1 Internet economics, digital economics

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1.1 Introduction

Since the "privatization" of the Internet in the United States in the mid-1990s, the network of networks has developed rapidly. This has been matched by a wave of innovation in information technology, as well as in many areas of its application, giving rise to a multitude of on-line services and new "business models". In the same period, the United States experienced unprecedented non-inflationist growth. As a result of this conjunction, certain commentators considered the Internet as the heart of a new growth regime, qualified as the "new economy". This contributed to the creation and then amplification of a speculative bubble around businesses involved in the Internet.

As these unfounded hopes necessarily met with disappointment, the euphoria disappeared at the turn of the 21st century. At the same time, the forecasts of a certain number of economists were confirmed a posteriori. These forecasts had highlighted, firstly, that the use of information and communication technologies (ICTs) does not lead *ipso facto* to an improvement in microeconomic performances (Brousseau and Rallet [1999]); secondly, that information goods and services do not escape from the fundamental rules of economics (Shapiro and Varian [1999]); and thirdly that American growth in the 1990s was not necessarily founded on the innovations linked to the use of ICTs exclusively (Gordon [2000], Cohen and Debonneuil [2000], Artus [2001]). However, these analyses do not claim that nothing changes with the large-scale dissemination of these digital networks and their associated practices. By extending earlier theories (e.g. Machlup [1962], Bell [1973], Lamberton [1974], Porat [1977], Jonscher [1983, 1994]), they simply pointed out that the changes are slower and more complex than is generally admitted,

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precisely because they have a fundamental character. David (1990, 2000b) refers to digital technology as *general purpose technology* whose impact on economic performance is linked to transformations in practices in all dimensions of economic and social life: norms of consumption, modes of production, organizational forms, and so on. In the same way as the great inventions at the end of the 19th century, this technology will radically change economics, spark growth and transform the face of society, but only in the long run.

In this long-term perspective, the Internet is situated at the confluence of two older economic evolutions: on the one hand, that of telecommunications networks, created in the 19th century and becoming electronic in the second half of the 20th century; on the other, that of computers, beginning during the Second World War. The transformation of societies, under the influence of these technologies, had been set in motion well before the sudden emergence of the network of networks that therefore does not mark the beginning of ICT-related transformations. Conversely, it is premature to consider it as the culmination of this technology. Given that the majority of the trajectories of change have barely begun, it is difficult to pronounce judgment on the final result of movements which are still emerging and unstable. However, the Internet, and more generally speaking digital networks, possess specific properties which leave their mark on a number of phenomena for which they become the basis: information processing and circulation, commercial transactions, organizational coordination, network management, and so on.

The ambition of this book and of this chapter is to highlight the aspects of the Internet and digital technologies that appear to be truly innovative, in terms of both economic practices and analytical concepts. Since the 1980s, telecommunications networks have constituted a melting pot producing, on the one hand, new practices in the management of "public facilities", the regulation of competition, the design of network services, etc., and, on the other, new analytical concepts such as the notions of "contestable" market, "yardstick" competition, "incentive" pricing, etc., which were then applied to all industries. Similarly, the Internet is today giving rise to innovative practices that call for renewed conceptualization.

There are three principal reasons explaining the Internet's double role as a catalyst of practices and theories. First of all, the Internet is a planetary federation of digital networks, whose technical potential, notably the ability to act as a medium for very differentiated modalities of information management, induces a growing "digitization" of activities: access to these interconnected and flexible networks incites

economic actors to increase the informational intensity of their services and to multiply their informational exchanges. Secondly, the logic of this modular and decentralized network, serving as a platform for the provision of services founded on information and innovation, deployed in a global space, makes it an archetype of contemporary economies, where industry tends to be organized according to a flexible assembly model thanks to standardized interfaces; where competitiveness is strongly associated with the ability to innovate; where products and services are undergoing an increase in informational intensity; where the economic space is more and more transnational, etc. Finally, the organizational innovations induced by the digital networks federated by the Internet are gradually spreading to the entire economy.

We shall highlight the fact that one of the Internet's central characteristics is the ability it grants economic agents to very finely control the information they exchange in accordance with the individual preferences of the issuing and receiving parties. Moreover, this control can be totally decentralized through the use of standardized interfaces. This double characteristic founds both the specificity of the Internet as a network and that of the digital economy it serves. Other frequently mentioned characteristics such as the global and multimedia nature of the Internet or its impact on information costs are certainly important factors, but they probably do not alone justify giving such marked attention to Internet economics.

