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Monkeys, Typewriters and Networks

The Internet in the Light of the Theory of Accidental Excellence

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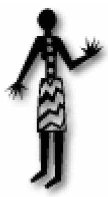

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Abstract

Viewed in the light of the theory of accidental excellence, there is much to suggest that the success of the Internet and its various protocols derives from a communications technology accident, or better, a series of accidents. In the early 1990s, many experts still saw the Internet as an academic toy that would soon vanish into thin air again. The Internet probably gained its reputation as an academic toy largely because it violated the basic principles of traditional communications networks. The quarrel about paradigms that erupted in the 1970s between the telephony world and the newly emerging Internet community was not, however, only about transmission technology doctrines. It was also about the question – still unresolved today – as to who actually governs the flow of information: the operators or the users of the network? The paper first describes various network architectures in relation to the communication cultures expressed in their make-up. It then examines the creative environment found at the nodes of the network, whose coincidental importance for the Internet boom must not be forgotten. Finally, the example of Usenet is taken to look at the kind of regulatory practices that have emerged in the communications services provided within the framework of a decentralised network architecture.

Contents

1. “f8 and be there”[*]

> It’s just the Internet.
> A million monkeys with typewriters could run it.
> *Simon Higgs*

The Internet is home to a vast assortment of quotations and experimental designs concerning monkeys and typewriters. They all expand on the theory often attributed to Henri Poincaré which contends that if an infinite number of monkeys were left to bang on an infinite number of typewriters, sooner or later they would accidentally reproduce the complete works of William Shakespeare (or even just one of his sonnets).[1]

So what, you might ask, do monkeys and typewriters, both of which might be seen as typical representatives of the pre-digital age, have to do with the Internet? And what, you might ask further, has prompted the authors of this essay to approach the question of the Internet from this rather unconventional perspective? Let us start with the second question: While this essay is the first we have written about the role of monkeys and typewriters on the Net, it is also the conclusion to a series of technical anthropology-inspired contributions which the WZB’s “Cultural Space of the Internet” project group presented between 1994 and 1998 (Helmers, Hoffmann & Hofmann 2000). Seen through a technical anthropology-tinted pair of glasses, the Internet represents a homogeneous blend of technical and social rules which shape each other reciprocally. The digital code, daily routines, turns of phrase and moral value systems found on the Net are all bound together by a common cultural framework, and jokes are a revealing and thus certainly a valid source of information for its investigation.

The first question might be answered by the theory of accidental excellence, which asserts that the creation of masterpieces is a matter of coincidence, or: “f8 and be there”.[2] In other words, in order to create something original and great, the most important thing is to be prepared and in the right place at the right time. The observation about monkeys and typewriters illustrates this position in the form of a statistical (im)probability.

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[*] Also published in German as: Monkeys, Typewriters and Networks. Das Internet im Lichte der Theorie akzidentieller Exzellenz. In: Wo wären wir ohne die Verrückten? Zur Rolle von Außenseitern in Wissenschaft, Politik und Wirtschaft. Berthoin Antal, Ariane and Camilla Krebsbach-Gnath (eds.), Berlin: edition sigma 2001, pp. 119-140.

[1] Jim Reeds hosts one such collection at [http://www.research.att.com/~reeds/monkeys.html]. The poignant story of Doctor Adam Safran’s monkey-and-typewriter experiments (which failed twice) can be found at [http://www.100monkeys.org/history.shtml].

[2] This figure of speech is, of course, mainly used by photographers. However, it may soon demonstrate its potential for generalisation in relation to the theory of accidental excellence. An initial discussion of its relevance to the topic can be found at [http://www.greenspun.com/bboard/q-and-a-fetch-msg.tcl?msg_id=0048t9].

The founding fathers of the Internet are all too aware of the significance of chance in the development of the network and its services: “There's always an absolutely incomprehensible amalgam of luck, chance and a lot of good guesses. On average we are a lot luckier than we normally admit.” (M.D.)[3]

“Monkeys with typewriters” jokes reveal themselves to be one of the ways the mathematically minded like to take an ironic look at their own work and its astounding effects. One of the most recent and also most detailed examples is a text entitled “The Infinite Monkey Protocol Suite (IMPS)”, which appeared as an informational Request for Comment (RFC 2795) by the Internet Society.[4] In actual fact, viewed in the light of the theory of accidental excellence, there is much to suggest that the success of the Internet and its various protocols derives from a communications technology accident, or better, a series of accidents.

In the early 1990s, many experts still saw the Internet as an academic toy that would soon vanish into thin air again. In fact, had the governments of Europe had their way, the TCP/IP Internet protocol (Transmission Control Protocol/Internet Protocol) would never have advanced beyond the status of clever toy. The protocol initially favoured in Europe was X.25 – a thoroughly paternalistic model of a public data network which had been inspired by the telephone system. X.25 foundered on the superior charm of a freely accessible Internet which was not controlled by any central authority. The Internet probably gained its reputation as an academic toy largely because it violated the basic principles of traditional communications networks.

The quarrel about paradigms that erupted in the 1970s between the telephony world and the newly emerging Internet community was not, however, only about transmission technology doctrines. It was also about the question – still unresolved today – as to who actually governs the flow of information: the operators or the users of the network? The dispute between the Internet and the telephony communities about sovereignty over cyberspace was mainly carried out in the relevant standardisation committees. Far away from the public eye, the rival parties defended two divergent communications philosophies which in fact have massive political as well as practical implications for communication.

In the following, we will first describe various network architectures in relation to the communication cultures expressed in their make-up. We will then

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3 This and the following initialled quotes are taken from interviews the authors of this essay carried out with Internet and Usenet pioneers within the framework of the project entitled “The Internet as a space of interaction. Net culture and network organisation in open data networks”, which was sponsored by the Volkswagen Foundation.

