Global Regulation of the Internet Domain Name System: Five Lessons from the ICANN Case

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A. Introduction

The spread of the Internet over the past two decades has been so spectacular that it became virtually synonymous with innovation. A sequence of different innovations on all the layers of the Net has led to continuous improvement. At the same time, the opportunities in data transfer and processing have supported a vast range of innovative activities on the Net by commercial firms, non-profit organizations and private individuals.

The continuing flow of innovations to improve the Net and to be used on the Net is dependent on the way in which it is regulated. „Regulation“ is here used in its widest possible meaning, applying to rules and procedures issued by national governments and international organizations, to self-determined rules by private associations of any nature and to regulation through the rules of markets.

This paper does not dwell on the question of desirable development because it seems impossible to determine the optimal trade-off between the benefits due to the universal applicability of a specific set of rules and the benefits of competing sets of rules. Instead, it tries to interpret a part of the short, yet remarkably rich history of regulatory efforts surrounding the growth of the Net up to today.

Arguably, the most prominent regulation project in the course of that history of institutionalization was the installation of a private corporation, ICANN, with the purpose of governing the assignment of domain names and IP numbers for Internet
hosts. The actual incorporation was the result of a long and eventful communicative process. Therefore, some of the lessons to be drawn from the ICANN case are based on events that took place a long time before the actual inauguration of the organization.

I will draw a total of five "lessons" from the case. They will span the time period from 1969 to the immediate present, and they will allow some conclusions with respect to social processes of regulation and institutionalization. 1

B. Creative Interplay: "Three for the Net"

The site of the first ARPANET node, installed in September 1969, was the ARPAnet-supported computer science research center at UCLA, headed by Leonard Kleinrock, an inventor of queuing theory. At UCLA, Kleinrock's graduate students Steve Crocker, Vinton Cerf, and Jon Postel were given most of the responsibility for implementing the ARPANET protocol. 2

It was this core group of students which contributed the major innovations that turned the ARPANET into the Internet. Steve Crocker was the inventor of the "Requests for Comments" (RFC), a participatory method of developing and documenting standards since 1969. Vint Cerf was one of the principal designers of TCP which had its breakthrough in 1978 when the internetworking TCP was separated from the connectionless address space of IP. Jon Postel took over the administration of unique number assignments for ports and protocols starting in 1972 and developed what was to become the Domain Name System (DNS).

Thus, the three fundamental features of the emerging Internet were determined: TCP/IP allowed the identification of individual hosts and the communication between networks. The two protocols gave the Net its unique technical capability of becoming a net of networks. The DNS made it possible to attribute unique and simple names to the IP numbers. A semantic layer was added to the code layer of the protocols. The link to common language couples human users to the Net. Thirdly, the RFC process enabled an open process of self-regulation. The process used its own invention, the Internet protocols, for communication. It permitted individuals to condense their interaction into a recognizable organizational form, and to maintain a set of rules for changing this organization.

Both TCP/IP and the RFC series have their own history. TCP/IP faced strong competition from other networking standards like the International Standardization Organization's OSI (Open System Connection) and the ITU's X.25 protocol, to name just two. In the end, TCP/IP prevailed because it was the only protocol that permitted the interconnection of thousands of heterogeneous, independently administered networks. The history of RFCs is even more remarkable: they were instituted in order to reach decisions without a given higher-level authority. The graduate students who were about to make the technical decisions determining the fundamental features of the new network used the "rough consensus" of participants in e-mail lists as a substitute. RFCs have remained the official mode of documenting self-set rules, relating to all layers of institutions from technical standards to governance issues. 3

The study presented in this paper focused on the history of only one of the three features, namely the development of the name space. It is this feature which has been most strongly exposed to the pressures of interested parties from outside the community of technical specialists which invented, installed and administered the Net. This community (and that is the content of the first lesson) was once so small that it fit into one office of UCLA's Graduate School. It needed the shelter of a grant-supported research system, the work culture of a particular institute, and the interplay of creative ideas and comments between the three individuals. 4 The maintenance of the basic determinants of such an "open source" situation where every player contributes to a common good is still the major goal of those leading the contemporary organized Internet community.