This chapter is divided into three parts. In the first part, we will recall some of the factual principles and elements clarifying the nature of the Internet network as well as the issues it raises for economic activities. In the second part, we will seek to specify the link between the "internal" morphology and economics of the Internet network and the new types of relations and exchanges which accompany the development of this network, which we will refer to using the term "digital economics". We will show that this link has more to do with engendering than with causality. To put it in other terms, rather than simply considering the Internet as a technological tool, a determining factor in a new type of economic development, it is more productive to analyze Internet economics *stricto sensu* as the seed or the incubator of a future digital economy where the ability to manage information in a decentralized and customized way is massively exploited. In the final part, we will seek to draw up a research program covering the issues raised by the multifaceted development of the Internet and the concomitant emergence of digital economics. We will explain how the different chapters of this book, as a contribution to the flourishing corpus of publications devoted to Internet economics, constitute the pieces of a puzzle which is yet to be completed, and whose final form is just beginning to emerge.

1.2 Internet economics: some principles and facts

1.2.1 The "end-to-end" principle

The Internet is not a network *per se* but a network of networks that relies on common standards allowing machines that process information digitally to "interoperate". More precisely, Internet standards enable the totally decentralized interconnection of computerized networks. On the Internet there is no technical discrimination between the resources dedicated to the administration of the network and the terminals that process the information carried, as is usual in a traditional telecommunication network such as the telephone network, where terminals process information while the administrative equipment of the network – switches – connects information flow and transmission (Curien and Gensollen [1992]). On the Internet, information-processing devices (IPDs) connected to the network are simultaneously terminals and routers. In addition, the use of a standard interface and a generic addressing system creates a sort of "meta-network" presenting itself as a homogenous and seamless system to the user.

The devices interconnected by the Internet, essentially computers, process information digitally. The network organizes communication between these machines on the basis of the "client–server" model. The "client" sends requests to the "server", which processes them and then sends a response. Any device connected to the Internet can be both a client and a server. This is notably the case for the most common applications on the Internet, e-mail and the Web. Sending an e-mail involves asking the server (recipient) whether he agrees to receive information. If he does, the client (sender) sends the information. In practice, e-mail servers carry out these operations. Unlike user terminals, the servers are permanently connected to facilitate data flows. Similarly, when consulting a website, the visitor sends a request to a computer in which information is stocked. The information server sends back HyperText Markup Language (HTML) codes to the client that enable the computer to re-build pages on the client's screen. Generally speaking, independently of the application being considered, requests and responses are broken down into data packets, which their senders and recipients identify and which circulate within the network where they are relayed by routers. After the packets are transmitted and received, the receiving terminal reconstitutes the original programming lines containing an informational content or instructions to the machine that pilots it from a distance. The following elements must be in place for everything to function correctly:

- All IPDs connected to the network must be clearly identified so that the data packets actually reach the addressee; this identifier is the Internet protocol (IP) number.
- An addressing language has to allow users to formulate their request with a suitable server: domain names (www.identifier.com) make up the visible part of this addressing system; servers known as domain name systems (DNS) transform these addresses close to "human" language into machine addresses (IP addresses).
- Common communication protocols are required for communication and routing between IPDs; the Internet protocol is at the center of a vast group of technical standards responsible for communication and interoperability among network components.
- The machines must use compatible programming languages in order to code and decode requests and responses transmitted between clients and servers; in this respect, HTML language is the foundation stone of the Web, enabling different kinds of IPDs to exchange texts, images, data and sounds.

Thus the very existence of the Internet stems from the use of a generic addressing system (IP numbers and domain names) and standards (Internet protocol and HTML). These form the basis of interoperability between various sub-networks. The technical regulation of the Internet therefore is essentially based on the management of these resources with the goal of guaranteeing interoperability. Three main organizations carry out this regulation:

- ICANN (Internet Corporation for Assigned Names and Numbers), set up in 1998, is a non-profit organization based in the US. Under a delegation contract with the US government (Department of Commerce), ICANN is responsible for organizing the distribution of IP numbers and domain names. In both cases, the addressing system is a hierarchical one in which a limited number of roots (e.g. .com, .org or .net) enables the creation of addresses. This hierarchy makes it possible to delegate the practical distribution of addresses among entities that manage portfolios of addresses according to their own rules. ICANN therefore supervises two distinct functions: the distribution of IP numbers that is ensured by the administrators of the subscriber networks (the Internet service providers – ISPs) and the distribution of domain names, by setting the features of the available roots (first-order domains, or suffixes, such as .com, .fr, etc.) and by selecting and supervising the organizations in charge of collecting and registering users' claims.

  ICANN's importance derives from its power over the private company Verisign (formerly Network Solution Inc. – NSI), the entity responsible

for the technical management of the domain names' *root computer*. This server contains the source file able to translate the domain names into IP addresses. ICANN can therefore "erase" addresses or entities that do not comply with the rules it sets out and thus exclude them from the Web. This is why ICANN is one of the possible sources of a non-technical governance system of the Internet.

