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Who Governs the Internet?

Along with the Internet's emergence as a valuable world resource, a debate has developed over how to ensure it continues to function despite its rapid scaling, technical innovation, and intense commercial competition. If its governance depends on a decision-making process ensuring its parts work together and move forward in the same direction, what mechanisms and organizations are needed to ensure such governance?

The Internet is a complex self-organizing system influenced by market mechanisms, government agencies, businesses, associations, and various allocative and standards-setting organizations. Some of these mechanisms and bodies date to the Internet's predecessor, the ARPANET, a U.S. Department of Defense research network. But, today, the Internet's commercialization and globalization are forcing changes in how governance decisions are made and who makes them.

The U.S. government has funded much of the research required to develop the Internet's technology. Although the National Science Foundation's (NSF's) backbone was replaced several years ago by commercial networks, the U.S. government continues to sponsor a range of activities, including the Internet Assigned Number Authority (IANA), which assigns the unique parameters needed to connect computers and networks. Now that commercial companies own and operate most of the Internet's physical infrastructure, it can be argued that the government should move ownership and responsibility for the administrative infrastructure to the commercial sector. Meanwhile, the commercial Internet community has struggled over acceptable use policy as well as how to organize itself since 1993 when it deployed a router to bypass the NSF's backbone and acceptable use policy.

Address Allocation

The Internet requires considerable coordination among the thousands of Internet service providers (ISPs). Though much of this coordination happens informally, it also involves meetings associated with the North American Networks Operators Group, the Asia Pacific Networking Group, the Reseaux IP Europeans (RIPE), the European Operators Forum, and such trade associations as the Commercial Internet Exchange. European ISPs created RIPE and Asian ISPs created the Asia
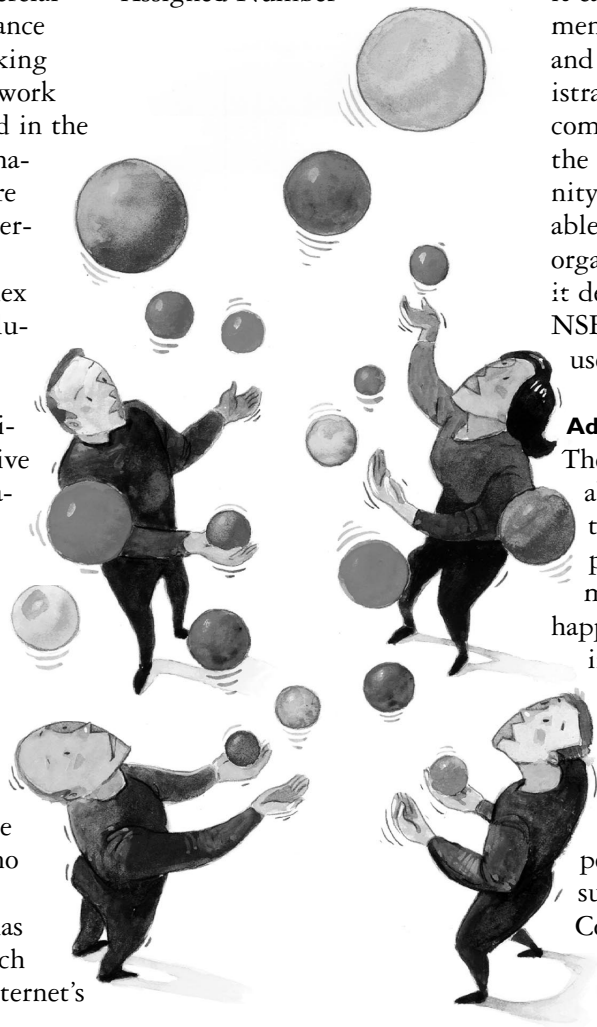
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Pacific Network Information Center (APNIC) to facilitate IP address allocation in their regions. Though ISPs have authority over their portions of the distributed architecture of the domain-name system, providing easy-to-remember locators to Internet hosts, they have decided not to seek control of the root of the domain-name system.

However, another separate but overlapping community also views responsibility for Internet infrastructure as its mission. This community stems from the formal control and funding relationships emanating from the U.S. government in the 1970s and

of extending liability coverage to the Internet Engineering Steering Group, which helps manage the IETF.

The IETF has developed some of the standards the Internet depends on. But it only sets standards and has historically avoided becoming involved in the Internet's day-to-day operations. Complicating matters, the IETF has been losing its ability to achieve consensus on critical issues and is being eclipsed by new industry forums and the initiatives of private companies rushing to establish de facto standards.