4 This RFC, published on 1 April 2000, describes a “protocol suite which supports an infinite number of monkeys that sit at an infinite number of typewriters in order to determine when they have either produced the entire work of William Shakespeare or a good television show.” (RFC 2795)

examine the creative environment found at the nodes of the network, whose coincidental importance for the Internet boom must not be forgotten. Finally, we will take the example of Usenet to look at the kind of regulatory practices that have emerged in the communications services provided within the framework of a decentralised network architecture.

2. The revolution against the telco circuit-switching empire

> "'Ford!', he said, 'there's an infinite number of monkeys outside who want to talk to us about this script for *Hamlet* they've worked out.'"
> *Douglas Adams*

At the end of the 1960s, when the ARPANET, the forerunner of the Internet, was being put through its first test runs, in most countries the operation of communications networks was a job for the state, which national postal and telephone administrations were still largely left to carry out unchallenged. Sovereignty over advances in communications technology belonged to a Byzantine conglomerate of national and international standardisation organisations in which the former monopolies and the manufacturers, the so-called "court purveyors" were organised. (Abbate 1999; Genschel 1995)

Seen from today's perspective, the postal authorities' monopoly was incredibly far-reaching. In addition to the network and the transmission technology, it also covered the services provided and the equipment required by the users. We only need to remember the German Bundespost's monopoly on modems, which seems completely absurd today, but was vigorously defended in the 1980s. (Werle 1990, pp. 307-308) The postal companies' unrivalled power allowed them to model the architecture of the telephone networks on their own organisational structure. As a result, the structure of the technology was just as hierarchical as the companies operating it (Genschel 1995, p. 46). The professional cultures of the manufacturing and operating communities in each country ensured that the looking-glass relationship between networks and organisational structures persisted, despite the gradual technical transformation:

> "The telephony people had an electrical engineering background. They'd come up through the AT&T training program. (…) If you came up through AT&T hierarchy, it was indoctrination. By the time you'd been there 20 years, you knew how telecommunications networks were supposed to be built and that's the way you built them." (L.C.)

The pioneers of the Internet lacked this "telephone mentality". They had studied neither electrical nor communications engineering, nor had they been trained by the telephone companies. Hence, they did not know how to construct communications networks. The Internet's trailblazers came from the world of computer science. Their interest in networks came about because of a typical bottleneck encountered in the technology of the time. It was the solution to this problem that accidentally evolved into the idea behind the creation of the Internet: resource-sharing. In the late 1960s, computing capacity was an expensive and therefore scarce commodity. Time-sharing systems, which gave several users simultaneous access to a central processing unit, were introduced so that computers could be used as efficiently as possible. The principle of time-sharing allowed computers and terminals to be networked at local level. What was missing was a data network that enabled communication between computers across large geographical distances. While it was already possible in the 1960s to transmit modest amounts of data across the telephone network, the procedures available were slow, unreliable and expensive.

Over the subsequent years, the academic principle of collective resource-sharing became a formative leitmotif in the development of the Internet.[5] The idea of creating long-range, real-time connections between computers attracted a new type of researcher and engineer who – as the immediate beneficiary – was willing to investigate new possibilities for the development of network technology:

> "The idea of placing a call was not where these people were coming from. The people originally doing the ARPANET had a very different background. They tended to be people who were highly educated in things like operating systems and physics and astronomy and mathematics, so they were facing the problem without a lot of preconceived ideas about how networks had to work. For them, the whole point was 'We're trying to collaborate on this set of physics standards, how about we arrange the communications around us that we are most likely to do what we need to do?'"(L.C.)

In the telephony world, the telephone call is the point of departure for the development of any communications network. Within this paradigm, data transfer between computers represents an exceptional case. The ARPANET and the Internet, by contrast, were developed in the computer centres of American universities, and their creation was based on the idea of seeing what would happen if exception were to become the rule.

The groundbreakers for the theory behind the architecture of the ARPANET were two scientists, who – independently of each other – had begun to develop new transmission procedures in the 1960s. In the mid-1960s, British computer scientist Donald Davies conceived of a method based on the same principle as the time-sharing system which would enable cheaper forms of data transmission in the commercial world. The American scientist, Paul Baran, by contrast, had been working since the late 1950s on military

5 For more details on time-sharing as the model for communication between computers, cf. Hellige 1996.

network architectures which would be able to withstand enemy attacks. While Davies' work focused on the civilian aim of interactive computing between enterprises, Baran was mainly interested in the survivability of communications networks. (for further details, cf. Hafner/Lyon 1996; Abbate 1999) Interestingly, despite the different objectives, the two researchers happened upon the same transmission procedure and, significantly, their ideas were also given a similar reception.

Davies' approach was centred on the principle of "packet-switching", whose main features are well known from postal and telegraph systems: Instead of transporting each message separately from the sender to the recipient, all the persons communicating share one transport path. The data flows, broken down into individual packets, all travel through the network together.[6]

Baran's ideas were mainly focused on the structure of communications networks. His argument against the design axioms of the telephone world was that survivability could be achieved if the hierarchical structure of telephone networks were abandoned in favour of a distributed and redundant system of loosely connected network nodes. If control over the data flow were distributed across numerous independent nodes, partial breakdowns in the network could be compensated for by new routes between the remaining nodes.

