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Critical Internet Uncertainties

How will governance, evolution and growth of the Internet affect sustainable development?

Maja Andjelkovic, Tony Vetter, and Heather Creech

November 2008

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Introduction

In 2006, IISD began to explore how the future of the Internet, its development and deployment, might affect progress towards sustainable development. As an early adopter of the Internet and the Web as our primary communications channel, we saw, as did thousands of other institutions, the potential for innovation and collaboration supported by a growing global infrastructure. But this potential may now be at some risk, given a number of critical uncertainties related to the governance of the system, the evolution of the technology, and concerns over its security and stability.

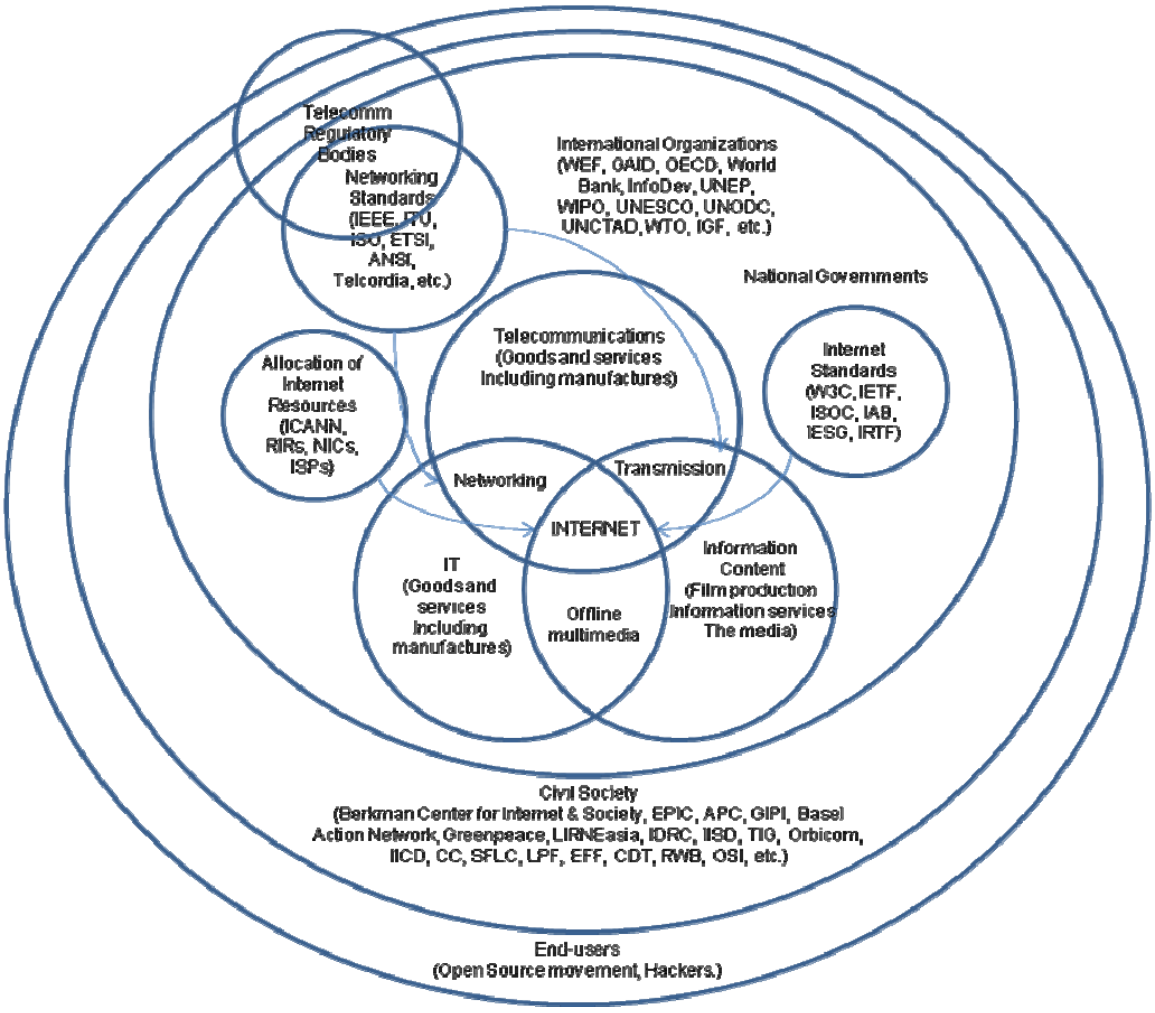
We have chosen to use scenarios as a methodology for better understanding what the future of the Internet might look like, and how possible futures might contribute to, or lead away from, sustainable development. As a first step in this work, it was important to more clearly identify the range of critical uncertainties around the future of the Internet.[1]

The introduction to this paper contains a brief description of what we are beginning to understand as the "Global Connectivity System" followed by an outline of the important choices the stakeholders and actors within that system are facing. **Our goal is to stimulate further inquiry through illustration, rather than, at this stage, provide an exhaustive treatment of the issues or a comprehensive analysis of policy choices.** It is written as much for the sustainable development community, which is for the most part, unfamiliar with the emerging challenge of managing global connectivity, as it is for those with more technical backgrounds, who are immersed in the details of particular choices but seek to better understand the broader implications of Internet policy decisions for global futures.

[1] As a starting point, IISD invited the Tellus Institute to share with us the findings of the Global Scenario Group—a set of six possible pathways that the world might follow. Based on our own research, we shared with Tellus the organization of the global system of the Internet and its associated technologies and stakeholders. This paper served as background for a two-day scenarios exercise that considered how the resolution of critical Internet uncertainties might take the world in one direction or another.

1.0 The Global Connectivity System

Any study of the history of the Internet quickly sheds light on a system of interactions, influences and linkages between the ICT sector core (hardware, software, telecommunications) and a much broader group of actors not normally considered a part of the traditional ICT sector that have played a critical role in shaping the evolution and use of the Internet. It is the full range of actors in this system, which can be referred to as the Global Connectivity System, that needs to be engaged in the development of policies aiming to ensure that ICT contributes on balance to achieving sustainable development objectives.



This layered system of actors and their interactions, influences and linkages, pictured above,

makes up the Global Connectivity System. How this system evolves and is used is significantly influenced by actors in all of these layers. It is worth noting that the Global Connectivity System is also growing in scope as a result of technological advances and regulatory changes that have served to break down the physical and regulatory barriers among its industry categories as well as to involve economic activities not previously having direct ICT association.[2]

Deregulation in many industrialized countries has encouraged an explosion of communication offerings. As a result, telephone, television cable and Internet service providers are increasingly invading each others' traditional markets, resulting in the convergence of voice, data and computing technology delivered over a combination of new and infrastructure. These trends suggest a future where one will be able to connect to the Internet anywhere and at any time, as well as a future where the Internet Protocol will be the foundation for all information and communication exchanges. In other words, the future of the Global Connectivity System is that of the Internet itself.

Strengthening our understanding of the critical uncertainties about tomorrow's Internet is, therefore, crucial for understanding what form the Global Connectivity System may take. International, national and multistakeholder body policies and agreements targeted to address these critical uncertainties could play a pivotal role in guiding the evolution of the Global Connectivity System will and in determining whether the transformations will continue to contribute to global sustainability.

2.0 Internet Policy Today

To date, the Internet has been governed through a minimalistic, multistakeholder approach, with private sector leadership. Instead of a traditional telecommunications governance structure, with a centralized intergovernmental body at the top, today's Internet governance practice includes millions of Internet users, thousands of IT vendors, network providers and ISPs, hundreds of governments and dozens of intergovernmental organizations, standards bodies and international NGOs.[3] Thanks to this fact, and the "end-to-end principle" that underpins the Internet's technical core, individual Internet users do not require permission from any other "nodes" or even the owners of the network infrastructure for any of their actions. There is, theoretically, no limit to the kinds of applications or content users and

[2] Tony Vetter, *The ICT Sector and the Global Connectivity System: A sustainable development overview*. Winnipeg: IISD, 2008.
[3] Dr. Michael Nelson, personal conversation.

developers could translate from imagination into existence.[4] It is as a result of this design and governance that the Internet has brought about unprecedented innovation in communications and exponentially increased global connectivity. By definition, innovation disrupts the status quo and this is reflected in current tensions in Internet governance: the powerful, pre-Internet interests have been mobilizing over the last decade to "exert pressure at both the physical and content layers of the network. […] They will [affect] the opportunity for growth and innovation that the Internet presents."[5]

The struggle for changes in governance mechanisms, more than any other, will determine the forces driving the future of the Internet. While broad-based innovation can threaten some existing interests, the potential gains to sustainable development from the Internet's openness and unfettered growth are likely to outweigh potential losses to private interests, especially in developing countries.[6] Unfortunately, "open search and access" for solutions towards global sustainability, aided by Internet-based innovation is not an inevitable outcome of the Internet revolution.

The following pages paint a brief background on a number of Internet policy areas that may turn out to be critical for sustainable development. As noted in the introduction, our goal is to stimulate further inquiry through illustration, and not to provide a thorough treatment of the issues or a comprehensive analysis of policy choices. The paper is organized in five sections: content and services; infrastructure; decision-making processes; security; and ecological footprint. Each one contains a few examples intended to illustrate Internet governance uncertainties that may prove critical to sustainable development.

2.1 Content and Services

The content and services "layer" of the Internet is the one with which most users interact, most of the time. Recent debates concerning this policy arena include those related to "network neutrality" and to the role for intellectual property rights in the digital environment, both summarized below. The question of the role of users as creators of content and services, and as active designers of their Internet devices, has recently gained some attention. A less publicized dilemma facing Internet policy-makers concerns choosing appropriate regulation philosophies from among those that governed previous mass and point-to-point communications technologies and services.

[4] L. Lessig, (2001, Nov./Dec.), *The Internet Under Siege.* Foreign Policy, No. 127 56-65, Carnegie Endowment for International Peace.
[5] Ibid.
[6] Ibid.

2.1.1 *Net neutrality*

The effect of increasing control by ISPs over the Internet is frequently discussed in the context of network neutrality, the concept allowed by the end-to-end principle that prevents any centralized body from "shaping" traffic and so deciding who gets what content, when or how. A neutral broadband network is one that is free of restrictions on the kinds of devices that may connect through it, on the modes of communication allowed, which does not restrict content, sites or platforms, and where communication is not unreasonably degraded by other communication streams.[7]

> "The Internet was designed with no gatekeepers over new content or services. A lightweight but enforceable neutrality rule is needed to ensure that the Internet continues to thrive."
>
> Vint Cerf, co-inventor of the Internet Protocol

The possibility of regulation designed to mandate the neutrality of the Internet has been subject to fierce debate. On the one hand, net neutrality advocates have warned against the distinct possibility that telecom and cable companies will impose tiered service models in order to increase their profits. These models would see some users with limited access to the Internet, potentially only allowing access to ISP-defined Internet "walled gardens" to most subscribers. They could also give preferential treatment to specific content, essentially reserving the equivalent of prime grocery shelf space to the content produced by the ISPs themselves, over the content produced by end-users. These visions assume elimination of the end-to-end argument and limiting of the potential for further Internet-based innovation.