C. Name Space is a Hierarchy

In October 1984, Jon Postel issued RFC 920. This document contained the ground rules for the name space in which the Internet was to take place, the Domain Name System (DNS). 5 The DNS has a hierarchical structure. On the top, there is an unnamed "root": a file which contains the authoritative list of top-level domain name assignments. The authority in charge of the root assigns the right to administer a given top-level domain name (TLD) to a specific organization. That organization also has the exclusive right to assign second-level domain names (SLDs). The regis-

3 For the role of Usenet in this process, see M. Hutter, a.a.O. (Fn.1), S. 10f.
4 The account given here, by necessity, a rather heroic abstraction. The complete development of the three Internet features involved a much wider circle. There are individuals who were members of the Network Working Group, to which Crocker's first RFC's referred, individuals who collaborated at ISA, like Joyce Reynolds, and many others who formed their own creative circles in the intellectual environment of the UCLA group. See, for examples, R. Rosenzweig, Wizards, Bureaucrats, Warriors, and Hackers: Writing the History of the Internet, in: The American Historical Review, 103 (5), 1998, S.1530-52 and M. Froomkin, Wrong Turn in Cyberspace: Using ICANN to route around the APA and the Constitution, in: Duke Law Journal, 50 (17), 2000, S.17-184.
5 The protocol was the result of an extended discussion that had taken place through an e-mail list.
The root was surrounded by 250 TLDs, 7 generic codes and 243 country codes. Every TLD is connected with millions of SLDs, most of them registered under the domain „.com“. Thus, the part of the concentric circle of SLDs connected with „.com“ is more densely occupied than other sections. Third-level names are basically up to the hosts with a SLD name. Since about 1996, virtually all of the SLDs use the third level application www. The use of this particular hyperlink program provides the hosts with the know-how to navigate on the Net. It also connects each through a common standard, thus locking the potentially loose network into a bounded circle.

The hierarchical nature of the system allows a virtually unlimited expansion of the name space without overloading the central assignment authority. In the days before RFC 920, every local network had to download a specific file (hosts.txt) which served as a global directory. Now, that information is distributed along the layers of the DNS hierarchy. The central authority needs only complete information about the top level of the hierarchy.

The system also allows a separation between its governing authority, the assignment service and the maintenance of the root servers. Governing authority remained with Postel who moved to Information Sciences Institute (ISI) at USC in 1977. The assignment service stayed with the private Stanford Research Institute and later, under a new government contract, was awarded to Network Solutions International (NSI), plus a number of „responsible persons“ who were given the administration rights of specific ccTLDs (Mueller 2002: 88). The 13 root servers were operated by government institutions and by research institutes. Thus, the governing authority was designed to be in one hand. Postel was quite accurate in describing himself as the „czar“, i.e. the despotic ruler of the naming system.  

6 Each of these organizations operates a name server that stores lists of domain names and associated IP addresses about a subset of the name space called „zone“ See M. Mueller, a.a.O. (Fn 2), S. 43.
7 The gTLDs are .com, .net, .org, .edu, .gov, .int and .arpa. Under the domain in-addr.arpa, every domain registration is listed in reverse order, which permits the identification of a domain name if the IP address is known. The ccTLDs were adopted from ISO-3166, maintained by DIN, Darmstadt. By 1990 only 46 country code delegations had taken place.
8 Postel used the term in early RFC 349. See M. Froomkin, a.a.O. (Fn 4), S. 53 f.

Given this infrastructure, the Internet was well prepared for the wave of new participants which was about to hit it. In 1984, when RFC 920 was issued, there were 1024 hosts on the Net. Ten years later, the 20 million mark had been passed.

The name space capacity, and this is lesson number 2, came at a price: the hierarchical structure creates scarcity at the top end. That scarcity can be alleviated without great technical difficulty, either by adding new TLDs within the existing name system, or by connecting it with another name system that starts from an independent root. But once an element of scarcity is introduced into the abundance of the Internet commons, a specific dynamic of action is triggered because market valuation becomes possible.