Seen from the military point of view, the packet-switching approach seemed to promise better survivability. From the business point of view, the method opened up the possibility of more efficient, and thus more economical, utilisation of transmission capacity. Seen from the perspective of the telephony world, however, packet-switching violated all the quality standards and organisational principles on which speech transmission was based. Consequently, there was massive political opposition to Davies' and Baran's attempts to convince the telephony community of the expediency of practical field tests:

> "Vulnerability notwithstanding, the idea of slicing data into message blocks and sending each block out to find its own way through a matrix of phone lines struck AT&T staff members as totally preposterous. (...) AT&T officials concluded that Baran didn't have the first notion of how the telephone system worked … 'So here some idiot comes along and talks about something being very simple, who obviously does not understand how the system works.'" (Hafner/Lyon 1996, pp. 62-63; Roberts 1978)

6 While telephone networks reserve a separate frequency for each data transmission between sender and recipient, in packet-switching systems the available bandwidth is divided up into portions of time. All the users then have access to the entire bandwidth and are alternately allocated "time slots" for transmitting data. The result is more efficient use of the network's capacity if the applications are not time critical. In the case of time-critical speech transmission, by contrast, reserved frequencies are the better option.

In the end, the “idiotic” idea of packet-switching was first picked up and put into practice on a larger scale by ARPA (Advanced Research Projects Agency), a U.S. Department of Defense research institute. Despite the objections of the “communications professionals” within its own ranks, too, ARPA launched and maintained the ARPANET as an experimental research network. One of the protagonists, Bob Metcalfe, tells the story like this: “Many web generations ago, the ARPA knights started a revolution against the telco circuit-switching empire and determined to destroy the death stars and their twisted pairs …” (cited at [http://cyber.law.harvard.edu/people/reagle/inet-quotations-19990709.html]).

The choice in favour of the risky packet-switching system was ultimately decided by its similarity to the concepts behind the design of computer operating systems. (Kleinrock 1978; Helmers 1996) The Internet’s pioneers were well aware of the affinity between computer culture and packet-switching technology: “Thus it remained for outsiders to the communications industry, computer professionals, to develop packet switching in response to a problem for which they needed a better answer: communicating data to and from computers.” (Roberts 1978, p. 1307)

However, ARPA was not the only organisation working on communications networks for data transmission. Computer manufacturers, in particular, but increasingly also telephone companies, worked on the development of data networks in the 1970s (cf. Werle 1990). Among the network architectures that these efforts produced, the ARPANET/Internet and the telephone companies’ public data networks came to symbolise competing network philosophies.

3. The monkeys' choice: Stupid networks and intelligent networks

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| SIMIAN/ | ----------> *         *
| MONKEY  |             *   ZOO   *
|         | <---------- *         *
-+-+-+-+-+-    KEEPER    -+-+-+-+-+-
                 /    \
                /      \
   IAMB-PENT /          \ PAN
            /            \
           V              V
    -+-+-+-+-+-     -+-+-+-+-+-
    *         *     *         *
    *  BARD   *     *  CRITIC *
    *         *     *         *
    -+-+-+-+-+-     -+-+-+-+-+-
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RFC 2795

Around the mid-1970s, the telephone companies began developing international standards for a public data network.[7] Driven by the market power of networks owned by their manufacturers, in particular IBM, the telephone companies set about introducing a standard public data network which would force computer manufacturers to provide compatible products (Abbate 1995). The result was X.25, the network architecture selected in 1976 and introduced in some European countries in the subsequent years. X.25 was based on the assumption that all the computers in a country would eventually be linked together via a centralised data network. The parallel existence of the many manufacturer-specific networks that had already been widely introduced in the 1970s was considered an awkward, but surmountable, temporary problem. Thus, X.25 took the usual "strictly uniform technology" stance in dealing with connections between private and public data networks (Werle 1990), and its technology largely did not accommodate what was considered a fringe phenomenon.

The advantage of a standardised data network for public network operators was obvious. Control over the network's operation would remain in the hands of a single organisation, which would also be free to draw up binding norms

[7] There are two official international institutions that deal with the development or standardisation of communications networks. The national telephone companies are organised in the Committee on International Telegraphy and Telephony (CCITT), a subdivision of the International Telecommunication Union (ITU), which is a UN organisation (cf. Genschel 1995). In a parallel capacity, the International Standards Organization (ISO) also deals with communications standards. The ISO has traditionally been a gathering point for manufacturers rather than operating companies.

for manufacturers and users. The idea of an independent data network administered by national postal authorities conformed perfectly to the telephone network's technical and administrative history: "The PTT's model was the telephone system, and they assumed that their monopoly on telecommunications would allow them to create a single, homogeneous public data network in each country." (Abbate 1999, p. 162)

The conditions facing those hoping to implement the ARPANET were very different. On the one hand, various computer centres first had to be persuaded to participate in a practical field experiment in packet-switching networking. On the other, the technical conditions varied across the different testing sites. The higher the number of universities communicating via the ARPANET, the more varied was the range of local networks that somehow had to be integrated in a common framework. As a result, local heterogeneity became one of the initial assumptions that flowed into the design of the ARPANET. Its creators assumed that both the locally operated university networks and the applications the ARPANET would have to support would be diverse. The common aim running through the development of the ARPANET and the Internet, therefore, was to develop a network architecture which was as undemanding and as neutral as possible both with respect to the physical infrastructure of the network and the ways in which it would be used: "Basically, reducing things to the smallest common denominator and coming up with ways of reading packets that were highly resilient in the face of failure. Regardless of what kind of technology you wanted to promote (…) you created the highest opportunity for packets to reach their destination." (L.C.)[8]

Another difference between the two types of network architecture, still disputed amongst engineers today, concerns control over the data flow. At first glance, this argument seems to be about finding the best possible method for ensuring the quality of transmission. Who or, more precisely, which authority will assume the responsibility that (the data) connections really take place? X.25, following the telephone network model, located data-flow control in the network itself – at the switching centres. This would mean that a network's operation is controlled by its administrators. The telephone companies' argument in favour of this solution is that it is the only way they can give their customers the guarantee they expect that the service is of high quality.