- The IETF (Internet Engineering Task Force) is de facto the entity responsible for the standardization of the communication protocols: the Internet protocol system. It has no legal status and is only a working group of the Internet Society (ISOC). The latter is a not-for-profit organization, founded by some of the "inventors" of the Internet, that constitutes a forum of reflection and a tool of influence aimed, notably, at promoting the development of an open and efficient network, which would benefit the greatest number.
- The W3C (World Wide Web Consortium) is responsible for the standardization of the multimedia languages used on the Internet. It is a kind of club where access is reserved to those organizations that can afford the relatively high membership fee.

These three organizations are, however, not really regulating bodies.

- They do not combine the three faculties of setting rules, supervising operators and users, and imposing sanctions for lack of compliance or for practices going against the principles which they stand for, such as fair competition, public freedom and secure operations. Indeed, the IETF and the W3C constitute mechanisms for sharing technical developments in a manner similar to that with open source software. Their standards are not mandatory for Net users and operators; however, they do facilitate interoperability. ICANN certainly has formal powers but it does not have sufficient means to supervise the Web, which would make the exercise of its prerogatives efficient and independent.
- Furthermore, the legal status of each of these organizations is unclear, or even non-existent in the case of the IETF. In principle, they are responsible for the traditional regulation of the World Wide Web. However, they are subject to American law and operate under contract with the United States government. Their functioning and membership principles do not guarantee their independence, which weakens their authority and casts doubt on the legitimacy of their decisions. The credibility of the norms they set and the decisions that they make is affected as a result because their enforceability is not guaranteed.
- Finally, the scope of these organizations' jurisdiction is unclear. In principle, they are responsible only for the technical regulation of the

Internet, the IETF and the WC3 in particular. However, for technical and historical reasons, the regulation of the network and its modalities of use are closely linked. Indeed, the regulatory bodies decide for or against authorizing the development of particular categories of services depending on the way in which the interoperability standards, the security mechanisms and the mechanisms for managing priorities are defined. Moreover, as Leiner et al. (2000) point out, there is a strong tradition in the Internet community to set ethical, social and economic norms in addition to technical rules. For example, until 1995, *Netiquette*, Net ethics, prohibited any commercial use of the Net.

1.2.2 Competition and complementarities among regulation frameworks

The regulatory bodies of the Net appear very different from the traditional mechanisms for regulation and international standardization, such as, notably, the International Telecommunication Union (ITU), the International Standard Organization (ISO) or the International Electrotechnical Commission (IEC). When the Internet was "invented", it was decided not to go through these different authorities for four principal reasons: firstly, they are known for being slow in elaborating standards, which seemed incompatible with the high rate of innovation in technologies linked to the Internet; secondly, these bodies did not immediately grasp the originality and the power of Internet standards and, moreover, certain aspects of the Internet put it into competition with the areas these bodies govern; thirdly, the Internet was limited to the North American continent until 1998 and even today the network is still predominantly American, despite a clear trend of internationalization; finally, the technicians and the entrepreneurs of the Internet, marked by a libertarian or liberal ideology, from the very beginning expressed an almost visceral suspicion with regard to State or international bureaucracies.

Despite their limits, the combined efforts of ICANN, IETF and W3C play an essential role in the technical governance of the Internet. However, this governance conditions in part the socio-economic regulation of activities for which the network is the basis. In fact, on a network of the Internet type, each participant has the possibility of influencing the way in which the flow of communication is administered. This possibility exists in relation to digital technologies' ability to encrypt information: in a digital system, all information is coded in the form of a digital sequence, which is then easy to encrypt. The encryption thus constitutes the key to a filtering of information use: according to the settings, one can authorize access to all or to a part of the information potentially

available, depending on the identity of the user or other criteria. The combination of encryption abilities and the decentralized administration of communication therefore enables all Internet users to regulate the use of information which they make available on the network, because they can lay down "norms" of use for this information which the technology will enforce. This opens practically infinite margins for maneuver to economic agents who wish to define informational services, as well as to social actors desiring to implement specific rules of informational interaction. However, interoperability imposes one notable constraint: in order for the actors to be able to implement such specific rules, these must be compatible with the interoperability standards defined by the IETF or the W3C. This gives these bodies a notable influence on the uses that are likely or not to develop on the Internet. Moreover, the way in which the addressing system is managed also influences uses. The modalities for the management of domain names – that is to say the recognition, or non-recognition, of brand rights, the question of creating categories allowing service providers to be classified and therefore "labeled", as well as the definition of rules of inclusion for these categories – have an influence on the conditions of competition between the operators. Therefore, in the long term, they influence the nature of the services and the uses made of them.