D. The bigger the Stakes, the bigger the Players

By 1994, it was clear that the design of the DNS name space had led to bottlenecks in the assignment process which showed the potential for commercial earnings. In consequence, Jon Postel initiated the regular process for reaching a decision. He started a mailing list on new top level domains, called „newdom“. But the process did not meet the expectations:

„The most important product of the newdom list was a draft RFC entitled „New Registries and the Delegation of International Top-Level Domains“, more widely known simply as draft-postel ...It proposed a fairly liberal, market-driven, but controlled method of allowing the top-level name space to expand in response to demand. And it proposed to use the authorization of new top-level domains to fund the IANA operation.“  

The draft, published in early 1996, proposed a total of 150 new TLDs. But the draft remained a draft – it never became an official RFC. Postel, and with him Crocker and Cerf, had already lost control over the process which they had created.

The major cause for the loss of control was the rate at which economic value was being either endangered or created on the Internet. The WorldWideWeb supplied the tool for finding „resources“ posted somewhere on the Web without expert knowledge. By 1996, the number of Web users had grown to 20 million, most of them located in the USA. The business prospects for those providing the channels – the telecommunication industry and the service providers – and the content to be sold online – merchandise, digital products, proprietary information - were looking better with every million of new hosts registering on the Net and being assigned a domain name.  

In this situation, a peculiar technical arrangement helped users overcome the barrier to what until then had been an expert system: users could type in any character string, without any attention to domain names. The web browser software (usually Netscape or Microsoft Explorer) would automatically complete the application by adding the appropriate third-level domain name, i.e. the name of the application www, and the first-level domain name .com, chosen as default identification.11 The .com TLD began to outpace all the other TLDs. By 1990, half of the names were still registered under .mil. By 1996, the majority of applications was under the .com domain. Network externalities had boosted its introduction as a standard. Its registry and the database connected with handling both domain names and IP numbers had become a commercially valuable property. When NSI made a public offering of shares in 1997, it was able to cash in $350 mio. on the NASDAQ market.12

While telecommunication, equipment and computer firms were waking up to the opportunities of the Net, enterprises in all other industries, particularly in the consumer industries, saw equally dramatic effects on the value of their trade marks. If anyone could register any name in the DNS at practically no cost, that name lost part of its exclusivity, and it lost the power to determine the context in which the name was to appear. What authority did DNS registries have to assign „their” names to SLD applicants? The action of the trademark bar was swift and effective: by 1995, NSI was made to issue a „Domain Dispute Resolution Policy Statement” which gave trademark owners the right to demand a suspension of disputed names. The policy shifted the transaction cost of negotiation to the new registrant, and the court cases drew the attention of the Intellectual Property Community worldwide.13 It was at this time that WIPO began to lobby for name rights as a new category of intellectual property rights.14

As the commercial uses grew in volume, various segments of government administration were alerted to the enormous value of an invention over which they could easily claim authority, if not ownership.

Until the mid-80s, most of the research and administration connected to the development of the Internet had taken place under contracts from the Department of Defense (DoD). Starting in 1986, the task was shifted to the civilian sector: NSF provided its telecommunication backbone structure, and it began to employ private sub-contractors. NSI gained its registry contract with NSF in 1993.15 Revenues grew from $6 mio. in 1995 - when NSI got permission to charge for registry – to $45 mio. in 1997. In the Department of Commerce (DoC), the DNS became an issue in at least two places: the PTO, which was closely counselled by the trademark association, and an interagency working group on e-commerce, headed by Ira Magaziner and directly linked to the President’s office.

Governments and international organizations also began to raise their voices. Major players were the European Commission, ITU and WIPO.

The traditional, technically oriented Internet community had been boosted in size by the growth in traffic volume and in participation. The institutionalization process, beginning with the Internet Architecture Board (IAB) in 1983, followed by the Internet Engineering Task Force (IETF) in 1988 and the coupling between the „elders network” IAB and the „young democratic community” IETF in the Internet Society (ISOC) in 1991 deserve more detailed study.16 In 1988, Postel formalized his activities at ISI as the Internet Assigned Numbers Authority (IANA), in order to enter into negotiations with DoD or the registries. Once ISOC was founded, IANA claimed that its function was „chartered” by this association, and thus by the Internet community itself. But that kind of self-referential claim to autonomy did not go unchallenged anymore. The „draft-postel” protocol had never come into effect because the pressure from the international organisations, the registrars, and the government agencies had become too strong.

