-Government depends on access and skills, since skills are an important element in terms of how the population uses the Internet—whether for general use, online purchases, or online information searches.

The healthcare industry claims to be one of the first service industries to introduce the use of ICT in electronic health services (e-Health), which began with telephone-based medical consultations and grew from there (Houghton 2002). e-Health is also the focus of the European health policy, which has led to a significant increase in health insurance cards and e-services like reimbursement and the electronic transmission of prescriptions. Telemedicine, an important part of the European healthcare agenda, has attracted considerable attention from the participating countries (Denz 2008).

(**2**) ***Threats and Requirements***. The regulation of cyberspace via *Internet censorship* is an important topic that has been linked to the topics of democracy, free speech, and privacy. Internet censorship is primarily defined as state-controlled Internet filtering (e.g., South Korea's blocking of pro-North Korean sites, India's blocking of sites of groups that foment domestic conflict, blocking search results from the Chinese Google website or Wikileaks). Actually, access to the unrestricted Internet cannot be found in any country in the world (Tariq 2006). The

states find new and more sophisticated techniques to restrict some of the Internet activities, and the motives, scope, and effectiveness of Internet censorship vary widely from country to country (Boyle 1997).

The convergence of media and digital content into a realm of common communication tends to exacerbate the *intellectual property* problem because of issues like the impermanence, multiplication, and heterogeneity of communication sources (ICT 2005). The property of ideas and their expression is hard to maintain in cyberspace in the forms in which they are usually protected (e.g., patents, trademarks, copyrights). Dynamic content can be modified in minutes, so it is difficult to preserve its integrity in order to claim property rights to it. The same applies to the varying formats in which digital content may be available. Legal issues in this area are complicated by the fact that some media formats, such as sound files, are covered by rules specific to the media (Okediji 2004). Another example of the complex nature of such issues is the legal claims of websites in respect to the display of their content (e.g., images) through search engines. The heterogeneous nature of digital collections often leads to confusion in terms of copyright infringements, such as the when one considers whether a print publication is allowed to add the work of freelance writers to an electronic database.

Because of its relative novelty, the vulnerability of the Internet has yet to undergo a complete assessment in terms of evaluating the threat of *cyberwar*. Each target infrastructure requires a much more detailed analysis of normal rates of failure and response, the degree to which critical functions are accessible from public networks, and the level of human control, monitoring and intervention in critical operations (Sommer 2001). The amount of damage caused by the launch of cyber-attacks imposes high economic costs in relation to the comparatively minor cost of launching such an attack (Ramsaroop 2003). Opportunity costs (e.g., lost sales or lower productivity) make up a large proportion of the cost of cyber-attacks and viruses (Lewis 2002).

(**3**) ***Technological Developments***

*Ubiquitous Computing.* Ubiquitous computing is based on Weiser's (1991) vision of the human world merging with virtual content, and computers vanishing into the background. Making this vision a reality involve a multitude of purpose-specific devices, such as communication micro-chips, pads, wall screens, and smartphones, that are connected in a ubiquitous network and provide content in ways suited for their specific purposes. Therefore, devices must be aware of their and their user's environment and be physically and cognitively available (Banavar and Bernstein 2002; Waller and Johnston 2009). This development is enabled by inexpensive hardware, small-form factors, and advanced human interfaces.

For global convergence, ubiquitous computing serves the goal of availability and provides access to digital information content and communication channels that are embedded in the contexts of prospective users, lowering entry barriers and learning curves. Its real-world application would be driven by falling prices, improved hardware performance, and the ability to connect to services through a variety of networks (Islam and Fayad 2003; Lyytinen and Yoo 2002). However, it

requires a large-scale, diffuse service infrastructure that can integrate a multitude of requirements and a large-scale understanding of how to adapt and understand technology (Lyytinen et al. 2004).

*Web 3.0.* Although researchers have not yet agreed upon a precise scientific definition, "Web 3.0 represents an evolutionary shift in how people interact with the web, and vice versa" (Green 2011). Certain themes are emerging to form the next-generation web, which provides information tailored to the individual user's needs, location, and identity. This web is likely to be a semantic Web that is not only readable by humans but also understandable and traversable for machines (Green 2011). Manual definitions of the relationships between types of content make complex information searches and aggregations more feasible than do text mining and AI algorithms, which are comparably slow and long-running (Berners-Lee and Hendler 2001).