ISPs running cable services have exercised their power to ban certain kinds of applications (specifically, those that enable peer-to-peer service). Last fall, the Associated Press reported that a U.S.-based company, Comcast, was secretly blocking users' legal peer-to-peer traffic, calling the company's practice the "most drastic example yet of data discrimination." In response, organizations Free Press and Public Knowledge filed a complaint, triggering the first test case of the U.S. Federal Communications Commission's 2005 Internet Policy Statement, which explicitly guarantees Internet users the right to access the lawful content, applications and services of their choice. On August 1, 2008, FCC ordered Comcast to stop

[7] Wikipedia, "Network Neutrality" http://en.wikipedia.org/wiki/Network_neutrality (Retrieved September, 2008).

its ongoing practice of blocking Internet traffic by the end of the year and disclose all past and future "network management" practices.[8]

Vint Cerf, the co-inventor of the Internet Protocol is among the best known proponents of net neutrality, while Bob Kahn, another co-inventor of the same protocol, has called the term a mere "slogan," arguing that some forms of traffic shaping are required for good network management and acceptable quality of service.[9]

A future Internet in which ISPs define most, if not all, of the user experience could fundamentally turn the network into a tiered delivery channel for traditional media and may have significant implications for global research and collaboration on global problem solving. But it is possible to imagine a case where it would be desirable to advance certain types of content over others, in recognition of limited bandwidth available in remote or developing areas. For instance, it may be beneficial to expedite delivery of community services such as those related to telemedicine or distance education, through what may be called "fair shaping."

2.1.2 *Intellectual property rights*

While our ability to produce and share knowledge has experienced unprecedented growth thanks to the technological advancements of the late twentieth century, the ability of the wider society to obtain the ideas of "learneds" has always been crucial for societal and economic progress. In the eighteenth and nineteenth centuries, growing levels of education among the general population, combined with the works of thinkers like Voltaire, Hume, Rousseau and other philosophers of the Enlightenment, enabled the spread of revolutionary ideas and inspired the end of feudalism in Europe. Thus, for example, it is believed that Voltaire sent some 20,000 letters to leading thinkers of his time, and that it was these, and writings of other authors, that impassioned the French "tiers état," or the third estate, leading to the French Revolution.[10] Today it is reasonable to assume that easier access to knowledge around the globe could lead to a more equitable world, one in which global economic disparities are reduced. As we witness the so-called "information revolution," the number of people who can access information and knowledge of all kinds is increasing exponentially, due in no small part to the proliferation of the Internet, availability of individual "blogs" and online journals, creation of independent broadcast services like podcasts, and other non-traditional information sources. Coupled with new technologies

[8] FCC (2008, August 1). *Commission orders Comcast to end discriminatory network management practices*. Press release Press Release at http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-284286A1.pdf (Retrieved September 2008).
[9] Wikipedia, "Network Neutrality" http://en.wikipedia.org/wiki/Network_neutrality (Retrieved September, 2008).
[10] W. J. McIver, Jr. and W.F. Birdsall. (2004) Technological Evolution and the Right to Communicate. *Electronic Journal of Communication/La Revue Electronique de Communication, 14*(3, 4).

that enable easier reproduction of digitized information in a variety of formats, these new channels of knowledge dissemination are supportive of the free use of knowledge as a public good,[11] and are seriously challenging models of knowledge distribution characteristic of the late twentieth century, which were dominated by large media conglomerates, for-profit scientific publications and business-like institutions of higher learning. In our post-industrial, information world, there appears to be a need to re-evaluate the system of knowledge regulation and management inherited from the industrial age and adapt it to current needs.

Organizational behaviour theory recognizes a "knowledge paradox" that seems useful in thinking about the new "knowledge economy." The paradox exists insofar as the building and sharing of knowledge is one of the highest potential sources of growth in the new economy, and yet knowledge is often also a carefully guarded and warily traded resource. Intellectual property rights (IPRs) regimes inherited from the pre-Internet era are currently being tested as the ultimate codes of conduct for managing information. IPR protections, however, may not provide incentives to share knowledge that would benefit the new economy, and they also seem to fail when used as a resource to organize and access knowledge resources. Current IPRs are also proving inefficient in balancing the treatment of knowledge as a tradable commodity and a public good, and, contrary to their original purpose, creating obstacles for innovation.

Instead, IPRs should help resolve the contradiction posed by the dual treatment of knowledge by economic theory: on the one hand, knowledge is one of the purest forms of a public good due to its non-excludable and non-rivalrous nature; on the other hand, the development of the knowledge economy presupposes that information and knowledge are the most highly valued tradable commodities, a status economists usually reserve for private, appropriable goods. The purpose of IPRs should be to foster innovation and creativity necessary for sustainable development, by allowing for a balance between knowledge as a public good and knowledge as a private good. Any solution to the knowledge paradox in the new economy must recognize the differences and the overlap between these two types of knowledge, private and public, so that each can be treated accordingly.

Many people can use knowledge and information at once, without reducing their value, quantity or utility in any way. This non-rivalrous nature, and the fact that concurrent usage does not result in exhaustion of the resource, is what distinguishes knowledge and information from private goods. Except in certain circumstances, such as when knowledge is somehow intentionally protected or made scarce, knowledge does not behave in the way material property would, which poses a difficulty for producers of knowledge looking to profit from their activity. Intellectual property rights are the most important legal tool for

[11] F. Pinto (2005, Spring), Public Enemy or Public Good? *Harvard International Review: International Health, 27*(1).

converting knowledge into a commodity, so that it can be treated more like palpable goods. This transformation allows for the laws applied to assets such as property and labour in the industrial society to remain relevant in the information society. As Christopher May writes,

> The most important role that IPRs play generally, and specifically of importance in an "information society," is the formal construction of scarcity (related to knowledge and information use) where none necessarily exists. Where there are information asymmetries, advantage may be gained by keeping information "scarce" (i.e., reducing its circulation).[12]

Once a legal form of scarcity is established through IPRs, a price can be determined and knowledge can be traded and sold. Just as it would be nearly impossible for an economy without intellectual property rights protection to maximize innovation and creativity,[13] an economy with excessive levels of IPR protection would undoubtedly create inefficiencies and societal costs that surpass the advantages. Figure 2 illustrates the idea that at a certain point the strength of IPRs take on a negative correlation with benefit to society.

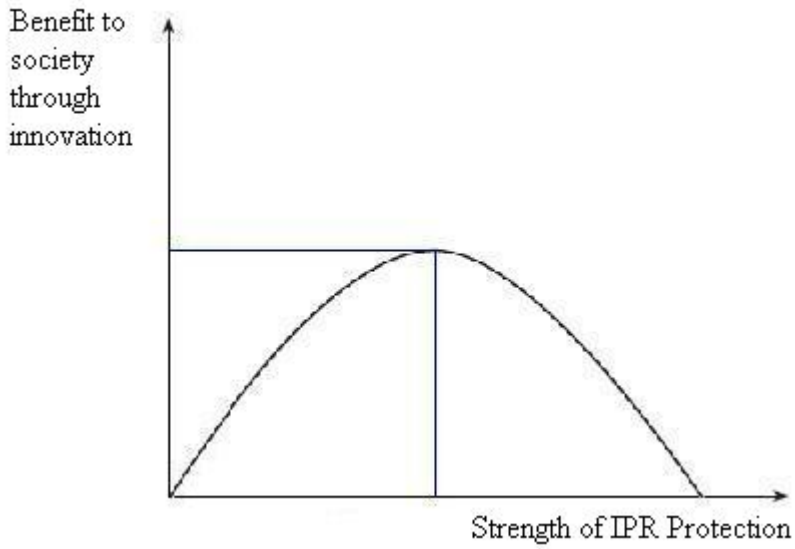


Figure 2: Benefits and strengths of IPR protection

Source: Peter Drahos' presentation at the "Politics and Ideology of Intellectual Property" conference, held in Brussels, March 20–21, 2006.

[12] C. May (2005), Between Commodification and 'Openness': The Information Society and the Ownership of Knowledge. *Journal of Information Law and Technology, Special issue 2/3,* 123–146.

[13] W.M. Landes and R.A. Posner (2003), *The Economic Structure of Intellectual Property Law*. Cambridge, MA: Harvard University Press.

IPRs most relevant to Internet governance include trademarks and copyrights. Trademarks are the primary tool used to address "cybersquatting"—the registration of domain names with the sole purpose of reselling them with a profit. ICANN requires all contracts for top-level domains, such as .com, .org and .net to recognize the Universal Dispute Resolution Procedure (UDRP) developed by the World Intellectual Property Organization (WIPO). Trademark holders increasingly encourage the extension of UDPR to country domains.[14]

Napster, the famous peer-to-peer music sharing network, provided one of the first major tests for copyright use online. Although it brought billions of dollars in losses to the music recording industry and was repeatedly ordered to shut down operations by the courts, the persistence of similar networks has highlighted the lack of practicality of applying established copyright tools online. Some attempts, including the U.S. Digital Millennium Copyright Act (1998) and the WIPO Copyright Treaty (1996), have been made to modernize copyright application without an examination of the fundamental logic and its applicability in the new environment: instead, most such efforts have focused on introducing stricter provisions for the limitations of authors' exclusive rights, the prohibition of circumventing the technological protection of copyrights and other related measures.[15] As the above discussion suggests, however, the effect of such measures may not, on balance, be beneficial for knowledge and information management in the networked economy.

2.1.3 Tethered devices

In addition to controlling the content delivered to the "last mile" of the network, e.g., people's homes or Internet-enabled mobile phones, another threat to the openness of the Internet is the potential of manufacturers to retain control over the devices they produce. In a recent book called "The Future of the Internet and How to Stop It," Jonathan Zittrain lays

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[14] J. Kurbalija and E. Gelbstein. (2005), *Internet Governance. Issues, Actors and Divides.* Retrieved from Diplo Foundation Sept, 2008: http://textus.diplomacy.edu/textusbin/env/scripts/Pool/GetBin.asp?IDPool=641.