Given these factors, and because the technical mechanisms for the governance and regulation of the Internet are neither totally legitimate nor perfectly complete, States have progressively become more involved with the socio-economic regulation of the network. More exactly, as long as the Internet affected only a coherent and closed community – that of scientists – the American State had little interest (and other States even less so) in intervening in a network which functioned according to rules that were specific to this community, and which in any case was ultimately monitored by the State. Yet with the diversification of uses and actors, the need to complement the technical regulation in order to organize competition, to enable the development of commercial activities, to protect citizens, and so on, made itself felt strongly. This resulted in intense legislative activity in the American Congress from 1995 onwards (Benkler [2000]). Other States, notably the members of the Organization for Economic Cooperation and Development (OECD) and those of the European Union, were soon to follow, from 1997/1998. The World Summit on the Information Society is the symbol of the globalization of this process, and of the attempts to harmonize the various national developments.

The first reflex in most countries was to extend the field of application for the existing regulations, as well as the jurisdiction of the authorities

responsible for enforcing them. However, this movement ran into two major obstacles:

- The re-evaluation of borders between industries inherited from the pre-digital era needs time and cannot take place without conflict and inconsistencies. The Internet is a platform integrating all communication and information-processing technologies, which inevitably tends to blur the borders traditionally established between the respective areas of voice, image and data; that is to say, in industrial terms, between the computer, telecommunications, audiovisual and publishing industries. For this reason, Internet activities have been subject to multiple regulations which are sometimes contradictory and sometimes simply costly and complex to combine. This leads to a "patchwork" of legislative and regulatory environments which is consequently very sensitive to the interpretation of administrative or judiciary authorities, which more often than not appear to be unprepared for the Internet's originality and technical complexity.
- The Internet's global and open character is not very favorable for establishing national regulations. The Yahoo! case in France in 2000 showed that it is a complicated matter to enforce a judge's ruling obliging a portal to deny its clients access to certain content. Furthermore, this case, arising from complaints lodged by anti-racist associations, raises questions concerning legal disputes. In the name of the "Gayssot" law condemning the justification of the Holocaust and revisionism, the French judge obliged Yahoo!, the provider of a portal and search engine, to deny French surfers access through its site to an American auction site selling Nazi objects, failing which Yahoo! would be subject to periodic fines. However, a decision of this kind imposes technical problems: how is it possible to effectively recognize the nationality of the surfers and, above all, to deny access, since it is sufficient merely to know the URL to access the "proscribed" content? There is also a legal problem: what standard should be established between the French conception of the regulation of certain content and American ethical standards defending total freedom of expression? The world legal system is organized on a territorial basis. However, the Internet is aterritorial, to the extent that its architecture ignores the geographical localization of information-processing operations: the data carried by the network uses pathways that cannot be regulated and the information bases consulted or used can be fragmented or duplicated in several places, in such a way that it is totally invisible to the user, or even for the administrators of the network. Given that operations carried out on the network lack a

geographical base, to a great extent legal norms turn out to be inefficient.

The pre-existence of regulation mechanisms for the Internet and their incompleteness, the limits of traditional State approaches, their lack of legitimacy in the eyes of the liberal and libertarian ideology that presided over the development of the Net, are all factors which explain why a so-called "co-regulation" approach imposed itself progressively, notably at the instigation of the US, the OECD and the European Union.

In fact, from the beginning of the 1990s, the United States tried to impose a model of self-regulation, which the creators of the Internet and industry had been lobbying for. However, it rapidly turned out to be impossible to maintain this logic, given the Internet's effects on intellectual property, national security, public freedoms, and so on. Moreover, it was also necessary to adapt the existing legislative framework in cryptography, evidentiary law and so on in order to allow for the development of economic activities on the Internet, notably electronic commerce. Thus, the idea of implementing cooperation between the State and non-governmental organizations (NGOs) for the regulation of the Internet progressively emerged. There were two aspects to this cooperation: on the one hand, to informally delimitate areas of responsibility between the State and involved NGOs, notably by applying the principle of subsidiarity, and on the other, to allow the parties involved in the Internet to fully participate in the elaboration of State standards, generally using the means of the network. The Europeans adopted an approach of this type straight away. However, they sought to use existing democratic institutions more than in the American approach.

1.2.3 Complementarity and competition between operators

The self-organization of the Internet is therefore not synonymous with a total lack of an institutional framework: it is "framed" self-organization. Moreover, even if, technically speaking, it would be theoretically possible, the network does not function in a perfectly homogenous and undifferentiated mode in which all the actors play the same symmetric roles. There are "network operators" which serve the purpose of supplying a range of telecommunication services – essentially access to the Web and management of communication services – making them an interface between users and the transport providers, that is to say the cable operators, the telephone companies, the owners of transmission infrastructure, etc. These Internet operators implement the standards and addressing systems described above and they perform the interconnection between networks. For reasons of efficiency, the different access