While Web 2.0 is user-centric, Web 3.0 will be personal, as the correspondence between the retrieved information and the user's need is improved by leveraging the social graph—that is, the user's contacts. Web 3.0 also takes into account the properties of ubiquitous computing (embedded virtuality, mobility of computing; Green 2011) and may become a "web of things", where not only users and services but also a multitude of autonomous devices communicate transparently, connecting appliances that share and consume data. Rich Internet applications form the heart of the dynamic, data-centric Web 2.0, but the mobile web emerges in Web 3.0 with interconnected applications, mobile websites, and a swarm of new types of devices that act as user interfaces. With the properties of collective intelligence, Web 3.0 may also have a positive influence on learning and organizational development (Green 2011).

*Information Infrastructure.* Network neutrality refers to the principle of an information network that treats all data packets equally (Schuett 2010) and does not favour one application over others (Wu 2003). Network neutrality is important if long-term public interest in having an innovative communication infrastructure, where services can build in natural competition, is to be achieved (Wu 2003). Standing against this effort are the short-term interests of ISPs, which (because of their control over the "last mile" to the customer) act as selective gatekeepers.

A recent example is the mobile Internet market: Because wireless network providers block voice-over-IP packets by employing deep packet inspection, they use their control power over the end user's technology to block competitors (e.g., Skype). Ensuring that the tools that enable information and communication are available to as many humans as possible poses several requirements on a feasible Internet architecture. We derived requirements from the emerging themes introduced in the literature and aligned them to six architecture goals, classified according to Paul et al. (2011).

In the next-generation Internet, security will be a part of the architecture rather than being overlaid on top of the original architecture (Paul et al. 2011). Confidential message exchange between parties (e.g., humans, devices, and services) that can trust each other is a necessary prerequisite for global communication, which requires user-centric privacy and identity management. Research

suggests the use of secure cryptographic identities (e.g., in resource-oriented networking) that enables identity-based access control on the level of packets (per-packet attribution) to be enforced throughout a network (e.g., Security Architecture for Networked Enterprises (SANE)).

Another architecture requirement is reliable *content delivery mechanisms* that ensure that information content is persistent, available, authenticated, and provided with preserved integrity for all users. The scarce bandwidth available at the transnational backbone must also be used effectively—that is, with the highest throughput and lowest latency. On the state-of-the-art Internet, content distribution networks (CDN) serve static (i.e., cacheable) content to fasten load times (Paul et al. 2011). Future Internet Assembly (FIAs) will make use of highly distributed content nodes (e.g., next-generation CDNs) and peer-to-peer delivery (e.g., next-generation peer-to-peer, swarming architecture), both of which will be aware of their underlying topology and the location of peers (e.g., swarming architectures, provider-aided distance information systems), resulting in fewer costly ISP transits and shortened content routes (Paul et al. 2011; Poese et al. 2012; Bell and Walker 2011).

Other requirements include architectures like delay-tolerant networks (DTN) and mobile ad hoc networks (Kumar 2009) for areas where Internet connections and power supply are flaky and routes between mobile devices are temporarily unavailable, fault-prone, or subject to long delays. These *challenged network environments* are defined as "heterogeneous network environments where continuous end-to-end connectivity cannot be assumed" (Paul et al. 2011). In addition, *management control frameworks* that prohibit censorship and ensure network neutrality must be found. Finally, in order to achieve network neutrality, manageable content policies and network path optimization, with regard to overall network efficiency, the *internetworking layer* must be redesigned to improve scalability, mediation between user-defined content policies, and ISP-based performance optimizations.

Basic ICT markets must be established in order to facilitate competition and enable foreign competitors to invest in local infrastructure. To ensure that ICT is used to its full potential, regulatory institutions are needed for broadcast infrastructure and content—either combined or split (Khalil and Kenny 2008)—that examine and leverage the impact of ICT and drive change and privatization (Jussawalla 1999). Such regulations may include the liberalization of state-owned monopolies or policies of open economies and export-oriented investment in technology, providing the basis for long-term economic growth, as has been observable in Asian countries (Jussawalla 1999). Regulation also includes the reformation of mechanisms of spectrum allocation for wireless communication, which is best handled through property rights (Khalil and Kenny 2008).