[15] Since DMCA and the WIPO Copyright Treaty, many other pieces of legislation have been passed at national and international levels. The broadest sweeping, though not yet adopted, is the Anti-Counterfeiting Trade Agreement (ACTA), a proposed plurilateral trade agreement that would impose strict enforcement of intellectual property rights related to Internet activity and trade in information-based goods. The agreement is apparently being negotiated by the governments of the United States, Japan, Switzerland, Australia, New Zealand, South Korea, Canada, and Mexico and the European Commission. If adopted, the treaty would establish an international coalition against copyright infringement, imposing strong, top-down enforcement of copyright laws in developed nations. The proposed agreement would allow border officials to search laptops, MP3 players and cellular phones for copyright-infringing content. It would also impose new cooperation requirements upon Internet service providers (ISPs), including perfunctory disclosure of customer information, and restrict the use of online privacy tools. The proposal specifies a plan to encourage developing nations to accept the legal regime, as well. The ACTA negotiations process has been criticized for its secrecy and exclusion of many stakeholders, and various groups have expressed concern about the agreement's potential for privacy violations and threat to free software. Source: Wikipedia entry on ACTA: http://en.wikipedia.org/wiki/Anti-Counterfeiting_Trade_Agreement

out the history of the PC and its role in allowing anyone to take advantage of the Internet's openness. He argues that the PC is "generative" because a user can change its code and put it to whatever purpose one wishes. The fact that most PC owners today use Microsoft Windows or Apple's MacOS has not stopped innovators from coming up with alternative operating systems and alternative computer uses. By contrast, Zittrain describes "tethered, sterile appliances" which are more and more prevalent as the choice devices for connecting to the Internet. The problem that a world of such devices creates is that they discourage or do not allow for "tinkering" and creative uses. Examples include Apple's iPhone and TiVo. Zittrain also mentions the AOL environment popular in the United States in the late 1990s, and current mobile phone networks as examples of tethered tools for connecting.

Zittrain warns against giving in to tethered devices and closed environments and assumes such tendencies are primarily caused by security concerns (related to cybercrime, viruses, spam or others):

> Today, the same qualities that led to [the Internet's success and innovation] are causing [it] to falter. As ubiquitous as Internet technologies are today, the pieces are in place for a wholesale shift away from the original chaotic design that has given rise to the modern information revolution. This counterrevolution would push mainstream users away from the generative Internet that fosters innovation and disruption, to an appliancized network that incorporates some of the most powerful features of today's Internet while greatly limiting its innovative capacity—and, for better or worse, heightening its regulability. A seductive and more powerful generation of proprietary networks and information appliances is waiting for round two. If the problems associated with the Internet and PC are not addressed, a set of blunt solutions will likely be applied to solve problems at the expense of much of what we love about today's information ecosystem."[16]

Devices that are closed and "tinker-proof" can be more easily controlled by their manufacturers, service providers, or even governments. Zittrain hopes to stop a future dominated by such devices, in order to preserve the maximum potential for Internet-based innovation.

As Adam Thierer writes, however, hybrid solutions, ones that offer creative opportunities within certain confines in an attempt to balance openness and stability, make perfect sense.[17] The question is whether the demand for controlled, risk-free digital experiences will take over the demand for generative appliances that lend themselves to innovation.

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[16] J. Zittrain (2008), *Future of the Internet and How to Stop It.* New Haven, CT: Yale University Press (p. 8).
[17] A. Thierer (2008, March 23). Review of Zittrain's *Future of the Internet.* Retrieved September 2008 from Technology Liberation Front: http://techliberation.com/2008/03/23/review-of-zittrains-future-of-the-internet/.

In the United States, Google is providing a test for this demand question. In contrast to Apple's iPhone, Google's new Android phone is completely open to developers to create applications and components. The decision to release Google's first phone at an early stage and let the users play an active role in its evolution is largely welcomed by the user community, and will likely contribute to finding workable solution for connecting users in developing countries. Unfortunately, however, the "generativity" of the phone will depend on the kinds of regulation to which mobile carriers will submit it.

Yinka Adegoke writes that while Google's Android shows real promise in terms of usability, carriers in each market still trump generativity of any particular device, since, after all, they have the final say over how devices can be used by deciding what services to offer. Both open devices and open access are necessary if the Internet as it was envisioned is to continue,[18] but these are at risk if carriers choose a more restrictive pathway.

In developing countries, the "generativity" of Internet-ready devices could prove especially important, since the next 1.4 billion users are expected to connect via handhelds. As the Google Android example shows, operator regulation is a related and equally important sphere of discussion in this context. Ensuring true competition among ISPs may provide sufficient choices for end-users who would demand appropriate levels of control over their devices as well as determine the kind of quality of service they desire.

> Few questions are fraught with more long-term implications than the way we shape our communications system. If the medium is indeed the message, and if these messages influence people and institutions, then today's media policy will govern future society and economy.
>
> But this also means that the structure of the media business and its public regulation needs to be reviewed and revised. Institutions cannot change at the rate of Moore's Law for semiconductor technology. But if they fall too far behind in adjusting, they will fail or cause harm.
>
> Eli M. Noam
> Excerpt from "TV or Not TV: Three Screens, One Regulation?" Report written for the Canadian Radio-television and Communications Commission.
>
> Source:
> www.crtc.gc.ca/eng/media/noam2008.htm

[18] Y. Adegoke (2008, September 17), Google's Android no match for iPhone—yet. *International Herald Tribune,* p. 17.

2.1.4 *Aging models for regulation*

In a recent report to the Canadian Radio-television and Telecommunications Commission, Professor Eli M. Noam underlines the importance of rethinking regulation in the Internet age. Although he addresses the specific question of regulating television when it adds the Internet and mobile wireless as delivery vehicles, his observations and the types of questions he poses are useful in thinking about media and communications—and therefore Internet—regulation in general. Noam writes that, for over half a century, the basics of the media structure in most Western countries were relatively stable. They include, in the order of seniority:[19]

- A newspaper sector of regional, and a handful of national, papers; private and largely unregulated, often connected to other print media such as magazines and books.
- Telecom network providers for individualized communication; mostly with market power, mostly regulated.
- An audio-visual content production sector in film, TV programs and music; often subsidized or protected.
- An over-the-air television and radio sector with a mix of private and public broadcast organizations; a mix of advertising, subscriptions, and public funding as an economic base; a mix of national and regional distribution; and a mix of licensed or regulated restrictions and press freedoms.
- Multichannel distribution platforms of video content over cable and satellites; usually franchised and regulated.

In each of these media, the role of government control differed; but this role and structure formed quite early in the life of the medium. Though the details varied over time, and subsequent changes were imbued by stakeholders with major import, Noam notes that it is remarkable how sturdy the basics of a medium's regulation proved over its lifetime.

The agents of change today are three related technological developments that rapidly transform media and raise the question of the role of government:

1. The broadbanding of networks, in which an increasingly powerful transmission infrastructure creates platforms for the individualized production, distribution and consumption of media content such as video. The most formidable such platform is the Internet.

[19] Noam, E. M (2008), "TV or Not TV: Three Screens, One Regulation?" Report written for the Canadian Radio-television and Communications Commission, Retrieved September 2008 from: http://www.crtc.gc.ca/eng/media/noam2008.htm

2. Wireless ubiquity, which creates a wide geographic reach for two-way communications through cellular networks of increasing power, and enables the transmission of media content such as video.

3. Digital convergence, which removes many of the technical barriers that separated the various media activities, companies, industries and regulations.

Professor Noam then focuses on the future of television regulation as the most influential medium for popular culture and politics of the last half-century, a huge business and the main vehicle of consumer marketing. He notes that its role and control have been fought over, and that this resulted in a certain regulatory structure.

The driver for the need to re-examine this regulation, Noam writes, is that the traditional television transmitted to the home TV-set by terrestrial broadcasting or over cable and satellite is now being joined by a TV over the Internet that reaches, in the first instance, home computers or other displays. It is further joined by the wireless television delivery aimed at the user's mobile phone.

Thus, television is moving from its traditional single screen to one of three types of screens, causing the question of whether the system of government policy and law directed at the "first screen" of TV should also apply to the second and third screens; or whether the regulatory system that applies to those new screens should also cover the first screen; or what other new system should be created.

A similar story could be told about telephones, with voice-over-IP (through desktop computers, traditional cellular telephones, Internet-enabled mobile devices and even home phones) entering the traditional telephony market.

The analysis reaches a framework for a long-term approach to the regulation of television media in the age of the Internet and mobile wireless.[20] Similar soul searching would be useful in thinking about regulation of mobile operators, and from the global perspective of

[20] While the details of his report are outside the scope of this paper, it is worth considering the principles he suggests for rethinking TV regulation. With respect to content, Noam suggests regulating all types of television content activities along the same lines and principles that media in Canada are treated generally. With respect to conduit, Noam advises that regulation of new types of TV is expected to emerge through the nexus of the underlying conduit providers—telecom, cable and wireless—and recommends common carrier-style access for video content, for a fee, to the Internet and mobile TV platforms. He also advocates permitting the conduit providers' own content provision activities. Noam's recommendation on Canadian-specific content is relevant for cultural concerns of many nations. He suggests pursuing specific Canadian content and other goals for new types of TV through a funding mechanism of support based on a surcharge on ISPs that is similar to the one on cable TV and satellite providers, as well as through a spectrum trust fund.

converging media and communications sectors. Any regulation exercise will have to factor in the "commons" nature of the Internet's code layer, as well as the effects of regulation on the innovation potential of the technology that is still in its infancy.

On a more practical note, some more specific criteria described in infoDev's 2007 ICT Regulation Toolkit, may be helpful when considering Internet regulation:

- Capacity – To what extent will the new technology increase the speed of transport and delivery and thereby enhance the potential for new services?
- Costs – How will the technology influence the level and structure of costs for infrastructure and service provision?
- Scalability – To what extent are the solutions offered by the technology scalable, i.e., possible for general application as opposed to only local solutions?
- Flexibility – How can the solutions offered by the technology adapt to change?
- Mobility – To what extent is mobility offered?
- Platform for innovation – To what extent does the technology enhance convergence and development of new services?

Overall, the purpose of regulation should be to open as many paths to network and service development as possible and to resist attempts to control or restrain participation, unless there is clear evidence of harm to the public interest.[21]

2.2 Infrastructure

Uncertainties related to Internet infrastructure include those surrounding universal broadband service and any major adjustments to the code, or logical layer of the Internet: one such adjustment described below is the ongoing transition from one version of Internet Protocol (IPv4) to the next (IPv6).

2.2.1 *Universal broadband*

The Internet has surprised even its own creators with the growth and innovation it has spurred, so it is no wonder that the initial Internet architecture cannot handle the demands being placed on it today. Demand for bandwidth—the rate of data transfer—is growing exponentially, quickly outpacing supply provided by existing infrastructure. This is the case in developed countries, where the Internet is a principal platform for personal and business activities, and it is even more pronounced in the South where inadequate connectivity only contributes to other social and economic disadvantages.

[21] InfoDev. ICT regulation toolkit. http://icttoolkit.infodev.org/en/index.html/ (retrieved September, 2008).