If we were to visualize the field of players around 1996, there would be, in the middle, the traditional community, structured by the various organizations. The pressure comes from the government side and its claim to authority, and from the commercial registrar whose return on investment depends largely on the rules of the DNS. From the side, new non-U.S. players enter the playing field.

The contingencies contained in the process of development between, roughly, 1994 and 1997 are certainly very large. Still, the lesson lies in the more fundamental pattern in which new competitors, participants and organizations entered the field – literally a new field since it was laid out with cables, stacked with host networks and interconnected with addresses and names. Once the Internet’s economic endowment17 had become big enough, such activities began to infringe on potential rights of large corporations, of the US government and, eventually, other governments. Name holders had to enter into litigation and feud with the owners of older claims.

11 The InterNIC, then run by NSI was handling applications for .com,.net and .org. By 1995, it had given up reviewing applications.
12 In 1996, NSI had been bought by SAIC, a major defense contractor. Although the move was strongly criticized, the new owner was able to make the investments necessary to adapt NSI to the rapid increase in applications to be handled.
13 See M. Froomkin, n.a.O. (Fn 4), S. 22 fn 10.
14 See M. Mueller, n.a.O. (Fn 6), ch. 11.
15 In 1991, NSF had given permission for access to the Net for persons outside of research and education networks.
16 For an ambitious attempt in this direction see M. Froomkin, Habermas@discourse.net, Towards a Critical Theory of Cyberspace, Manuscript: Coral Gables 2002.
17 The term is suggested by Mueller to indicate the ability of technological capabilities to provoke new forms of economic activity. See M. Mueller, a.a.O. (Fn 2), S. 106 ff.
and with entrepreneurs who realized commercial opportunities which the Net community members had not even been aware of.

E. To privatize means to leave alone

Up until 1997, the public support of the Internet had been a case of spectacular success. The course of events followed the textbook: In the first phase, basic research was supported by government grants, devoted to the superior public good „national security“. In the second phase, the military authority of the DoD was substituted by the civilian authority of the NSF, with a mandate to support the entire education and knowledge community. In the third phase, private contractors were employed for administrative tasks and the NSF withdrew from the telecommunication backbones. Now, it was time for phase four, the privatization of the DNS.

Magaziner had formed his interagency working group on global e-commerce in 1995. When the pressure from the PTO for intervention into the name assignment process mounted, he founded a separate group in 3/97. In 7/97, President Clinton directed the Secretary of Commerce to privatize the DNS. Magaziner was charged with the task under the auspices of NTIA, a division of the DoC. On Jan. 30, 1998, he published a „Green Paper“. The paper declared competition and bottom-up processes as basic guidelines for institutional development, but, at the same time, it asserted residual authority of DoC over name and address root, and it submitted the rule-making process to the US Administrative Procedures Act (APA). The DoC had begun to think of the Internet, and particularly of the DNS, not as a „global resource“, but „an entity belonging to the U.S.“.19

The opposition which met this proposal was probably effective because it had organized itself already quite well. In 1996, ISOC and the telecommunication interests around the ITU had begun to forge a coalition. The instrument was an International Ad Hoc Committee (IAHC), representing ISOC, ITU and trademark interests. In 10/96, representatives of ITU and ISOC signed a Memorandum of Understanding (gTLD-MoU) which declared the name space to be in „public trust“. The memorandum foresaw a Geneva-based top registry and 7 new TLDs, to be administered by competitive registrars. The protocol drew a sharp response from the US government – and by NSI which saw its registration monopoly in danger. Nevertheless, a committee was charged to prepare the start of the new registry for 1/98.

The Green paper did not even mention the IAHC process. In addition, a peculiar incident gave Magaziner the occasion to make it clear to Postel that it was the US government that would decide about new TLDs: In a surprise move on Jan. 28, 1998, Postel directed the 12 secondary root servers to point to IANA’s own name server instead of the A-root server. The 8 servers placed at universities and research institutions complied, the 4 servers at US government institutions did not. Postel declared the action to be a „test“. Magaziner stated publicly that any attempt to manipulate the root would be prosecuted as a criminal offense.20 The true owner of the root zone file had declared himself.