The objective of this paper is to answer the question concerning how the global convergence of ICT can work for everyone. While seeking to close the gap between information and communication (Fig. 4.1), one must find the opportunities, threats, and requirements and define which solutions fit best. While one cannot say that there is only one right answer, focusing and narrowing down the opportunities and threats reveals some of the most plausible topics.

In defining the opportunities, threats, and requirements, we find that the IT area is important but should not be the sole focus. We try to link the thoughts of the Millennium project with other fields, such as the political view, the judicial view, and the socio-cultural aspects of the issues. Combining those four areas, we identified the topics of Free and open-source-software (FOSS), technological leapfrogging, e-Government, and Tele-Medicine. While looking for best-practice methods among these areas, we must also consider the threats that are related to the four areas and that are also linked to other problems throughout the project work. Intellectual property, cyberwar, and censorship were identified as threats, while intellectual property can also be seen as an opportunity.

We narrowed the topics to five that may give an answer to the question posed for the literature review. The main point was to define areas that are important to our ability to connect the world. We listed critical issues within these points, such as issues within the topics of internet diffusion and network neutrality, as well as technological concepts that can address them. Although we are setting a good pace in achieving global connectivity, future technologies—such as a new internet architecture that optimizes bandwidth usage but also installs centralized censorship possibilities—may also slow our ability to overcome these critical issues. We highlighted the cross-disciplinarily of these issues by bringing together the views and aspects of IT, politics, law, and socio-culture.

We developed an overall method and framework to add the technological developments of Web 3.0, ubiquitous computing, network neutrality, internet diffusion, and future internet architecture. We combine these developments with the opportunities of FOSS, technological leapfrogging, e-Government and tele-medicine while considering at the same time the threats and requirements of intellectual property, cyberwar, and censorship.

## 4.4 Research Agenda

Performing a literature review on the topic presented here uncovered a gap in the research on the global convergence of information and communication: Although the areas presented here are already adequately covered, research on the core nature of global convergence is missing. Therefore, our conceptualization can serve as a basis from which to outline future research's attempts to strengthen the links between the socio-cultural factors and information systems to improve the future global state. Interdisciplinary collaboration from diverse disciplines, such as politics, law, computer science, and socio-culture, will be necessary in this effort.

Many questions are yet to be answered, including how to find a working balance between preventing censorship and governmental control of access to content against the need to preserve value for cultural minorities (which is likely to require a filtering infrastructure). The question of internet diffusion and the role of governments in this process will become even more important as Internet penetration increases in the near future.

A possible model for a diffusion process that is cost-effective and that preserves the public interest in an innovative infrastructure could be *technology transfer through governmental incentives for open source*. Openness of interfaces and platforms is an essential prerequisite for establishing a global infrastructure like the internet. Therefore, developed countries should set incentives for the domestic technology markets to pursue open source. The more open source components are developed (and, consequently, the more open interfaces are used), the more developing countries can benefit from this technology, save costs, and leapfrog their development by extending on the state of the art. In addition, open source teams can help to achieve the transfer of knowledge into developing regions, support the externalization of first-world knowledge, and enable a global virtual and physical exchange of professional talent. Finally, private competition in developing countries' markets is enhanced because suppliers can build on available commons like the FOSS infrastructure components.

## 4.5 Conclusions

According to Khalil and Kenny (2008), and as confirmed by the findings of our literature review, developing countries will set the trend in applications, revenue models, and cost-saving approaches, especially for mobile networks. We created a framework that can serve as a guideline to answering the question concerning how the global convergence of information and communication technologies can work for everyone. We focused not only on IT but also on aspects of politics, law, and socio-cultural issued, combining them with current affairs. In seeking to close the gap between information and communication (Fig. 4.1), we had to consider other important areas, such as threats and requirements, to give a shape to the framework.

Future research should improve the framework and detail it to the point at which it can be evaluated and include other findings to round it out. The developed framework should be seen as a basis from which to provide an answer to the questions concerning to connect the people all around the world using tools, considering the opportunities and threats that are present, and taking into account the challenges and complexity of the task.

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