Many commentators have called for national Internet strategies to provide universal access to broadband as an essential requirement for prosperity.[22] They argue that in an information society, Internet access that is fast and reliable is not a luxury, but should be considered a necessity in the same vein as other infrastructure elements. The primary requirement for universal access—or anything approximating it—is for the Internet backbone—the large networks that interconnect with each other and may have individual ISPs as clients—to reach all parts of the world.[23]

The physical Internet network is made up of a variety of components including fibre networks owned or leased by Internet backbone providers, Network Access Points (NAPs), where ISPs exchange traffic, content hosting servers and access lines that provide the "last mile" of the connections to the end-user.

Currently, Africa's only connection to the Internet backbone is an undersea cable running from Portugal along Africa's west coast. The cable has been in operation since 2002 and was expected to lower the costs of access (previously, connecting from Africa was only possible via satellite and, therefore, extremely expensive); however, monopolies held by national telecommunications companies have prevented new entrants from competing in access delivery, resulting in similarly high costs of access.[24] Another fibre optic project has been planned for East African coast,[25] but has stalled over political issues, leaving most of Eastern Africa dependent on satellite connections. Once in place, the Eastern Africa Submarine Cable System is expected to significantly reduce the cost of broadband connectivity. It is worth noting that land-locked countries (for instance, Rwanda, Malawi, Zimbabwe, Zambia, Botswana, and potentially Lesthoto, Swaziland and Burundi) will face a special challenge since they will only be able to access bandwidth via an intermediary country with a landing station.

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[22] In 2004, American President George W. Bush stated that universal broadband access for Americans would result in billions of dollars in new economic development, over a million new, high-paying jobs, increased security and public safety, better and cheaper healthcare, enhanced educational opportunities, greater citizen participation in governance, and more access to information.

[23] Local ISPs provide service to individual homes or business using bandwidth that they purchase from another company with a backbone network. Backbone networks can be commercial, educational or government owned, such as military networks. (Wikipedia)

[24] R. Nixon. (2007, July 22), Africa, Offline: Waiting for the Web. *New York Times*. Retrieved September, 2008 from: www.nytimes.com/2007/07/22/business/yourmoney/22rwanda.html?_r=1 .

[25] The Eastern Africa Submarine Cable System (EASSy) is an initiative to connect countries of eastern Africa via a high bandwidth fibre optic cable system to the rest of the world. EASSy is planned to run from Mtunzini in South Africa to Port Sudan in Sudan, with landing points in six countries, and connected to at least five landlocked countries in order to eliminate dependence on expensive satellite systems to carry voice and data services. However, due to technical and political difficulties, the future of the project is uncertain.

Policies promoting Internet infrastructure development and deployment have relied on the pursuit of a) open and vigorous competition, b) investment from a combination of private and public sources and c) technological neutrality, or equitable treatment of different technologies by policy provisions. By all accounts, these drivers will continue to be important as the Internet further evolves and expands.

2.2.2 *IPv6 v. IPv4*

When a user types a domain name into the address bar of a browser, it is translated into a numeric address (for example, 192.0.2.235). Currently, most such translations follow Internet Protocol version 4 (IPv4), the first to receive widespread use. The number of available IPv4 addresses is being exhausted by the enormous demand created by the growing numbers of people and devices connecting to the Internet. In response, the Internet Engineering Task Force (IETF) has designated IPv6 as the successor to version 4 for general use. The new version has a much larger address space and aims to improve flexibility in routing traffic and to simplify address assignment and renumbering necessary when Internet connectivity providers change. At this stage of development, though, sometimes IPv6 connectivity is a good deal slower than IPv4, or it doesn't work at all.[26]

There are a number of reasons for the move to the new version:

- IPv4 address space is in short supply. The last blocks of IPv4 address space will be allocated within the next two years. Remaining space will likely be reserved for regions where there is little demand for devices requiring individual unique addresses and little money to purchase them.
- Lack of IP address space will impact Internet growth.
- This situation has slowed technology advancements, and has hurt security and quality of service.
- The "next billion" users expected to get online will likely require a corresponding number of individual IP addresses.[27]

The International Telecommunications Union, however, points out that while the IPv6 meets the current shortage, it is not clear whether countries in the South will benefit from the switch. In particular:

- The business case for making the transfer to IPv6 does not yet exist in "developed" economies, let alone in developing countries.
- IPv6 may turn out to be a temporary solution itself—poorer countries may be better off waiting to "leapfrog" over the switch.

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[26] See: http://arstechnica.com/news.ars/post/20080514-one-small-step-google-officially-supports-ipv6.html

[27] P. Twomey (2008, April 24), *How Can We Actualize the Sustainable Internet Society?* Keynote Speech to the GIIC-Keidanren Conference on ICT and the Environment, Tokyo, Japan, April 24, 2008. http://www.icann.org/presentations/Fnl_PL_Keynote_GIIC_24Apr08_mf_final.doc

- Costs of migration to IPv6, in particular for developing countries, are difficult to estimate, and would include capacity building, new equipment (routers, etc.) and new protocol configurations.
- It is not clear what network externalities may be brought about by the migration to IPv6.
- Adoption of IPv6 may create a secondary market for IPv4 addresses, if current holders of IPv4 addresses are allowed to sell them. The economic or tariff effects of such a market have not been fully considered. Developing countries in particular may face unexpected impacts on interconnection rates and other economic costs.[28]

Developing country users have been marginalized to date in terms of fair access to IPv4 address blocks. With IPv6 abundance, theoretically that should no longer be a problem. However, their ISPs will need to invest in IPv6 in order to make that address space available to users. If a pre-existing IPv4 ISP in a developing country is unwilling or lacks the financial capacity to invest in IPv6 then marginalization will increase over time as IPv6 use spreads, leaving the South on an IPv4 side road.

In a report launched at the Organisation for Economic Co-operation and Development (OECD) Ministerial Meeting on the Future of the Internet Economy, the OECD presented a thorough study on the risks and benefits of migration to IPv6, that "the only sustainable solution to deliver expected economic and social opportunities for the future of the Internet economy is the deployment of IPv6." This is because the cost of supporting IPv4 and interim network extension measures will rise sharply in the near future, given the growing demand for IPv6-enabled devices and systems along with the diminishing supply of IPv4 addresses.[29]

Failure to manage a transition from IPv4 will lead to an increased incidence of information and communication blind spots that the majority of non-technical users will have no idea exist other than being alerted to them on a case-by-case basis through alternative communication means (phoning people to ask why you have not returned my e-mail, hearing about a Web site via word of mouth, and so forth).

Google may eventually help with this in terms of finding Web sites in both the IPv4 and IPv6 universes but this is not yet the case. Google made its search service available under

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[28] International Telecommunications Union. Background Materials for Workshop on IPv6, September 4–6, 2008, Geneva, Switzerland. www.itu.int/ITU-T/worksem/ipv6/200809/

[29] *Internet Address Space: Economic Considerations in the Management of IPv4 and in the Deployment of IPv6*. (2008). Ministerial Background Report DSTI/ICCP(2007)20/FINAL, prepared as background to the 2008 OECD Ministerial Meeting on the Future of the Internet Economy.

http://ipv6.google.com but it is *only* accessible over IPv6 rather than over both versions of IP. Apparently http://www.google.com proper is only available via IPv4.

What really happens to my company's Internet access if it or my ISP network doesn't transition in time?

Without a dual-stacked network or deployed protocol translation services, an individual user gaining Internet access for the first time from an IPv6-only ISP may not be able to access the Web sites or mail servers for organizations that operate IPv4-only networks.

There are implications to not adopting IPv6. These implications become evident as wide-scale deployment of IPv6 accelerates. Not adopting IPv6 may cause the following types of issues for the various types of Internet users.

Individual users: Individual users may not be able to view Web sites and communicate with certain destinations. Many individuals use the Internet to communicate with distant friends and family, research medical issues and participate in group discussions, among other things.

Enterprise organizations: Enterprise organizations and corporations may not be able to communicate with certain critical government resources, clients and potential customers. E-mail is a critical form of communication for most enterprise organizations today and their Web sites are vitally important resources for them to communicate with the public.

Governments: Governments may lose their ability to see and communicate with the "whole Internet." Access to information is critical for governments. There also may be an inability for citizens and other Internet users to access information about the government and communicate over the Internet with government agencies.

Service providers: Organizations that provide services over the Internet may experience customer and/or revenue losses if they do not update their offerings to include IPv6. Customers will expect to be able to communicate with everyone else on the Internet and may seek out other ways to do that if their current service provider is not capable.

Even organizations that have enough IPv4 address space and continue to operate their IPv4 networks will still need to implement IPv6 on their networks. Today, some people are voluntarily attempting to reach mail and Web servers via IPv6 connections to the Internet. Once the RIRs have no large blocks of IPv4 address space remaining and start allocating IPv6-only blocks to ISPs and other large networks, some people will have to use IPv6 to reach the Internet.

Therefore, any organization that has a Web site and communicates via e-mail will need to take steps to ensure those services are visible over both the IPv4 and IPv6 networks. The IPv4 network will allow continued communications with the legacy Internet, and the IPv6 network will allow Web site and e-mail communications to be visible for individuals connecting to the Internet using IPv6 only. When services are available over both IPv4 and IPv6, it's referred to as "dual-stacked."

As the free pool of available IPv4 addresses diminishes over the next couple of years, Internet service providers will begin to deploy services to customers using IPv6 only. When this occurs, there will be an IPv6-only portion of the Internet that begins to grow. For mutual communications to occur among an organization's Web site, e-mail, and other communication services and individuals who are part of this IPv6-only portion of the Internet, the organization will need to first make services IPv6 capable.

(Source: http://blogs.techrepublic.com.com/10things/?p=443)

2.3 Governance Processes

Questions surrounding Internet governance processes have focused on ICANN, the Internet Corporation for Assigned Names and Numbers. The description of the organization and its operations should be evaluated against the principle of multistakeholderism on which the future of effective Internet regulation relies. In addition to the work of ICANN, the role of users in Internet governance and the sustainability of volunteer efforts in the Internet Engineering Task Force are discussed in this section.

2.3.1 The future of ICANN

Since this institution is one of the rare points of centralized decision-making on the Internet, the future of ICANN is seen as part of a compass that will guide the future of the Internet itself.

ICANN represents a new, emerging Internet self-governance model, one that can be difficult to explain to outsiders, but that has promising features for the future of the Internet and, perhaps, other types of governance.[30] The organization has managed the Internet domain name system (DNS), the most critical infrastructure of the Internet, since 1998, under contract with the U.S. Department of Commerce. Since then, it has become clear that ICANN's relatively narrow technical mandate is linked with a variety of non-technical areas, including in economic, social, cultural, political and even environmental fields.

The philosophy behind ICANN's founding is apparent in Clinton administration's "Framework for Global Electronic Commerce" (1997), which sets out the following five principles:

- The private sector should lead.
- Governments should avoid undue restrictions on electronic commerce.
- Where governmental involvement is needed, its aim should be to support and enforce a predictable, minimalist, consistent and simple legal environment for commerce.
- Governments should recognize the unique qualities of the Internet
- E-Commerce over the Internet should be facilitated on a global basis.