The Internet's creators, by contrast, consciously avoided locating control functions in the network itself. Instead, TCP/IP delegates this function to the computers of the users communicating via the Internet. The so-called "end-

[8] The Internet Protocol IP – the technical core of the Internet – accomplishes the principle of the smallest common denominator by limiting itself to the role of a virtual network linking up autonomous networks. IP defines the rules governing communication between local networks (cf. Helmers *et al.* 2000).

to-end" principle stands for a division of labour between the network and the network nodes, which reduces the network's contribution to a minimum and instead hands the responsibility for error control over to the applications running on individual computers. "Keep it simple, stupid" is the rule of thumb.

The reason for this decentralised or distributed design philosophy is not only rooted in the Internet's military background. The fact that a "stupid network" (Isenberg 1997;[9] Hofmann 1999) significantly increases the scope for development and the flexibility of the users plays an equally important role. The more modest the range of functions carried out by the network, the more comprehensive is the individual user's autonomy to act or communicate and the more flexibly the network can integrate new applications:

> "… building complex function into a network implicitly optimizes the network for one set of uses while substantially increasing the cost of a set of potentially valuable uses that may be unknown or unpredictable at design time. A case in point: had the original Internet design been optimized for telephony-style virtual circuits (…), it would never have enabled the experimentation that led to protocols that could support the World Wide Web …" (Reed *et al.* 1998, p. 2).

Because the first users of the network were also its creators, they were able to create scope for development in their architecture that they would never have been given by third parties. The most important quality of the "stupid network" is probably the fact that it avoids making prior assumptions about the way it will be used in the future. The liberal nature of the end-to-end principle is the technical prerequisite for the possibility its users have to integrate as many services and applications as they want in the Internet right up to the present day. At the same time, the stupid network is the greatest obstacle to all well-meant attempts at political regulation of content: "The Net interprets censorship as damage and routes around it." (John Gilmore)[10]

The relatively large degree of autonomy granted to the users also has a dimension related to property rights, however. Because both the ARPANET and the Internet were developed *by* research institutes *for* research institutes on the basis of state funds, public access to the network architecture was a central concern. The technical specifications were published and released for general use.[11] The non-proprietary character of the network technology is what distinguishes the Internet from all the communications networks in the telephony world. Unlike the latter, the academic world's understanding of a public data network neither provided for controlled access nor did it include a tariff system. The end-to-end principle and the network architecture's free

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9 This essay written by a former AT&T employee about the weaknesses of intelligent (telephone) network architectures attracted the disapproval of his former employer (cf. [http://www.isen.com/stupid.html]).

10 http://www.toad.com/gnu/

11 Only the infrastructure of the network, known as the backbones, was reserved for use by research institutes until the privatisation of the Internet in 1995.

source code, both typical examples of accidental excellence, each strengthened each other's unforeseeable effect. Together they are creating a public communication space which is largely shaped by its users:

> "... the end-to-end principle of the Internet is based in the common resource of TCP/IP. This is the logical layer of the Internet. It is not owned by anyone. It is a free resource, like the air. It is not consumed by use. My use of it does not deprive you of your use of it. It is therefore not subject to the tragedy of the commons: overgrazing. It allows me to launch a product on the net and not have to ask a telco, a broadcaster, a regulator, Disney or Time Warner for permission. (...) The Internet, by freeing the logical layer from private ownership, permitted enormous technical and service innovation." (Timothy M. Denton, from a mail sent on 27.03.01 to the Cybertelecom mailing list; also cf. Lemley/Lessig 1999).

4. At the nodes of the network – J. Random Hacker: "Just playing with the software …"

> Dilbert writes a poem and presents it to Dogbert:
> DOGBERT: I once read that given infinite time, a thousand monkeys with typewriters would eventually write the complete works of Shakespeare.
> DILBERT: But what about my poem?
> DOGBERT: Three monkeys, ten minutes.
> *Scott Adams*

The ARPANET was not the only network project of the 1960s based on the concept of time-sharing, which sought to use remote data transmission to also provide geographically distant users with access to the capacity of high-performance computers. The primary objective was balanced utilisation of resources; exchange of information and interaction between individuals was only a negligible consideration, for the computer was seen more as a tool and machine than as a medium. But once the network was up and running, this relationship was soon turned on its head and hardware- and program-sharing took a back seat to informal communications between the researchers involved in the project. After the first e-mails were exchanged between two ARPANET nodes in 1972, by 1973 electronic mail already accounted for three quarters of the data flowing through the network. (Hafner/Lyon 1996, p. 194)

> "The ARPANET was not intended as a message system. In the minds of its inventors, the network was intended for resource-sharing, period. (...) But once the first couple of dozen nodes were installed, early users turned the system of linked computers into a personal as well as a professional communications tool. Using the ARPANET as a sophisticated mail system was simply a good hack." (Hafner/Lyon 1996, p. 189)

The decentralised and open architecture of the ARPANET and later the Internet granted its users a scope for creativity which gave birth not only to electronic mail but also to a host of other services and applications. Internet Relay Chat (IRC), the virtual playgrounds of MUDs (Multi-User Dungeons) and even the World Wide Web are ultimately achievements that are best characterised as "a good hack". These applications were not invented and designed by developers *for* users who were looking for innovative and commercially viable technologies and products, but by developers *as* users. The innovative milieu of open data networks is very substantially shaped by the hacker community, which is not given the designation as a professional culture it deserves.