Still, the opposition, organized around the signatories of the gTLD-MoU was strong enough to block the attempt of the Green Paper to make the DNS and its administration just another regulated utility. Another coalition had to be forged to come up with a new proposition. That proposition was called the „White Paper“, issued in 6/98. The new coalition which supported it linked DoC with ISOC and a group of 11 large businesses, led by IBM and MCI-Worldcom,21 which called itself the Global Internet Project (GIP). The „White Paper“ assumed the form of a non-binding „statement of policy“. It announced the intention of the US government to recognize a new not-for-profit corporation (NewCo) to administer the DNS (Mueller 2002: 173). Meanwhile, IANA had already formed a committee to transform itself into a new international nonprofit corporation with a board of directors, incorporated under California law, to be called International Corporation for the Assignment of Names and Numbers (ICANN).

By the fall of 1998, it became clear that IAB and GIP on one side and DoC on the other side had formed an „axis“ that seemed strong enough to withstand the opposition of those excluded from the deal, notably the larger Internet community and the international stakeholders. Right at this crucial moment, on Oct. 16, 1998, Jon Postel died from complications after heart surgery.

The process set into motion continued nonetheless. In 11/98, DoC entered a Memorandum of Understanding with the newly formed ICANN. In 2/99, ICANN was formally recognized as the new private corporation. But the balance had been lost. The basis of the hybrid construction had been DoC’s ultimate political authority on one hand, and the technical competence and authority of Jon Postel, who was to become Chief Technical Officer of ICANN, on the other hand. Now, there was an organization with a weak board of directors, selected explicitly to not continue the „DNS wars“ within the organization, a powerful registry owning the database of 75% of the world’s registrations and a government agency that had no intention to leave the privatization process to itself.22

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18 See M. Froomkin, a.a.O. (Fn 4), S. 62.
19 The quoted words are from an email by Steve Crocker, written in 1997. See M. Mueller, a.a.O. (Fn 2), S. 159.

20 See M. Mueller, a.a.O. (Fn 2), S. 162.
21 Vint Cerf had by then become vice president at MCI.
22 A separate agreement between DoC and NSI, signed in 10/98 compelled the registry to design a shared registry system, and fixed a price of $ 9 per name-year („Amendment 11“).
23 M. Froomkin a.a.O. (Fn 4) provides a detailed argument why the regulatory actions taken by ICANN with the consent of DoC are unconstitutional.
ICANN immediately began to develop an ornate „Byzantine”\textsuperscript{24} structure, which included a moderate and much contested amount of at-large representation.\textsuperscript{25}

It also took up its regulatory tasks. A Uniform Dispute Resolution Policy (UDRP) was drawn up which satisfied trademark owners. Procedures for accrediting competitive registrars were worked out. In 9/99, after strong pressure from DoC, NSI finally consented to a „Tripartite Agreement“ which gave it authority to operate the .com, .net and .org registry under a „registry agreement“ with ICANN. In return, NSI agreed to pay ICANN, which was still without regular funding. Registrar fees which were not to exceed § 2 mio. per year.\textsuperscript{26} In 11/00, ICANN announced plans for seven new TLDs. Four of them would be open TLDs (.biz, .info, .pro, .name), three of them restricted or „sponsored“ TLDs (.aero, coop, .museum).

All through the four years of its existence, the criticisms over ICANN’s internal structure never subsided. In 7/02, the board presented the draft of a new set of bylaws. Essential changes are a stronger role of the Government Advisory Committee (GAC) which reflects the increased interest and weight of non-US governments, and a stop to at-large membership representation on the board.\textsuperscript{27} The proposed changes were essentially endorsed at an ICANN General Meeting in 10/02.