[30] Lee, M. J. (2008), Linking Governance and Performance: ICANN as an Internet Hybrid. Virginia Polytechnic Institute and State University. Ph.D. Dissertation in Public Administration..

Directed by President Clinton, the U.S. Department of Commerce published the so-called Green Paper (NTIA/U.S. DoC: "Proposal to Improve Technical Management of the Internet Names and Addresses" (Docket No. 980212036-08036-01) and the White Paper (NTIA/U.S. DoC: "Management of Internet Names and Addresses" (Docket No. 980212036-8146-02), stating "its intent to enter an agreement with a not-for-profit entity to establish a process to transition current U.S. Government management of the DNS to such an entity based on the principles of stability, competition, bottom-up coordination, and representation." [31] The two papers outlined ICANN's mission, principles and structures as follows:

> ICANN shall … pursue the charitable and public purposes of lessening the burdens of government and promoting the global public interest in the operational stability of the Internet by (i) coordinating the assignment of Internet technical parameters as needed to maintain universal connectivity on the Internet; (ii) performing and overseeing functions related to the coordination of the Internet Protocol ("IP") address space; (iii) performing and overseeing functions related to the coordination of the Internet domain name system ("DNS"), including the development of policies for determining the circumstances under which new top-level domains are added to the DNS root system; (iv) overseeing operation of the authoritative Internet DNS root server system; and (v) [pursue (i) through (iv) through other legal means].[32]ICANN's bylaws were revised in late 2002, as a result of its efforts to improve transparency in its decision-making.

[31] Previously, the management of global IP address allocation, **root zone management** for the Domain Name System (DNS), media types, and other Internet protocol assignments was operated by Dr. Jonathan Postel, who served as the first director of the Internet Assigned Numbers Authority (IANA). In January 1998, Postel instructed the 12 operators of Internet's regional root nameservers to change the root zone server from Network Solutions (NSI)'s A.ROOT-SERVERS.NET. (198.41.0.4) to DNSROOT.IANA.ORG (198.32.1.98). The operators complied, which resulted in the splitting of control of Internet naming between IANA and the four remaining U.S. Government roots. Shortly thereafter, he was asked by Ira Magaziner, President Clinton's senior science advisor, to undo the change. Postel complied; however, the episode illustrated the need for accountable management of the Internet root. A week after the episode, the "Green Paper" mentioned above was published, asserting the U.S. government's definitive authority over the Internet DNS root zone.

[32] ICANN's foundational documents include (1) the Clinton administration's "Framework for Global Electronic Commerce" of July 1, 1997; (2) the White Paper of the U.S. Department of Commerce (DOC) of June 5, 1998; (3) the Memorandum of Understanding between DOC and ICANN of November 25, 1998; (4) the revised "Article of Incorporation" of November 21, 1998; (5) and the Bylaws of December 15, 2002 (known as the "New Bylaws").

Structure

ICANN's complex structure reflects both the need for the body to involve a variety of stakeholders in its operations and its historic relationship with the U.S. government.

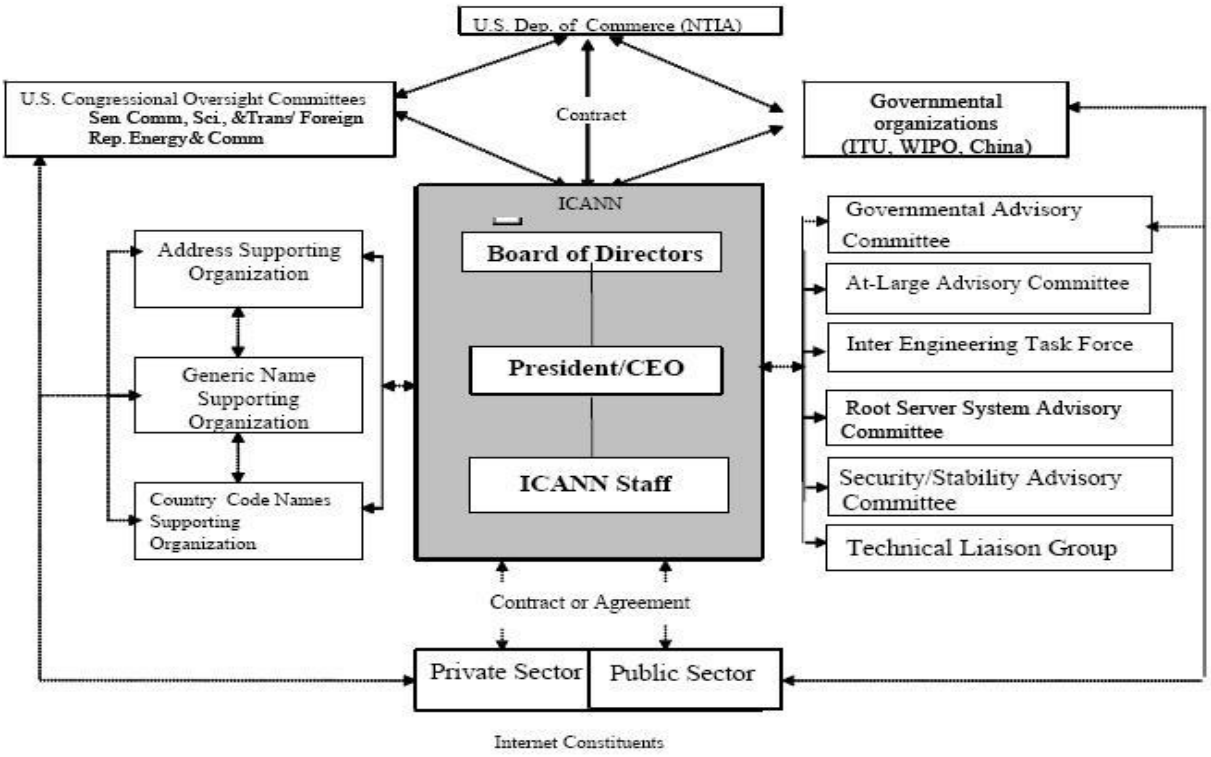

Figure 3: ICANN's institutional arrangements and links with external entities

Source: Maeng Joo Lee, Linking Governance and Performance: ICANN as an Internet Hybrid, Virginia Polytechnic Institute and State University. Ph.D. Dissertation in Public Administration, 2008.

The Board, with the exception of the president, is composed of volunteers and includes six directors from three Supporting Organizations, eight directors chosen by the Nominating Committee and six non-voting members who serve as liaisons between the Board and ICANN's advisory committees. The Board retains all residual powers not assigned to other components of the organizations. Seats are usually distributed across the world's regions. It is important to note that, under California corporate law, ICANN's Board owes its duties to the corporation itself, and the public at large, and not to individual interests within the ICANN community. As a result, the Directors must occasionally act in a way that may run counter to the interests of individuals or groups in the community in order to meet broader fiduciary duties or to comply with other legal obligations. This is a source of tension surrounding the debate on ICANN's accountability.[33]

[33] See ICANN (2008, January), *Accountability and Transparency Frameworks and Principles:* www.isoc.org/pubpolpillar/docs/psc-transition_20081020.pdf

The Supporting Organizations ("SOs"), governed by "councils" and SO-specific rules, develop policies and procedures related to ICANN's technical mission. Both individuals and organizations can be members, as long as they meet minimum criteria established by each SO. According to Maeng Joo Lee, SOs are important channels for political support, human capital (e.g., experienced and knowledgeable directors) and funding.

In addition to SOs, "executive" (consisting solely of Board members) and "expert" (including directors and non-directors) committees advise the Board. Finally, there are over 80 full-time ICANN staff, including the president, secretary and chief financial officer.

ICANN considers itself to be an open, transparent, fair and accountable organization, resting on bottom-up, consensus-based governance processes. It seeks public input, via its Web site, whenever new policies are being considered for adoption, and when existing policies are changing. ICANN's meetings are open to any member of the community, and meeting notes are publically available.

In the past, some tension existed due to the Board's ability to overturn decisions that enjoyed a "rough consensus" achieved in Supporting Organizations. Today, whenever a policy is recommended through a supermajority (over 66 per cent of the membership) by an SO, the Board is obliged to adopt it, unless it is a supermajority of Board members find it to be against the best interests of the community or ICANN.

Stakeholders

ICANN's stakeholders are often grouped into technical, business, civic/non-commercial, and governmental. The "technical community" includes the IETF (the Internet Engineering Task Force), ISOC (the Internet Society) and W3C (the World Wide Web Consortium) and has been represented by prominent Internet pioneers and technical advisory committees.

Lee divides business interests into non-domain name businesses (those concerned with the online protection of their extant trademark rights or intellectual property), and domain name businesses (those advocating loose regulation of the use of domain names so as to respond to diverse, often innovative, market demands). This is a useful distinction, although the full diversity of private sector actors involved is beyond the scope of this discussion. Non-commercial and civil society stakeholders also include a wide variety of interests and often perform the "watchdog" function, highlighting the importance of free-speech online on e-mail list-servers, through the Generic Names SO Non-Commercial Users Constituency and the At-Large Committee.

Government stakeholders can perhaps best be divided into those who emphasize private sector leadership (e.g., U.S. and Canada), and those who focus on the role of governments and intergovernmental bodies in addressing impacts of ICANN's decisions on public policy. All are meant to work within the Governmental Advisory Committee to bring issues to the Board's attention.

In meeting its technical objectives, ICANN works closely with the technical community composed of businesses and civil-society groups who develop technical standards, guidelines and policies. Following the World Summit on the Information Society, where political pressure on ICANN came to a head, the organization has increased its collaboration with governments and intergovernmental institutions, including the UN, EU, OECD and others, in order to address public policy concerns related to its work. Lee argues that both of these groups are critical to ICANN's survival and finds that, to date, ICANN has been more attentive to private actors in the technical environment and to governments in the public policy sphere. Lee also concludes that assessments of ICANN have been varied and often short-sighted: ICANN has therefore been called ineffective by those who seek more formal regulation of the DNS, while at the same time being accused of overstepping its mandate and hindering innovation in the Internet by those who favour deregulation.

Going forward, we can expect ICANN to come under increasing pressure to internationalize its governance, and thus reduce the role of the U.S. government in its operations. Many see the GAC as the crucial space where the success of any such attempt will be measured. Some propose the committee as the alternative oversight mechanism to the U.S. government, in order to prevent creating another, external, layer of supervision. Currently, however, the GAC seems to suffer from a lack of quality communication between represented governments and other stakeholder groups within ICANN, including private entities, civil society and the At-Large community. This includes the lack of appropriate translation capabilities, giving English-speaking governments an advantage. In addition to language barriers, real participation is limited due to high costs of travel and meeting attendance and a significant lack of capacity on the part of smaller and developing country governments to dedicate resources and personnel government to Internet policy issues.