The hacker culture combines technical virtuosity, a sense of aesthetics which tends towards the nonsensical, and a pronounced tolerance for things which would be considered extraordinary in the real world with the desire to be someone special, all of which culminates in an all-embracing lifestyle with the computer at its centre. The hacker culture has developed its own rules and rituals, heroes and rogues, modes of thought and behaviour, sub-cultures, and a language which is only barely comprehensible to outsiders.[12] Hackers are considered outsiders by others and generally see themselves as an elite. The way they apply their technical skills is more similar to an artist playing with his material than to an engineer pursuing a specific goal. The work of art they hope will make them famous is known as their "hack", while "to hack" is: "To interact with a computer in a playful and exploratory rather than goal-directed way. 'Whatcha up to?' 'Oh, just hacking.'"[13]

The hacker culture and what it does cannot be narrowed down to a specific programming environment or specific programming tools. However, as regards the innovations emerging from the nodes of the network since the birth of the Internet, the UNIX operating system, in particular, has achieved a significance as a local programming environment which can hardly be exaggerated. Without UNIX, the Internet would not exist in the form it does today. One of the ironies of Internet history is the fact that the development of UNIX began at AT&T Bell Labs. Bell Labs employed their own computer scientists who worked on developing operating systems for the company

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[12] On hacker culture cf. Helmers 1996; Helmers/Haase 1998; and Turkle 1984, pp. 241-293. For a compendium of hacker slang and hacker folklore, cf. The Jargon File 2000.

[13] [http://www.elsewhere.org/jargon/html/entry/hack.html].

computer centre. The quest for an interactive operating system for on-site time-sharing resulted in UNIX, and a familiar pattern had once again been repeated: Hackers created a toolkit fashioned according to their own needs and problems which any skilled user who was interested was free to use and extend with his or her own contributions.

> "UNIX is unique in that it wasn't designed as a commercial operating system meant to run application programs, but as a hacker's toolset, by and for programmers. (…) When Ken Thompson and Dennis Ritchie first wrote UNIX at AT&T Bell Labs, it was for their own use, and for their friends and co-workers. Utility Programs were added by various people as they had problems to solve." (Peek *et al*. 1997, p. 1)

> "UNIX was (...) treated by the Bell system as 'Oh, just something we happen to do for our own internal use. You can have a copy if you want, but if you got problems, don't bother us.'" (Henry Spencer, cited in Hauben/Hauben 1997, p. 140)

In the computer science faculties of the universities where the UNIX operating system quickly gained a foothold, generation after generation of computer science students had to do battle with UNIX's source code. This turned academic institutions into UNIX development centres. One of the most important was the University of California at Berkeley, which provided the world-wide academic computer community with Berkeley UNIX for free. It was at Berkeley that a UNIX version (4.2 BSD) was written with ARPA's support in the early 1980s in which the ARPANET communications protocol TCP/IP was already "built in". This meant that an operating system capable of networking was now available, and commercial workstations were also equipped with it from 1983 onwards.

> "The first Sun machines were shipped with the Berkeley version of UNIX, complete with TCP/IP. When Sun included network software as part of every machine it sold and didn't charge separately for it, networking exploded." (Hafner/Lyon 1996, p. 250)

As UNIX computers equipped with TCP/IP spread through universities, telephone companies and (computer) firms, an expanding group of potential Internet hosts and users developed outside the ARPANET research community. From 1983 onwards, TCP/IP became the only binding protocol on the ARPANET itself. Chance had taken on a tangible form.

5. Regulating the new medium: Controlling the content of Usenet

> Come to think of it, there are already a million monkeys on a million typewriters, and Usenet is NOTHING like Shakespeare.
> *Blair Houghton*

Alongside the Internet, a host of what were known as grassroots networks[14] also emerged in the late 1970s and early 1980s. One of these was Usenet. Usenet was developed in autumn 1979 on the east coast of the United States as a hack by three computer science students who created a communications service for a new version of the UNIX operating system. “We wanted something different in Seventh Edition [of the UNIX operating system] when the Code changed.” (S.B.)

Their program used the UUCP (Unix-to-Unix copy) transmission procedure for sending messages to subject-specific newsgroups. The initial transport medium for the “News” was the telephone network. With the help of modems, the messages were exchanged at regular intervals between the sites involved in the form of compressed data packets. The possibility of transmitting data using UUCP, which had been developed at AT&T Bell Labs and had been a standard component of UNIX since 1978, had already given the UNIX community e-mail, originally called “network mail”. Now, thanks to Usenet, they had a “network news” service as well.

Initially, grassroots networks like Usenet often grew more rapidly than the ARPANET because there were no restrictions on access. The ARPANET had 113 network nodes in 1983, compared to 600 Usenet sites (Hafner/Lyon 1996, p. 249; Gene Spafford, cited in Hauben/Hauben 1997, p. 44). TCP/IP connections later increasingly replaced UUCP as the traditional transport medium for the News and, as the years passed, Usenet became one of the most popular communications services on the Internet. It is thus no coincidence that it has often played a prominent role in battles against institutional and state efforts to tame the Net.[15]

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[14] On grassroots networks cf. Abbate 1999, pp. 200–205, and Rheingold 1993, pp. 110–144.

[15] Some readers may remember how, at the end of 1995, Bavarian law enforcement authorities instructed a commercial online service to block its subscribers’ access to certain Usenet newsgroups, which led to an international wave of protest on the Net. In the United States, Usenet, with its allegedly primarily pornographic content, provided substantial legal advice during the controversy about the “Communications Decency Act”, which was passed by the Senate in June 1995 and later deemed unconstitutional by the Supreme Court and revoked.