Privatization of the DNS, then, is a process much larger than the actions of a single government or its agency, even if it is a US-agency. The DoC, at bottom, follows standard procedures in setting up a regulated utility with administered prices and an agency which appears to be private yet is bound by decisions taken at a public agency, presumably DoC. The US government, then, does not let go – and it will do so even less under a new political program which promotes US political and commercial interests aggressively. ICANN remains programmed by US government, and the business interests behind it. But within a DNS increasingly constrained by private exclusive rights and by international regulatory procedures, ISOC tries to preserve a kernel of intellectual commons, based on technical competence. This is its prize for a coordination effort which benefits the total community of individual, commercial and political interests.\textsuperscript{28}

The international organizations try to move the new entity into the direction of an administrative center for a new global regulatory regime. At present, they seem to be fairly successful because the IAB/IEFT community has noticed that the international regulation scene is a potential source of financing and a sophisticated forum for its self-regulation processes which have reached an astounding complexity (series of comments, and comments on comments) and which are increasingly international in their composition.\textsuperscript{29} Privatization, then, would mean the inauguration of a „public trust“ which moves control of the root zone away from the US and towards an international coalition. Within the authority of the trust organization, and within its internal dispute policy, private registries would be authorized to administer a subset of the DNS. On the other hand, national governments would gain a stronger influence on the administration of their country’s registry. At the present time, ICANN seems torn between the interests and powers of the „Geneva coalition“ including organizations like ITU and WIPO on one side and the „Washington coalition“ including government agencies and business representatives on the other side.

All these regulatory processes happened and are still happening simultaneously. They are all reactions to the economic endowment that infused the Internet since 1995. They are sufficiently diverse and countervailing to slow down the regulatory progress in administering the DNS name space to a crawl. But is DNS the only imaginable way to organize a name space?

F. The Net is a net of nets

Root zone files are fairly simple kinds of data. It is easy to set up a name system that is organized in ways different from the organization of the „legacy root“.\textsuperscript{30} The DNS root gains its value through an extreme type of network externality: the name of a host (PC or network) is contained in the root zone file which is accessible to almost all other hosts. Universal compatibility is the source of value. If a name is not „visible“ for other hosts connected to a root zone, there is no purpose in registering it. However, the technology of assigning names and numbers is sufficiently developed to offer services that include the legacy root zone file as well as the root of a further, extended name space.\textsuperscript{31}

Offers to expand the name space by registering new TLDs were made shortly after economic Internet valuation took off in 1996. The requests were taken up by NSF – not IANA – and, on counsel from DoC and PTO, they were not granted. The policy of ICANN has not been much different. In 2000, it issued RFC 2826 which stated that there should be only a single set of rules for the legacy root. The attempt of new competitors to enter the ongoing standardization process are regularly repelled. Domain names of independent competitors are recognized in some cases, but

\textsuperscript{24} See M. Froomkin, a.a.O. (FN 4), S. 71
\textsuperscript{25} Table 1: ICANN Organization Chart. Source: Mueller 2002: 187
\textsuperscript{26} In 10/2000, NSI was bought by VeriSign and now operates under this name.
\textsuperscript{27} A graph of the proposed changes can be found at www.icann.org/committees/evol-reform/second-supplemental-implementation-report-23Oct02.htm, last visited 14 January 2003.
\textsuperscript{28} A few weeks ago, ISOC succeeded in having the .org registry moved from Verisign to a nonprofit registry.
\textsuperscript{29} „The ccTLDs represent a hole in the regime, just as NSI did during most of 1999.” See M. Mueller, a.a.O. (Fn 2), S. 225.
\textsuperscript{30} This is the official name of the DNS root in documents of the Internet community.
\textsuperscript{31} The program on which the root zone files are run is called BIND (Berkeley Internet Name Domain) and dates to the days of the SRI registry in Stanford.
not in others.\textsuperscript{32} Rebuffed competitors have organized an Open Root Server Confederation (ORSC), and companies powered by new venture capital try to develop a market for name spaces. The most successful attempt up to now is New.net which created 20 new TLDs in 2001 and formed alliances with Internet providers. New.net’s domains are said to be visible to about 20% of the Internet users in the US. A coalition of major industry players, however, would „possess the economic and technical clout to establish an alternative DNS if they choose to do so.”\textsuperscript{33}

Table 2: Root server confederations; Source. Mueller 2002:55

The odds, then, of starting a successful alternative to the legacy root are low, but they are not much lower than those of competing with Microsoft Windows in the market for computer operating systems: if the technological advance contained in the alternative technology is sufficiently high (which tends to go along with lowered cost), then the incumbent natural monopoly can be eroded successfully.