Other than internationalization concerns, ICANN has been, for some time, under pressure to drastically improve transparency and accountability in establishing formal contracts with specific stakeholders. For instance, many in the community feel that the VeriSign negotiations on the terms and conditions on the .com registry agreement illustrated the need to establish general terms and conditions for all types of contracts that have the potential to broadly affect the DNS. In recent years, ICANN has made some improvements in its processes, especially in tasks related to stability and reliability of the DNS, and in attempting

to make its decision-making more transparent. It continues to hold public consultations on its institutional reform and internationalization.

Another subject of debate is the continuing relationship between the U.S. DoC and ICANN and the "governance by contract" model that derives from this relationship and extends to root server operators, regional Internet registries, DNS registries and registrars.

According to some observers, as articulated by Carlos Afonso and relayed by Hindenburgo Francisco Pires, "the role of the United States is a provocation to other governments, encouraging them to seek equal, sovereign rights in the supervision of ICANN. This tension between governments causes instability. Over the years, it has produced a growing politicization of ICANN and of its functions. Alternative root systems such as Open Root Server Network in Europe are already being formed to counterbalance U.S. authority over the root zone."[34] While a thorough examination of these tensions is beyond the scope of this paper, their influence on negotiations surrounding the future of the Internet is worth noting. The President's Strategy Committee of ICANN has outlined steps to ease these tensions in their 2008 proposal for a Transition Action Plan.[35] Specifically, the plan mentions the need to ensure freedom from capture, strengthen ICANN's accountability to its community, internationalize the organization, ensure financial and operational security and maintain secure and maintain secure and stable operations.

> IETF members take pride in the open standards philosophy and the flat hierarchy that are hallmarks of the organization. The sentiment is captured in the following slogan, seen on t-shirts worn by members:
> *We reject kings, presidents, and voting.*
> *We believe in rough consensus and running code.*

2.3.2 *Sustainability and scalability of decision making by IETF*

The Internet is the Internet Engineering Task Force (IETF), along with other standards bodies, including the World Wide Web Consortium and the International Standards Organization/International Electrotechnical Commission. IETF develops and promotes Internet standards of the TCP/IP and the Internet protocol suite. The organization has no formal membership or membership requirements and prides itself on its "open standards" philosophy. Every member is a volunteer, although meetings and the work of the membership is normally funded by their employers and sponsors. The Task Force works

[34] H.F. Pires (2006, May 26–30), *Global Internet Governance: The Representation of Country Toponyms in Cyberspace.* Paper presented at Colóquio Internacional de Geocrítica, Barcelona, Universidad de Barcelona. Retreived September , 2008 from: www.ub.es/geocrit/-xcol/415b.htm
[35] See: www.icann.org/en/jpa/iic/action-plan.htm

through a large number of working and discussion groups, each with a limited mandate to solve a specific topic or address a precise issue of concern.[36] Each area is overseen by one or two area directors (AD), who, along with the IETF Chair, form the overarching Internet Engineering Steering Group (IESG).

Beyond the IESG, the IETF is overseen by the Internet Architecture Board (IAB). Although not a legal entity in itself, IETF functions under the umbrella of the Internet Society (ISOC). Most tasks performed by IETF members follow a similar format: draft specifications are published, reviewed, tested and republished, with interoperability being the final test before IETF specifications can become standards. The protocols developed by the IETF are used by many different bodies to create larger architectures. Funding for the IETF comes from meeting fees, corporate or government sponsors and the Internet Society.[37]

Over the last 30 years, these coordination processes have

The Unique Political Soul of the IETF

At first, I found the IETF's insistence on consensus and the humming as a method to determine rough consensus a bit silly. Eventually, the psychological effect grew on me. One can feel the strong hum of a majority in the chest, and no matter how logical your objections, that feeling cannot be erased. It will hold back every not-very-well-grounded opinion. It may not prevent participants [from] objecting for the sake of objecting, but a good [...] chair will in that case make sure the meeting proceeds.

Within the IETF's system, if I crave the cult status of having initiated, written, and published an IETF standard in the form of a finished RFC, I first have to convince an area director that we need to have a meeting—known as a birds-of-a-feather meeting—to discuss it. Even if I think it is a splendid idea, there will be no working group, no draft, and no nothing if I can't come up with enough support to keep it going. The best way to get support for your ideas is to first gain respect for your knowledge.

This is the essence of the third political system: Anyone—no matter their social or cultural background—can take a leadership position [...] and [contribute] to the IETF. If you earn respect, [...] demonstrate [your knowledge], then you will be heard.

- Tomas Carlsson

Source:
http://www.isoc.org/tools/blogs/ietfjournal/?p=173

[36] Wikipedia lists current areas as Applications, General, Internet, Operations and Management, Real-time Applications and Infrastructure, Routing, Security and Transport.

[37] ISOC collects membership fees and benefits from proceeds of the Public Interest Registry, which manages the .org top-level domain.

successfully addressed areas of common concern (e.g., the rapid depletion of Internet Protocol addresses). They have also evolved from being performed by a handful of individual volunteers to being performed by several independent, but closely coordinated, activities and organizational structures such as the IETF and ICANN.

Stress Points

It is not certain, however, whether the current system of governance can survive Internet's future growth. In their Request for Comment 3716, IETF's Network Working Group observes the following stress points:

- Dependence on meeting attendance: Meeting attendance has declined in recent years, resulting in a decline in IETF revenue, even as the requirements of the IETF operation are constant or increasing. The resulting budget deficits, even after a substantial increase in meeting fees, deplete working capital, making the IETF less robust against potential future budgetary constraints.
- Vagueness in the definitions of distribution of responsibility for management and oversight of administrative relationships: Lack of clearly articulated rules makes key processes opaque to the IETF community, and sometimes leaves the leadership in a poor position to manage effectively. Additionally, the informality of the relationships with some of the organizations that are carrying out key IETF functions compounds the problem of determining who has responsibility, and how IETF community consensus and desires are reflected in the activity.
- Lack of institutional memory: important IETF institutional memory is recorded nowhere other than peoples' minds in many cases—which requires significant transmission of oral history for IETF leadership transition to be effective.
- Latency for mechanical processes: The IETF needs to decrease the amount of manual labour required for routine and simple tasks, in order to more resources available to focus on the special cases. Lack of automation in basic request services has caused delays or failures in processing simple, routine tasks. Automation, however, also requires resources and significant management.
- Difficulties in determining reliable channels for directions: In the absence of written agreements, supporting organizations may not be clear from whom to take direction. Even where agreements exist, the authority to provide direction may not be clear. The genesis of both problems is that the IETF relies on external bodies for support, but external relationships are unclear.

RFC 3716 concludes its discussion on "stress points" by observing that the current state does not provide an adequate structure from which to reach into the future.[38] As the Internet grows, the current systems and informal provisions under which the IETF operates are likely to come under even greater pressure from the expanding Internet community.

[38] The Internet Society (2004, March), *Request for Comments: 3716 - The IETF in the Large: Administration and Execution.* Retrieved September , 2008 from: www.faqs.org/rfcs/rfc3716.html

2.4 Security

Security is one of the most influential driving forces for the future of the Internet; indeed, with its transnational nature and unusual openness, the Internet can be seen as particularly risky to personal, economic and national security. Many subtopics fall under this broad heading, from creating user trust, to identifying and authenticating people and devices, to corporate or state-based firewalling, to the development national Internet security agendas. Recent trends toward cloud computing (where computational functions are delegated to remote servers on the "grid" and not to the local machine through which the user is accessing the network) make security concerns even more important.[39]

"At every level, our security now is dependent on computers."

Scott Borg, director of the United States Cyber Consequences Unit, a non-profit research institute

I want to know if I look up a whole lot of books about some form of cancer that it's not going to get to my insurance company and I'm going to find my insurance premium is going to go up by 5% because they've figured I'm looking at those books. [...]

I myself feel that it is very important that my ISP supplies Internet to my house like the water company supplies water to my house [...] with no strings attached."

Sir Tim Berners-Lee, creator of the World Wide Web

While there are private certifications and initiatives that aim to build user trust in e-commerce and Internet transactions, no international organization or forum concerns itself solely with online security, nor ar Critical Internet Uncertainties: How will governance, evolution and growth of the Internet affect sustainable development

e there international security conventions or agreements. For the end-user, the most problematic security issue is the exchange of messages without effective authentication, which allows spam, "phishing" for passwords, especially of banking information, and identity theft.[40] Further to financial record disruption, compromising sensitive data, and business process disruption, cyber security concerns extend to interconnected electrical grids and the potential of devastating outages of electric service to

[39] W. Vogels (2008, September 20), *Expanding the Cloud: Microsoft Windows Server on Amazon EC2.* All Things Distributed: http://www.allthingsdistributed.com/2008/09/amazon_ec2_with_microsoft_wind.html

[40] Afonso, C. A. (2008) Governança da Internet, contexto, impasses e caminhos, São Paulo: RITs, 2005 in Pires, Hindenburgo Francisco. GLOBAL INTERNET GOVERNANCE: THE REPRESENTATION OF COUNTRY TOPONYMS IN CYBERSPACE. Instituto de Geografia. Universidade do Estado do Rio de Janeiro. Retrieved September 2008 from: http://www.ub.es/geocrit/-xcol/415b.htm .

large geographic areas and the accompanying risk to national security.[41]

Equally concerning are attacks on national IT infrastructure. During the brief Georgia-Russia conflict, the Georgian IT infrastructure was swamped by attacks from state-sponsored and rogue elements. The U.S. has reported numerous incidences of attacks against military and government assets by groups in other countries. In March of 2008, the Department of Homeland Security conducted Cyber Storm II, its second attempt exercise to test the security of government and critical infrastructure—such as the power, communications and transportation networks. Agencies, solution providers and government contractors reported that the exercise was a miserable failure and replete with miscommunications, poor planning, and unrealistic expectations and constraints on attacks and responses.[42] Other countries have also taken steps to protect their infrastructure from cyber attacks.[43]

Anonymous and trustworthy?

The difficulty in "securing" Internet communications is that the above mentioned pieces of critical infrastructure, along with business models, are dependent on the Internet as an infrastructure built on a platform of anonymity. Bob Khan, co-inventor of the Internet Protocol, has articulated the need to be "anonymous, yet trustworthy online," and that the quest for technical solutions to this challenge of balancing privacy with trustworthiness is crucial for the future of the Internet. What some propose is adding an "identity layers" to the Internet, one that would at least approximate the kind of trust built in the physical world.[44] An identity-enabled Internet, they argue, would allow for new areas for innovation to emerge, for example, in the healthcare industry where privacy is critical and confidential medical information can only be shared among small groups of certain family members, doctors and specialists. Social networking sites are already under scrutiny to offer more protection to children from online predators, since it can be very difficult to determine who is really on the other end of the line. Networking sites like Facebook and MySpace could utilize an identity service to create a differentiated "space" where real identities are validated to ensure there are no imposters. Identity-validated email services would also be attractive in the efforts to restrict spam and cybercrime.