Understanding the governance

Internet within their borders. In some countries, such as those of the Persian Gulf, Internet services are provided by the government-owned telephone company. Other countries, such as Singapore, require ISPs to have licenses to operate. In China, users also need to be registered with the government. The Internet is generally considered an enhanced service, exempt from the regulatory regime developed for basic telecommunications services.

The initiative for developing shared national infrastructure, such as the various national Network Information Centers

COMPETITION IS REPLACING COLLABORATION

as the force for innovation on the Internet.

early 1980s onto which were grafted university computer science and research communities in the 1980s. It aggregated around the Internet Activities/Architecture Board (IAB) established by the Defense Advanced Research Projects Agency (DARPA) to oversee the Internet, then expanded into the nonprofit, tax-exempt Internet Society (ISOC). According to its charter, the ISOC is an educational institution dedicated to supporting research and academic networking, but its trustees have expressed their desire for a leadership role in promoting the Internet as a whole.

The ISOC tries to provide an umbrella for the Internet Engineering Task Force (IETF). The umbrella has consisted primarily

of the Internet requires that we consider not only the standards-making processes but the operational processes. Also essential is that we understand the relationships between ISPs and the relationships between ISPs and the broader Internet business community.

As cultural anthropologist Clifford Geertz has said, "models of" how the world operates also become "models for" how the world should operate [2]. Therefore, the model we choose for governing the Internet influences the choices we make about how it should be governed.

Governance by Government
Various countries have followed their own policies when attempting to promote and control the

(NICs), usually comes from the first service providers established in a particular country, though the national government may provide some oversight or authorization.

Other countries, such as Brazil, have established joint government-business panels to oversee the Internet. In the U.S., the Federal Networking Council (FNC), comprised of 17 federal agencies, coordinates government decision making regarding the Internet. For example, in the fall of 1996, the FNC proposed that the Federal Communications Commission become more active and that the NSF, which has played a major coordinating role in the Internet, remove itself from Internet administrative functions.

International Perspectives

In April 1997, NSF acting deputy director Joseph Bordognaformally announced that NSF had no intention of extending or rebidding its five-year cooperative agreement with Network Solutions, Inc. to administer the .com, .org, and .edu addresses [5]. Today, a task force from various U.S. government agencies is developing policy recommendations for administering the domain-name system and IP-address allocation.

Governance by Public International Organizations

Telecommunications transcends national borders. The International Telecommunication Union (ITU) has been involved in international telecommunications since the telegraph first crossed national borders. Today, the ITU is the United Nations' agency for telecommunications, coordinating radio frequencies, satellite orbits, and the settlements system for telephone calls between countries. It has established many important communication standards, though many of the Open Systems Interconnect standards for interconnecting computers developed jointly by the ITU and the Organization for International Standardization have been eclipsed by Internet standards. Some in the Internet community question the size of the ITU's role in Internet governance, concerned that the ITU is a big bureaucracy whose constituency—the various national telecommunication ministries—is often inextricably linked to the national monopoly telephone companies. Others criticize the ITU because it is powerless to impose decisions on any

country, even in the interests of the entire world. However, despite such criticism, the ITU has the potential to serve as a mechanism for national governments to coexist with the Internet.

Governments also actively participate in regional and other international organizations, such as the Organization for Economic Cooperation and Development, which is gathering information on government regulation of the Internet and held a conference in April 1996 on Internet administrative infrastructure. Such international forums play an important role in gathering information and helping countries coordinate their policies.

Governance by Requests for Comments

Computer systems do not necessarily need the same software or hardware to communicate, as long as they use the same protocols. The Internet Protocol (IP) was engineered for decentralized interoperability [3], and the Internet works because everyone chooses to use the same communication protocols. The designs of these protocols assume that networks relate as peers. Unlike SNA (the IBM network architecture requiring a network hierarchy with a mainframe on top), the IP design constrains the emergence of "king" networks governing the overall Internet.

For the IETF, interoperability is sacrosanct. The IETF standards process expects and requires multiple implementations of protocols. To interoperate, these implementations must be conservative in what they send and liberal in what they receive. Instead

of depending on centralized quality control or licensing of service providers to guarantee compatibility, errors and differences between implementations are anticipated in the design of the protocols.

The culture of the IETF is particularly suited for fostering interoperability. In *The Tao of the IETF*, a guide for new attendees of the IETF, G. Malkin of Bay Networks describes how decisions are made through a process he calls "rough consensus" [4]. There is no actual voting on what should be in a standard and anyone can participate in the process. Workgroups, during thrice yearly meetings and through extensive use of email, develop requests for comments (RFCs) on proposed solutions to technical problems. A protocol proposed in an RFC to be considered for standards status must involve multiple implementations that must then be tested for interoperability. "Working code" is integral to the decision-making process when establishing interoperability.