From the moment of its conception, Usenet shared the same decentralised network philosophy that underlies the Internet. To the exclusion of any institutional authority, responsibility for drawing up the constitutive rules for Usenet use was left to its day-to-day operation and its users (cf. Hoffmann 2000 for more detail). The autonomy of the individual network nodes and their administrators was of primary importance: “Every administrator controls his own site. No one has any real control over any site but his own.” (Moraes 1999) A network of this kind is the ideal medium for a culture of mavericks who maintain a close web of relationships within their own world and in the process grant each other huge leeway.

Written guidelines for behaviour first appeared on Usenet in 1983 in the form of “Netiquette” (Djordjevic 1998, p. 17). The history of debates about how to deal with unwanted content, or that which is considered harmful, is as old as the Net itself. Controversy about which types of communication should be permitted or excluded and which strategic approaches to regulation of content seemed legitimate was certainly never forced on the Net by “external” intervention – despite the declared principle of “free flow of information”. The following three examples illustrate different solutions which have been proposed in the quest for rules and practical ways to regulate an open and decentralised network.

5.1“… putting the bad stuff in one place”

The News was still extremely small in 1981, consisting of an average of only 20 articles per day (Hauben/Hauben 1997, p. 44). Messages which were not to everyone’s taste thus stood out all the more. The first bone of contention turned out to be dirty jokes. According to one eye witness:

> “The very first flap over that sort of stuff happened in 1981. We had a group, *net.jokes* – I guess I’ve always been involved in that. And *net.jokes* had some dirty jokes in it. Someone said, ‘Well, you know, not everyone wants to read these dirty jokes and we want to sort of divide it out. So let’s make a newsgroup for just the dirty jokes and jokes in bad taste. We’ll just call it *net.jokes.q*, which means <questionable taste>; and if you know, you know; but if you don’t know, we’re not advertising that here’s where to go to find jokes in questionable taste.’” (B.T.)

The creation of a new group by partitioning the content of the old group seemed an elegant solution at first. By giving the objectionable messages their own forum, the friction in the original group was reduced without any need to resort to censorious intervention. However, a serious disadvantage soon emerged: Not everyone immediately realised what was hidden behind the name *net.jokes.q*:

> “The downside was that people could subscribe to *net.jokes.q*, then, and not know what they were getting into. The story went that someone’s secretary at a company on the net had subscribed to *net.jokes.q* and had read some really

> sick joke. Then it had come to the attention of people in the company that there was this newsgroup full of sick jokes, and why were we doing this? They shut down their feed because of that." (B.T.)

After the selection and concentration of questionable content had turned out to be a double-edged sword, the new group was discontinued and the Usenet community learned an important lesson: The preferences of computer nerds are not necessarily appreciated by all the other users.

> "People decided that it was a mistake putting the bad stuff in one place. Only, unfortunately, us techno-nerds think that's a good solution. We think, 'Well, clearly, we've put it in one place so now you can select whether you get it or not.' But the truth is, what it means is that if you put all the bad stuff in one place, you concentrate it, and those who would be bothered by it don't at all get impressed at the fact that you've gone to this effort to make sure that they can turn it off; they just come and they see it all in one place and they take offence, and it just drives people wilder. So *net.jokes.q* was probably the first group to be deleted, that I know of. And it was deleted because people realized, 'If we put it all in one place, it just causes more problems, not less. Better to take the offensive jokes, mix them in with the rest and say, <This is the real world. There's dirty jokes and there's – well, there aren't that many clean jokes – but there's *some* clean jokes. You get them all together and it's part of the ordinary world.>'" (B.T.)

5.2 Kill files

As Usenet expanded, the problem of objectionable content was soon overshadowed by the question as to how individual users could handle the growing number of messages sent daily. The problem was no longer just the selection of specific content, but the general issue of selection by individual users. The options open to Usenet users depend primarily on the functions offered by their newsreaders. These programs are used to download the desired newsgroups from one of the Usenet sites, to browse through the News, to read individual articles and to send other articles. In 1984, when Usenet counted around 900 sites and over 200 articles a day, a newsreader software which included a filtering option known as "kill files" appeared. The author of the newsreader recalls:

> "I invented the kill files. It was partly because there was too much and partly because even back then there were people on whose articles people wanted to avoid reading. There were flame wars from the beginning and so people would get mad enough at somebody or would just get tired of reading them and they wanted to have some way of saying 'I just don't want to read anything by this person anymore.' So I put in kill files and they were very warmly received. Basically it took people up to another level being able to stay reading their interesting newsgroups without having to give up on them because there was just too much stuff." (L.W.)

Kill files are lists of names and words compiled by the users. The newsreader searches through all the new articles and, when displaying the contents of a newsgroup on the computer screen, automatically filters out those messages that contain the specified terms. In later versions the filter options allowed not only negative, but also positive selection.

> "Eventually the kill files were refined to where you could not only select things that you didn't want to read but also say by default, 'I don't want to read stuff but show me stuff made by such and such an author or that contains such and such a keyword.' That was all based on regular expressions so it was very powerful. For many years I ran a filter of my own on news, mostly to find things I was interested in, in newsgroups I don't read, rather than the other way around. I had a rule file that was 50 or 70 rules for things you might be interested in. Up until a year ago I was pretty famous for being one of the people who did that, what do they call it? Kibozing was one name for it, after Kibo, you know Kibo, he did that. I sort of invented it about the same time but he got famous for it." (L.W.)

Kill files proved to be a success and Usenet users still happily implement them. Not only do kill files increase the user's range of options, but they also reinforce the network policy concept of complete local control at the receiver end.