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41 J. R. Stanton (2007, Spring), Cyber Security under the NERC Reliability Standards. *IT Compliance Magazine, 2007*; B. Griggs (2008, August 18), *U.S. at risk of cyber attacks, experts say.* CNN Online Edition. Retrieved September 2008 from: www.cnn.com/2008/TECH/08/18/cyber.warfare/index.html

42 R. Mark (2008, September 25), *Feds Get Tough on Cybersecurity Weaknesses.* Retrieved Septmeber, 2008 from E-Week Channel Insider: www.channelinsider.com/c/a/Security/Feds-Get-Tough-on-Cybersecurity-Weaknesses/.

43 Summary of Estonian Cybersecurity strategy: http://gadievron.blogspot.com/2008/09/estonian-cyber-security-strategy.html.

44 M. Bregman (2008, April 7), What's Possible in an Identity-Enabled Internet? *Internet Evolution Magazine.* Retrieved September, 2008 from: www.internetevolution.com/author.asp?section_id=590.

At the same time, taking away any portion of anonymity would have stifling effects on the Internet's innovation potential and erode trust of users. In the U.K., plans by leading Internet providers to use Phorm, a company which tracks Web activity to create personalized adverts, have sparked controversy. Sir Time Berners-Lee, the creator of the Web, has said consumers need to be protected against systems which can track their activity on the Internet. He has also spoken against giving ISPs ability to track which Web sites users visited. Eventually, Phorm was forced to give customers a universal opt out after negative coverage in the media.[45]

In the U.S., executives for Verizon Communications, Time Warner Cable Inc. and AT&T Inc., the biggest Internet service provider in the nation, have testified before Senate Commerce Committee, proposing that ISPs set their own industry-wide guidelines to protect privacy online.[46] This has caused concerns among many citizen groups who fear that, in addition to corporate interests, national security agendas may also endanger privacy. They assert that an Internet Patriot Act has been drafted and is ready to be implemented quickly once the need is demonstrated. [47]

In many developing regions, lack of confidence in the security of Internet communications, only adds to the lack of trust in legal institutions in hindering commerce and content development.

2.5 Ecological Footprint

Decisions made about the Internet's future will inevitably have environmental impacts. As Tony Vetter notes, the good news about ICT-driven economic growth is that there is compelling evidence this growth is accompanied with reduced energy consumption per dollar of economic output through productivity gains and net gains in cost-effective energy savings.[48] Information carried over the Internet, however, is housed in data centres whose numbers are growing along with the network: according to market-research firm IDC, there

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[45] R. Cellan-Jones (2008, March 17) Web creator rejects net tracking. *BBC News Online Edition.* Retrieved September, 2008 from : http://news.bbc.co.uk/2/hi/technology/7299875.stm.

[46] Los Angeles Times (2008, September 26), Internet service providers want to set industry guidelines for online privacy. *Bloomberg News.* Retrieved September, 2008 from: www.latimes.com/business/la-fi-privacy26-2008sep26,0,2317855.story.

[47] F. Barrio (2008, September 11), *Caring About Cybersecurity or Preparing the Ground for an I-Patriot Act?* Retrieved September, 2008 from CircleID: http://www.circleid.com/posts/89111_cybersecurity_or_ground_for_i_patriot/.

[48] Vetter notes that one study has estimated that for every extra kilowatt-hour of electricity that has been used to power ICTs, the U.S. economy increased its overall energy savings by a factor of 10. See Tony Vetter (2008), The ICT Sector and the Global Connectivity System: A Sustainable Development Overview. Winnipeg: IISD.

were more than 7,000 data centres in the United States alone in mid-2008, and around 15 million servers.

With so much of the world's economy reliant on computer and the Internet, data centres are becoming as indispensable to society as power stations or water towers. In addition to requiring energy for operations, data centres' cooling systems draw additional energy, often in similar amounts as those required for computing. The largest data centres, or server farms, now equal aluminum smelters in energy consumption.

> "The Internet is the fastest growing source of CO_2 to the atmosphere...it doubled from 2002 to 2006."
>
> *Bill St. Arnaud, CANARIE*

A facility owned by Microsoft near Chicago, for instance, requires three electrical substations amounting to the capacity of 198 megawatts.[49] Others server farm operators have submitted requests for over 1,000 MW of capacity as long ago as 2001.[50] By comparison, a modest server farm that draws only 20 to 30 megawatts uses enough electricity to power 20 to 30 thousand homes.[51]

According to Bill St. Arnaud of CANARIE, the Internet is the fastest growing source of CO_2 in the atmosphere. St. Arnaud highlights that personal computers account for 50 per cent of the Internet's energy consumption, with server farms responsible for other half.

Some Internet companies, like Google, are currently developing zero-carbon data centres with the aim of using alternative energy sources and freshwater coolants in place of fossil fuels. In Nova Scotia, Canada, a company is exploiting tidal energy in the Bay of Fundy for the same purpose.[52]

While the energy and emissions issues currently dominant discussions about the footprint of the Internet, less obvious, but of considerable concern are the issues around materials consumption in the production of equipment and the related implications of e-waste. Regulatory efforts to manage the use of hazardous substances in ICTs are having some unexpected rebound effects. Witness the EU's Restriction of Hazardous Substances

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[49] The Economist (2008, May 28). *Down on the server farm: The real-world implications of the rise of internet computing.* Retrieved September, 2008 from: www.economist.com/business/displaystory.cfm?story_id=11413148.
[50] S. Mandel (2001, May/June), Rooms that consume, *Electric Perspectives.*
[51] J.A. Morris (2008, Winter), Feet in the Cloud; Head in the Sand: The Energy Nightmare of Web Server Farms. *Synthesis/Regeneration 45.* Retrieved September, 2008 from: www.greens.org/s-r/45/45-03.html.
[52] St. Arnaud. Interview (2008, January 16). SPARK Hosted by Nora Young. CBC Radio. Retrieved September, 2008 from: www.cbc.ca/spark/blog/2008/01/bill_st_arnaud.html.

Directive, or RoHS, which took effect July 1, 2006. As a substitute for lead in the solder used by the ICT industry the price of tin has more than tripled (although it has relaxed somewhat along with many commodities with the global economic crisis). The overall trend is still very much up though, and may be driving unsustainable practices in tin-rich countries like the Democratic Republic of Congo (DRC). Some analysts are predicting a major imbalance in the supply and demand of the mineral tantalum in 2008—a key ingredient for compact electronics—and quite possibly a major escalation in its price in the years ahead. In fact, several sources already report a 25–30 per cent increase in tantalum ore spot prices over the last 12 months. This trend is of potential concern since the last price spike in tantalum played a major role in fuelling the conflict in DRC, considered to be the bloodiest conflict in the history of Africa.[53]

And then of course there is e-waste. The precise quantities of e-waste imported into China alone are uncertain:

> The Basel Action Network estimates that 70 per cent of the 20 to 50 million tonnes produced globally end up in China (e.g., 14 million to 35 million tonnes annually). Greenpeace estimates that the total e-waste imports going to China increased from just under a million tonnes in 1990 to 17.5 million tonnes in 2000… Tshingua University, drawing from data from the Beijing Zhongse Institute of Secondary Metals, estimates total illegal imports of e-waste to be around 1.5 million tonnes per annum…
>
> Regardless of the actual amounts of imported e-waste coming into China from foreign markets, two conclusions remain undisputed:
>
> 1. That illegal e-waste imports account for a major part of, if not the majority of, Chinese e-waste being treated in the major dismantling centres found along the Pearl and Yangtze river deltas.
> 2. That these illegal wastes are a major source of highly toxic chemicals giving rise to dangerous living and working conditions in the Chinese dismantling districts.
>
> Source: *Martin Eugster, Duan Huabo, Li Jinhui, Oshani Perera, Jason Potts, Wanhua Yang. A commodity chain sustainability analysis of key Chinese EEE product chains Sustainable Electronics and Electrical Equipment for China and the World. IISD, 2008.*

While creative, sustainable solutions may be on the horizon to address energy and emission issues, much more research is needed to define and evaluate choices that exist for Internet policy-makers concerned about the full range of environmental sustainability issues.

[53] T. Vetter (2008), Resource Wars and Information and Communications Technologies. IISD commentary, Retrieved September, 2008 from: www.iisd.org/pdf/2008/com_resource_wars.pdf.

3.0 Conclusion

Some commentators suggest that the original design of the Internet cannot survive the challenges now facing it, and that the uncertainties such as the ones described above could be resolved by redesigning the Internet from the ground up.

The European Future Internet initiative (www.future-internet.eu/), the Stanford University Clean Slate program (http://cleanslate.stanford.edu/) and the Global Environment for Network Innovations (www.geni.net) are three projects that aim to foster network innovation unrestricted by existing Internet standards. The Next Generation Network design being developed at the ITU, while IP-based, also seeks to remedy challenges faced by the Internet and telecom networks, by separating services from transportation in an effort to improve security and quality of service. While the innovation potential of these initiatives is inspiring, it will be important for policy-makers concerned about sustainable global development to understand in detail the inevitable trade-offs involved in any proposals resulting from them.

At the second meeting of the Internet Governance Forum, Leslie Daigle, the Chief Internet Technology Officer for the Internet Society, reinforced ISOC's position that the Internet model of open, collaborative processes and stewardship is necessary to ensure development of a truly global and inclusive Internet. If one considers the bigger picture, one may find that openness in governance, collaboration across interest groups and responsible stewardship of the Internet will play a greater role in achieving global sustainable development than anyone could have predicted mere decades ago.

4.0 Considering the implications for sustainable development

The following questions are intended to stimulate debate on the connections between these uncertainties and sustainable development. It is the intention of IISD and its partners to identify those issues where we think the greatest risks and opportunities for sustainable development lie, and to begin to develop, test and propose what we think might be the most useful principles and policy responses.

- What would happen if the "commons" nature of the code layer of the Internet were compromised?

- What are the key public value elements and benefits of the Internet that support sustainable development, and who should be responsible for them?
- What would an Internet without net neutrality or the end-to-end principle look like?
- What would happen if universal broadband access is not achieved by developing regions?
- What does the future hold if we do not rethink regulation in light of Internet-based innovation?
- What will happen if ICANN is not internationalized?
- How will security and trust be managed on the Internet?
- What are the advantages and disadvantages of the shift to IPv6?
- How will the demands and creativity of the "next billion" affect the network?
- What will happen if we lose "generative" Internet devices?
- What is the environmental impact of the Internet?
- What are the energy requirements of future growth in an information society?
- Are current Internet governance methods sustainable?

A Web site for dialogue on these questions has been set up at http://groups.iisd.org/internetgovernance. We invite you to contribute your thoughts to these questions.