The odds increase if the artificial scarcity of domain names is cultivated. The following statement could be dubbed „Mueller’s Law”:

„When the process of adding new TLDs to the incumbent root is stymied or in disarray, alternate roots grow. When there appears to be hope that the process will accept new TLDs, alternate roots wither.”\textsuperscript{34}

The incumbent root, furthermore, faces the risk of being attacked with electronic violence by those who feel excluded from the governance process. On Oct.21, 2002, a week before the start of the ICANN General Meeting, the root servers were subject to a denial of service attack which tried to put the servers out of operation through an overload of requests. Little damage was done. Noone took responsibility for the attack, but the message seemed clear: it is not too difficult to bring the DNS to the brink of break-down, if the rule of the one authority should be too restrictive.\textsuperscript{35}

And, finally, there is another, more fundamental reason why we should expect a future Internet with an entire layer of name spaces on top of the IP addresses:\textsuperscript{36} the Net is a net of nets. TCP/IP has prevailed over alternative protocols because it has its strength in linking networks, without entering into their internal operation. The self-regulatory process of the Internet community has been based on connectivity which generates „rough consensus” between all stakeholders of a common resource. In the same way, alternative name spaces can and will be linked. Our browsers will be able to recognize them. Most probably, there will be one or two major DNS services which link 80% of the hosts, and minor DNS services which offer added features, yet make their registrants visible to the major name spaces. As such competing services grow, the regulatory tasks of a global assignment authority shrink to the maintenance of a name space standards protocol. The self-regulating decision-making processes within the technical Internet community will remain essential for its innovative potential. But they will move their attention away from the layer of name spaces, on to more complex semantic issues.

G. Summary

The unusually quick development of rules and regulations surrounding the construction of ICANN allowed a study of basic principles of institutionalization within a relatively short stretch of time. To repeat:

1. new ideas and new rules of developing them emerge in small, protected research environments
2. the operational rules complementing new technological capabilities imply structural asymmetries, like hierarchies. The asymmetries lead to economic opportunities
3. economic opportunities trigger the social pressure of all interest groups related to the new resource
4. de-regulation differs from the installation of private regulatory regimes for new network resources. For privatization to work, a public core of common standards for the network and for rule-setting in the network is necessary
5. any further development is subject to an evolutionary process of selection among alternatives. The nature of the Internet suggests that institutional innovations will eliminate the pressure on the existing regulation of a single name space by adding a new layer of network connections. But it is well

\textsuperscript{32} See M. Mueller, Competing DNS Roots: Creative Destruction or Just Plain Destruction, Manuscript 2001, S. 14.

\textsuperscript{33} See M. Mueller, a.a.O. (Fn 2), S. 54.

\textsuperscript{34} See M. Mueller, a.a.O. (Fn 32), S. 15.

\textsuperscript{35} See icannwatch.org for details. One of the comments put it this way: „... an alternate root fancier trying to demonstrate why it's not a good idea to put all our eggs into one basket -- or why ICANN was wrong to rebuff Karl Auerbach's suggestion that it encourage the distribution of a CDROM „DNS in a box” kit that would contains all the pieces that one might need to build emergency DNS service. The proposed CD would have contained the configuration files for BIND plus zone files for a root and selected contents of the big TLDs, plus some sort of wildcard for in-addr.arpa ... but it would have dented ICANN's claim to being uniquely necessary, and besides the idea came from the wrong source.”

\textsuperscript{36} IP addresses may be the next constraint reached, causing scarcity reactions. See M. Froomkin, a.a.O. (FN 4), S. 21.
possible that coalitions of current rights owners are able to prevent such a step in institutional development.

Further development will also depend on a host of other, simultaneous developments. This study concentrated on just one of the three fundamental features of Internet development. It also ignored changes in the wider scientific, economic, legal and political environment: New capabilities of information transfer are invented and turned into applications at a rapid rate; the industries providing the channels and the content for the new communication media change their corporate configuration and their products; the legal, even constitutional conception of information provision is under discussion; the very notion of territorial political governance is challenged by a global information medium, leading to sharp interventions in a number of countries.

All these developments will have an impact on the future institutionalization of the Internet, just as the new medium of information distribution will impact on the evolution of the major social subsystems and their organizations.

37 See L. Lessig, The Future of Ideas, New York: Random 2001, and most of the contributions to this volume.
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