> "I think kill files contributed to the notion of local control over the news. They also contributed to the notion that Usenet itself is an amoral medium, it should not be trying to enforce standards of any sort, however you want to define them. Rather it's just the ground of all being and you propagate the stuff all over and then each individual site can control what it gets. You can control what you see if your newsreader is smart enough. There have always been these grand proposals for how to control the network, how to fix this or fix that from the beginning. And most of them fall down because they require the co-operation of more people than are willing to co-operate." (L.W.)

5.3 Recipes, drugs and Rock n´ Roll

In 1986, there were around 2,500 Usenet sites exchanging an average of 500 articles daily. The growing volume of news led to one of the few cases of organised change on Usenet. The administrators of a number of larger sites got together in order to restructure the name space on Usenet. This group, known as the "Backbone Cabal", agreed to replace the original single-level name space with several hierarchies, so that the individual newsgroups could be classified under several higher-level subject areas. Thus, newsgroups dealing with leisure-time activities, for example, were to be grouped in the rec (recreational) hierarchy, while groups dealing with computer technology would be placed in the comp hierarchy. This rearrangement would allow the administrators of the individual sites to make a pre-selection at the hierarchy level when receiving the News.

The reorganisation of Usenet name space ("The Great Renaming") was in fact carried out as planned, and was accompanied by numerous skirmishes about the renaming of individual newsgroups. For example, the *mod.recipes* group, whose members exchanged cooking recipes, was to be renamed *rec.food.recipes*, much to the chagrin of the group's moderator. Another News administrator was annoyed by the Backbone Cabal's refusal to set up a group called *rec.drugs*. Against this background, the two administrators created an alternative distribution channel which was independent of the Backbone sites – the "alt.net".

> "The famous barbecue at which the alt net was created was held at G.T.'s Sunset Barbecue in Mountain View / California on May 7, 1987. John Gilmore and I were both unhappy with the decision making process of the 'ordinary' net. John was distressed because they wouldn't create rec.drugs, and I was distressed because they wanted to force me to adopt the name 'rec.food.recipes' for my recipe newsgroup. Gordon Moffett of Amdahl also sat with us. (...) We set up a link between us, (...) and we vowed to pass all alt traffic to each other and to nurse the net along. By the end of May the groups *alt.test*, *alt.config*, *alt.drugs*, and *alt.gourmand* were active." (Brian Reid, cited in Hardy 1993)

On the alt net, also known as the "alternative backbone", any user is entirely free to create a newsgroup on a self-chosen subject under whichever name he or she desires. The newsgroups on the alt net were soon integrated into Usenet under the alt hierarchy and were surprisingly successful.

> "My machine was sort of the center of the alt backbone, and it stayed that way for more than a year. I think we never got propagation in that time to more than about 40% of the Usenet, which was a little bit of a disappointment, but fine. But then something happened that changed all of that. Brian Reid for some reason created *alt.sex* and then, simultaneously *alt.rock&roll*. *Alt.sex* turned out to be a very popular topic. Within six months of the creation of *alt.sex* and a couple of its subgroups, we had propagation to like 80 or 90% of the Usenet." (J.G.)

The establishment of the alt groups on Usenet showed its creators that there was only a loose coupling between Usenet software and the social structures of network organisation. The software allowed a different control regime to exist in each of the Usenet hierarchies – eventually all under the one roof.

> "The central insight of all was that the software existed independently of the social structures around it, and that we could use the same software with an explicitly different set of social structures and social conventions, and that would be okay. There was almost no technical hacking involved. It was just a social hack." (J.G.)

6. “Nobody is close enough to affect everything …”

```
KEEPER Message Request Codes (ZOO-to-SIMIAN):
CODE  NAME         DESCRIPTION
+--------------------------------------------------+
| 0 | RESERVED   | Reserved                        |
+--------------------------------------------------+
| 1 | STATUS     | Determine status of monkey      |
+--------------------------------------------------+
| 2 | HEARTBEAT  | Check to see if monkey has a    |
                   heartbeat                       |
+--------------------------------------------------+
| 3 | WAKEUP     | Wake up monkey                  |
+--------------------------------------------------+
| 4 | TYPE       | Make sure monkey is typing      |
+--------------------------------------------------+
| 5 | FASTER     | Monkey must type faster         |
+--------------------------------------------------+
| 6 | TRANSCRIPT | Send transcript                 |
+--------------------------------------------------+
| 7 | STOP       | Stop all monkey business        |
+--------------------------------------------------+
```
RFC 2795

History repeats itself on the Internet, too. The same self-regulation measures that have been discussed since the early days of Usenet can now also be seen on the World Wide Web. Once again, there is an attempt to differentiate between the ethically reprehensible and the socially acceptable, and if the former cannot be disposed of entirely, then one tries to at least create a separate compartment for generally undesirable content. A current example is the proposal – rejected to date – to create separate name zones for children (.kids) and for pornography (.xxx).

In addition to the proposals, the arguments are also repeating themselves. Which software would be secure enough to block specific user groups' access to Internet content which is freely accessible to others? And, more importantly, which Internet authority would have enough legitimacy and power to ensure that all the content really does end up in the same compartment? Would the so culturally and politically heterogeneous Netizens even accept such an authority? Would one not have to expect that the undesired side-effects of technical or administrative forms of centralised Internet regulation would greatly outnumber the advantages?

The Internet's creators fought and won (at least for the present) the battle against the telephone companies for control over cyberspace on technical ground. Hence they are relaxed about efforts towards hierarchical regulation of the network's distributed operation: “Because it's global, nobody is close enough to affect everything.... I think [policy folks] are going to have a lot of trouble internalizing the fact that just because they want it really bad and because they write it down, it doesn't make it sell." (M.D.)