5.0 Appendix: Description of the Global Connectivity System

Tony Vetter, IISD

To define the Global Connectivity System it is helpful to start with our traditional understanding of the ICT sector. Attempts to define the ICT sector began in earnest in the 1990s as it became clear that ICT was significantly contributing to rapid technological progress and productivity growth, which in turn appeared to be catalyzing accelerated economic growth. Industrialized countries benefiting from strong economic growth at the time were highly motivated to understand and compare the evolution of ICT activities across time and between countries in order to understand how such effects could be further promoted. Understandably, the common approach was to attempt to isolate and measure economic activities directly contributing to the production of ICT goods and services. One prominent example is the agreement reached in 1998 between the OECD countries on an industry-based definition of the ICT sector. A high-level explanation of this definition is best illustrated by the diagram below which was central to early OECD discussions on the ICT sector.

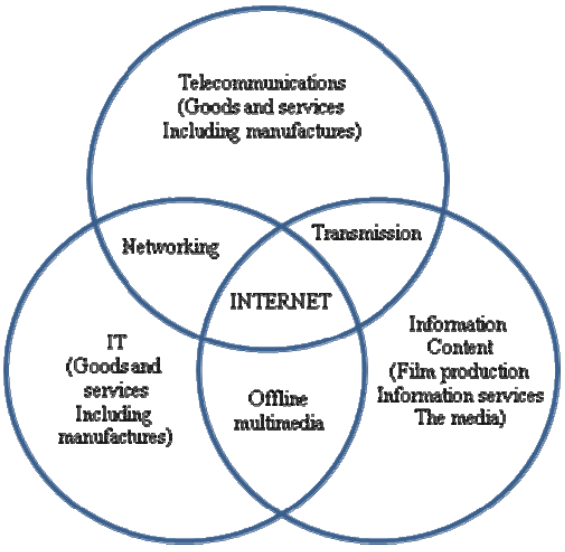

Figure A1: Overlap among the information technology, telecommunications and information content activities of firms (adapted from a Finnish model)[54]

[54] OECD (2007). *Guide to Measuring the Information Society*. Paris: OECD. Retrieved Oct 30, 2008 from http://www.oecd.org/document/22/0,3343,en_2649_34449_34508886_1_1_1_1,00.html.

> Conceptually … the ICT Sector can be viewed as the activities which fall into the union of the Information Technology (IT) and Telecommunications activities in the diagram above. It includes therefore the intersections between them and the Information Content activities. However it excludes those Information Content activities which fall outside those intersections; that is, those which have no direct ICT association.[55]

In this diagram, the union of IT and telecommunications represents networking activities, or the connecting together of computers over telecommunications infrastructure. The overlap of telecommunication and Information content represents content transmission activities such as television; whereas the intersection of IT and Information Content defines ICT-based offline multimedia activities like DVDs or game consoles. Finally, the union of all three represents the activities of the Internet, arguably the epicentre of the ICT sector today.

However, this focus on the ICT sector as a producer of goods and services omits many key players. First, the innovation and production of telecommunication and IT goods and services has been significantly influenced by the actions of international and national standards bodies such as IEEE, ITU, ISO, ETSI, ANSI, Telecordia, among others; as well as national telecommunication regulatory bodies in which national governments play a critical role. In the case of the Internet, a range of consortiums and organizations such as W3C, IETF, ISOC, IAB, IESG and IRTF—of which many of the participants are volunteers—have loosely coordinated through rough consensus the development and promotion of Internet standards. Institutions which also emerged to manage the allocation of Internet resources such as ICANN, RIRs, and NICs have been equally important to shaping the evolution and use of the Internet.

The activities and impact of the core ICT sector as well as the supporting institutions mentioned above have been of increasing interest and concern to a wide range of international organizations. Many of these international organizations have had significant influence in turn on the activities of the ICT sector in a global context. These have included: international economic development organizations such as the OECD, World Bank and WEF; development organizations more specifically focused on role of information and communication technology in development including bridging the world-wide digital divide such as GAID, infoDev and UNESCO; international organizations concerned with the implications of the Internet on IPRs and trade implications such as WIPO, WTO, UNCTAD; as well as international environmental organizations such as UNEP through its

[55] Ibid.

support of ICT sector efforts to tackle a range of environmental issues attributable to their activities.

Surrounding the ICT sector core, supporting institutions, as well as the many international organizations mentioned above, is an even broader range of civil society actors who seek to influence the choices of actors at all three levels on a variety of issues of concern to their constituencies. These issues include: the application of law in cyberspace; the protection of civil liberties and privacy online; access to ICT services by civil society and their disadvantaged constituencies; the responsible management of toxic technological waste; policy and regulation capacity-building in developing countries; and the use of ICT for sustainable development, to name just a few. Their advocacy has, for example: influenced ICT sector responses and adaptations to legal challenges against online activities; rallied support for customized lower cost ICT solutions; encouraged sustainable changes to supply chain management practices and the disposal of ICT; among many other outcomes.

Finally, surrounding all of the above mentioned institutions and actors are the end-users themselves. The individual actions of end-users have had significant influence on ICT sector innovation, the development and distribution of online content, as well as on responses to issues of infrastructure security and online privacy. Social movements such as free and open source software (FOSS) have been entirely end-user-led and have resulted in the general available of many free alternatives to proprietary software applications, Linux being the most prominent example. This has led to significant adaptations to many business models in the ICT sector. Through Web 2.0 applications user posted and generated content is increasingly dominating Internet traffic which has forced the ICT sector to adapt its management Internet capacity. The hacker community has also has significant influence on the evolution of online security for individual and enterprise users, as well as for government institutions with online presence.

It is this layered system of actors and their interactions, influences and linkages that makes up the Global Connectivity System. How this system evolves and is used is significantly influenced by actors in all of these layers. It is worth noting that the Global Connectivity System is also growing in scope as a result of technological advances and regulatory changes that have served to break down the physical and regulatory barriers between its industry categories as well as drawing in economic activities not previously having direct ICT association. A case in point is the move of traditional Information Content providers such as media and entertainment conglomerates into the online space and their legal clashes with Internet Information Providers such as Google whose business model leverages end-users' appetite for accessing ubiquitous, freely available and sometimes copyright-protected content online.

The rapid growth of the Internet has been partially attributable to a self-reinforcing dance between the increasing pace of ICT innovation and regulatory changes. Prior to the deregulation of telecommunications services connectivity services industrialized countries were dominated by Public Switched Telephone Networks (PSTNs). However deregulation in many of these industrialized countries has encouraged an explosion of communication offerings where traditional landline telephone, cable companies and wireless companies are increasingly invading each others' traditional markets. The continued advancement of routing and switch capability and the continued advancement of the corresponding protocols are driving the convergence of voice technology, mobility technology, data technology and computer technology over these communication offerings. These trends suggest a future where one will be able to connect to the Internet anywhere and at any time, as well as a future where the Internet will be the foundation for all information and communication exchanges. In other words, the future of the Global Connectivity System is that of the Internet itself.

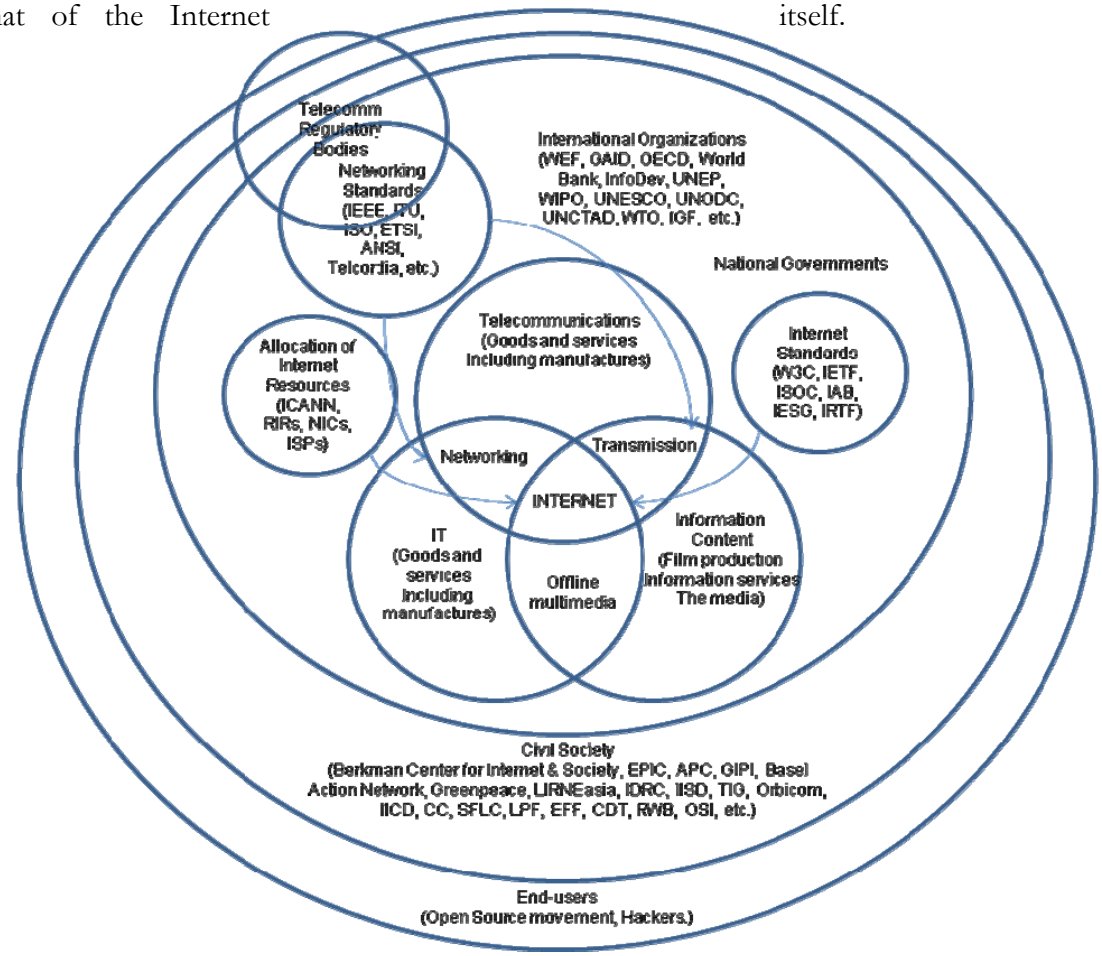

Figure A2: The Global Connectivity System

Evolving our understanding of the critical uncertainties regarding the development and deployment of today's Internet is therefore critical for understanding what form the Global Connectivity System will take in the future. International, national and multistakeholder body policies and agreements targeted to address these critical uncertainties could play a pivotal role in guiding how the Global Connectivity System will evolve and whether the transformations that it will continue to bring about will contribute to global sustainability.

A more detailed description of the Global Connectivity System appears in: Vetter, Tony (2008). *The ICT Sector and the Global Connectivity System: A Sustainable Development Overview.* Winnipeg: IISD.