Many Internet standards emerge from outside the IETF. For example, the World-Wide Web's html and http protocols were designed at CERN in Switzerland and are now controlled by the World-Wide Web Consortium at MIT. The ATM Forum, the Frame Relay Forum, and the Network Management Forum are vendor-driven consortiums working to set standards.

Governance by the Market

Hardware and software manufacturers bringing products to market share a commitment to interoperability, but they are also

desperately trying to establish a proprietary advantage protecting them from commodity pricing and allowing them to control their own destinies. Netscape, for example, has rapidly introduced innovations into its Web browser, bypassing not only the IETF but also at times the W^3 Consortium. Netscape's mission statement calls for continually developing new "open" standards that Netscape then makes available to others in the market, thus pushing the Web forward.

haps the greatest threat to our success" [1]. Though the IETF may be suited for making good technical decisions, it is not well suited for resolving political and commercial conflicts that influence and are influenced by the Internet's technical infrastructure.

Many believe that governance by the market is good. Ultimately, users and corporations, through their purchasing decisions, choose the winners and the shape of the technology. To sur-

tionships (direct or indirect) with every other network on the Internet. Networks can agree to exchange traffic on a peer-to-peer basis, or a network can sell others "transit," agreeing to advertise the second network's routes while serving as an intermediary with other ISPs. These negotiated relationships determine not only if and how ISPs compensate one another for carrying each other's traffic but determine the terms and conditions of what it takes to connect to the Internet.

MISSING TODAY IS GLOBAL CONSENSUS

on the proper balance of market mechanisms, government regulation, and international accords.

Competition is replacing collaboration as the force for innovation on the Internet. Not clear is how well the culture of interoperability will survive as software and hardware companies battle to establish market share for their proprietary products.

Debatable is whether the Internet protocols, such as TCP and IP, would have been developed and implemented by the market or could be developed without U.S. government funding and the IETF's unique culture. However, the competitive pressures of the commercial world are undermining the IETF's ability to achieve consensus and make decisions. "The problem," says the IETF's Dave Clark, "is that when rough consensus fails, we have nothing to fall back on, and we grind to a rough halt. The commercial world cannot tolerate failure to make progress, and this is per-

vive, technology vendors are forced by the market to remain interoperable with the rest of the market, even as they add innovations.

The major fear associated with allowing the market to determine winners and losers is that one powerful company can—through market power or patents—control a key niche or even the entire Internet. In the same vein, many also believe that IBM held back the pace of innovation in the computer industry during the 1960s and 1970s. And some believe that Microsoft could do so again in the 2000s. Microsoft's advocates counter that Microsoft is fundamentally technology driven and has continued to rapidly innovate even when "controlling" parts of the market.

The Internet is a network of networks. For users to have access, their ISPs must have rela-

Though there are more than 5,000 ISPs worldwide, most of them buy transit from a handful of very large ISPs. The large ISPs—including ANS, BBN, MCI/British Telecom, Sprint, and UUNet—have significant power based on the fact that an ISP needs to connect with at least one of them to deliver global connectivity to its customers. The reticence of this group to take a more active joint leadership role on Internet governance can in part be attributed to their fear of antitrust enforcement by the U.S. Department of Justice.

Governance by Allocation of IP Addresses

With the rapid growth of the Internet, one of the greatest concerns is that IP addresses, which identify every Internet host and client, will be depleted because of inefficient allocation. There-

fore, the IETF and the ISPs began to implement Classless Inter-Domain Routing in 1992, assuring more efficient use of the IP address space.

There has also been contention over allocation of large blocks of IP address space and the related policies. IANA allocates IP blocks to three regional organizations: InterNIC (Americas), RIPE (Europe), and APNIC (Asia Pacific). These organizations in turn allocate IP addresses primarily to ISPs in their regions. Both RIPE and APNIC are run by the ISPs that are members of each organization. Even though their authority to allocate IP addresses comes from IANA, RIPE's and APNIC's allocation rules are set by their own members who vote on those rules.

An effort is now underway to create a new organization for the Americas—ARIN (American Registry for Internet Numbers)—that would take over InterNIC's job of allocating IP addresses. Though ARIN would not initially be governed by member ISPs, ISPs would get a greater role in ARIN's decision-making processes than they currently have through InterNIC, which is owned and operated by Network Solutions, Inc.

There have been discussions about ARIN, RIPE, and APNIC forming a joint council with IANA to allocate IP addresses and to develop shared policies. By including the three regional NICs in its decision-making processes, IANA would take a major step toward further integrating those with the greatest stake in IP address allocation— namely the ISPs—in the IP-allocation decision-making process.