The consequence of the forms of local control that are dominant on the Internet is by no means total lawlessness. But every innovation and every effort seeking translocal coordination requires the active agreement of every single site. The decentralised architecture which makes the network immune to censorious interventions in data flow does not guarantee "free flow of information" for all eternity. The cooperative anarchy of the Internet is not primarily the expression of an ethic of tolerance in the name of freedom of information, but of a pragmatic awareness of the limits of the participants' will to cooperate.

And so our provisional answer to the question as to whether the flow of communication will now be governed by the network operators or the users is this: By neither. It could also, more often than one thinks, turn out to be a matter of chance.

References

Abbate, J. (1999): *Inventing the Internet*. Cambridge, MA: MIT Press.

Abbate, J. (1995): "'Open Systems' and the Internet." In: [*http://www.wam.umd.edu/~abbate/papers/4S.html*].

Djordjevic, V. (1998): *Von 'emily postnews' zu 'help manners'. Netiquette im Internet*. Discussion paper FS II 98-105, Wissenschaftszentrum Berlin für Sozialforschung. Berlin.

Genschel, P. (1995): *Standards in der Informationstechnik. Institutioneller Wandel in der internationalen Standardisierung*. Frankfurt: Campus.

Hafner, K.; Lyon, M. (1996): *Where Wizards Stay Up Late. The Origins of the Internet*. New York: Simon & Schuster.

Hardy, H. E. (1993): "The History of the Net." Master's Thesis. School of Communications, Grand Valley State University, Allendale. In: [*http://www.ocean.ic.net/ftp/doc/nethist.html*].

Hauben, M.; Hauben, R. (1997): *Netizens. On the History and Impact of Usenet and the Internet*. Los Alamitos: IEEE Computer Society Press.

Hellige, H. D. (1996): "Leitbilder im Time-Sharing-Lebenszyklus: Vom 'Multi-Access' zur 'Interactive On-line Community'." In: Hellige, H. D. (ed.): *Technikleitbilder auf dem Prüfstand. Leitbild-Assessment aus Sicht der Informatik- und Computergeschichte*. Berlin: edition sigma, pp. 205-234.

Helmers, S. (1996): "Kampfmaschinen. Computer als Objekte von Virtuosenleidenschaft." In: *Anthropolitan*. Themenheft: "Computerwelten", Vol. 4, pp. 15–22.

Helmers, S.; Haase, A. (1998): "enter hack mode". (Quicktime version of a 7 min amiga video for 1). Cyberfeminist International, Hybrid Workspace of documenta X. In: [*http://duplox.wz-berlin.de/docs/hack/*], September 1997.

Helmers, S.; Hoffmann, U.; Hofmann, J. (2000): *Internet ... the Final Frontier: An Ethnographic Account. Exploring the Cultural Space of the Net from the Inside*". Discussion Paper FS II 00-101, Wissenschaftszentrum Berlin für Sozialforschung. Berlin.

Hoffmann, U. (2000): "Neues vom Baron Münchhausen. Die institutionelle Selbstorganisation bei der Bildung virtueller Gruppen im Usenet." In: Thiedeke, U. (ed.): *Virtuelle Gruppen – Charakteristika und Problemdimensionen*. Opladen: Westdeutscher Verlag, pp. 168–187.

Hofmann, J. (1999): “Deadheads, Netheads, Ringheads, Bellheads.” In: Spiegel Online: [*http://www.spiegel.de/netzwelt/telekommunikation/0,1518,33987,00.html*]

Isenberg, D. S. (1997): “Rise of the Stupid Network – Why the Intelligent Network was once a good idea, but isn't anymore. One telephone company nerd's odd perspective on the changing value proposition.” (full version). In: [*http://www.hyperorg.com/misc/stupidnet.html*].

[The] Jargon File 4.2.2. In: [*http://www.elsewhere.org/jargon/*], 20. August 2000.

Kleinrock, L. (1978): “Principles and Lessons in Packet Communications.” In: *Proceedings of the IEEE* (Special Issue on Packet Communication Networks), Vol. 66, No. 11, pp. 1320-1329.

Lemley, M. A.; Lessig, L. (1999): “Written Ex Parte to address the question of ‘open access’ and its relationship to the architecture of the Internet.” before the Federal Communications Commission, Washington. In: [*http://cyber.law.harvard.edu/works/lessig/lem-lesd.pdf*].

Moraes, M. (1999): “What is Usenet?” In: [*ftp://rtfm.mit.edu/pub/usenet/news.announce.newusers/*].

Peek, J.; O'Reilly, T.; Loukides, M. *et al*. (1997): *UNIX Power Tools*. (2nd ed.). Cambridge, MA: O'Reilly.

Reed, D. P.; Saltzer, J. H.; Clark, D. D. (1998): “Comment on Active Networking and End-to-End Arguments.” In: *IEEE Network*, Vol. 12, No. 3, pp. 69-71. In: [*http://web.mit.edu/Saltzer/www/publications/pubs.html*].

RFC 2795: S. Christey, “The Infinite Monkey Protocol Suite (IMPS)”. In: [*http://www.rfc-editor.org/rfc/rfc2795.txt*], 1 April 2000.

Rheingold, H. (1993): *The Virtual Community. Homesteading on the Electronic Frontier*. Reading, MA: Addison-Wesley.

Roberts, L. G. (1978): “The Evolution of Packet Switching.” In: *Proceedings of the IEEE* (Special Issue on Packet Communication Networks), Vol. 66, No. 11, pp. 1307-1313.

Turkle, S. (1984): The Second Self. Computers and the Human Spirit. New York: Simon and Schuster.

Werle, R. (1990): *Telekommunikation in der Bundesrepublik. Expansion, Differenzierung, Transformation*. Frankfurt: Campus.

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