Governance by Allocation of Domain Names

Domain names were developed as a supplement to using IP addresses to identify host computers in order to come up with easy-to-remember identifiers. Because human memory and attention are limited and as millions of dollars are invested in the Web, significant competition has developed for domain names that are easy to recall or guess.

InterNIC, which gives out secondary domain names within the .com top-level domain (TLD), has faced many suits, as owners of trademarks and holders of domains fight over the right to particular domain names. Network Solutions, Inc., which operates InterNIC, has changed its domain name policy three times, angering many in the Internet community. The company's current policy leaves it to the courts to decide between competing trademarks.

InterNIC gets its authority to delegate IP address and domain names from the same IANA that allocates IP numbers. IANA, run by Jon Postel, Internet pioneer and currently working at the University of Southern California, has historically been responsible for unique parameters required by IETF protocols. Though IANA gave most countries the right to operate their own TLD and assign secondary domain names within it, the .com TLD has developed a cachet not only for U.S. businesses but to some degree for businesses in other parts of the world.

In the spring of 1996, Postel proposed creating new registries to manage up to three new international TLDs, stating he hoped that offering multiple TLDs would reduce trademark conflicts, as businesses could get the secondary domain name they wanted, albeit in a non.com TLD. Some members of the Internet community have also been concerned about AlterNIC'S effort to create new top-level domains without IANA's approval as well as an alternate set of root-level domain name servers including the new TLDs.

Governance by Committee

The Internet Society's board of trustees agreed in June 1996 to adopt Postel's proposal and to serve as its legal and financial umbrella. Four months later, Don Heath, the Internet Society's new president, announced the creation of the Internet International Ad Hoc Committee to resolve issues regarding Postel's proposal; it includes representatives picked by the Internet Society, IANA, ITU, World Intellectual Property Organization (WIPO), NSF, and Internet Trademark Association. Those chosen declared they repre-

sented only themselves, not the organizations that sent them. This disclaimer was important for the ITU, since its charter gives its secretariat limited authority to negotiate agreements.

On February 4, 1997, IAHC announced it was creating a memorandum of understanding regarding generic TLDs (known as the gTLD-MoU) between ISOC and IANA and other interested parties. The gTLD-MoU established a gTLD Policy Oversight Committee (POC) to oversee creation of seven new domain names (see http//:www.gtld-mou.org/gtld-mou.html). The new registries would participate in and be governed by a Council of Registers (CORE); they would also agree to abide by the decisions of the Administrative Domain Name Challenge Panel set up by WIPO to handle trademark disputes.

The IAHC final report, signed May 1, 1997, established an interim POC (iPOC) to begin selection of registers. The gTLD-MoU does not address whether domain-name root servers are obligated to update the root servers with the new iPOC-sponsored domain names. The ultimate question is: Who controls the root servers at the top of the domain-name hierarchy? Unclear is whether iPOC claims the right to determine who is and who is not a domain-name root server. The gTLD-MOU implies that the POC has authority over the highly valuable TLDs .com, .org, and .net upon expiration in 1998 of Network Solutions, Inc.'s cooperative agreement with NSF.

The U.S. government is required to follow certain administrative procedures before chang-

ing its roles, activities, and policies. The IAHC committee is seeking to establish public policy without recourse to U.S. or international law while avoiding the very difficult process of getting the U.S. government and the other nations to work out governance of the domain-name issue. But it also leaves itself exposed to court challenges based on the lack of administrative review that could create a crisis of legitimacy for Internet administrative organizations.

Critics have also questioned whether IANA can sign a legal document when it does not legally exist. IANA is a function funded by the U.S. government until March 1997 but was never formally incorporated. Without the signatures of IANA and ISOC members to establish the gTLD-MoU, can it ever be a legal document?

Governance by Relationships

The Internet is governed by the complex interaction of consumers, businesses, researchers, and governments throughout the world—each creating new organizations or working through existing ones to coordinate their Internet efforts. These organizations are in turn building relationships with other organizations. The Internet is a self-organizing system spawning self-organizing relationships among its stakeholders. Missing today is global consensus on the proper balance of market mechanisms, government regulation, and international accords.

Complicating matters, many emerging associations are promoting new industries that depend on the Internet, such as Web hosting and advertising, electronic commerce, electronic publishing, and

digital telephony. The Internet is a global ecosystem that is rapidly generating other ecosystems requiring their own governance mechanisms. These ecosystems are also stakeholders in the larger Internet ecosystem. Good governance requires their effective integration into the decision-making process. ▣

Follow-up

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