BROADBAND INTERNET AND THE KNOWLEGDE SOCIETY

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Dedication
The present paper is dedicated to
prof. George Metakides.

1. INTRODUCTION

The Internet is the main technological vector of the information society. For the knowledge society were defined technological and functional vectors [1]. These are not only theoretical concepts, they are pillars for action toward such a society. Broadband Internet becomes together with artificial intelligence the main technological vectors for the knowledge society. Broadband Internet is not a simple technical notion. In this paper this notion is examined in the context of the concept of knowledge society.

2. LARGE BANDWIDTH IN TELECOMMUNICATIONS AND BROADBAND INTERNET

If in the field of classical telecommunications the bandwidth is smaller or greater after the technical necessity of various types of transmissions {1}. Instead, the contemporary **Broadband Internet** has a more complex approach, looking at the same time at three main factors:

1. The INTERNET as a means for communication and services, because Internet becomes "*a single general-purpose communications platform capable of delivering a wide range of content and applications*" [2]. Upgrading the Internet to the broadband is a requirement for the Knowledge Society**.**
2. The largest possible range of applications and services using broadband technologies, for the benefit of the users, but also for the economy of the industry of broadband transmission, and for the progress of the entire society.

3. Broadband local access links to the homes, small enterprises and offices, to make the Internet more useful to most people. As it was observed "all hinges on higher capacity in the 'first mile' or 'last mile' (our note M.D.: first mile or last mile is the same thing, depending how the local access link is looked at) that connects the user to the larger communication network [2]. *Broadband refers most commonly to high-speed transmission services aimed at residential and small business users*. (Broadband connection "is often adequate for large organizations such as universities and corporations, but enhanced connections to homes are needed to reap the full social and economic promise" [2]).

For the Knowledge Society we may add a fourth point,

4. Broadband together with Semantic Web and Grid technologies to assure the construction of a global network of knowledge (see part 3 of this paper).

All these factors together are characterizing the broadband Internet.

Taking into account all these factors we can not speak of broadband Internet in a country like Romania, excepting perhaps a few homes that are using television cables also for digital transmission of data. It seems that also DSL begins to be used. Still, because there is no large home use of Internet, and the Internet is not yet extended at the entire geographic scale of the country, we can not speak today of real broadband in Romania. With best dial-up links (speed 56 kbps) on twisted wires, this is under the broadband range (even IDSN technologies are under broadband range).

The first mentioned factor of Broadband Internet *is technological.* The first-generation Broadband Internet used primarily DSL (digital subscriber line) and coaxial cable technologies (shortly, cable) and future generations will use optical fiber cables (shortly, fibers) and wireless technologies.

The thresholds for Broadband Internet are given by the technologies used: DSL, cable, optical fiber, wireless. The threshold of DSL technology may be evaluated from the following table [1], [6],

Length of the link	*Speed of data transmission*
5,5 Km	ADSL 1,544 Mb/s
4,9 Km	ADSL 2,048 Mb/s
3,7 Km	ADSL 6,312 Mb/s
2,7 Km	ADSL 8,448 Mb/s
1,4 Km	VDSL 12,96 Mb/s
910 m	VDSL 25,82 Mb/s
300 m	VDSL 51,84 Mb/s
ADSL - DSL asymmetric VDSL - DSL for very great speed	

The technical characteristics of Broadband Internet are: *speed* and capacity (often taken as equivalent), *latency* (delay = how long it takes to deliver a packet of data across the network to its destination), *jitter* (variations in latency), *symmetry* between upstreams and downstreams speed of transmissions or capacity, and in many cases *always-on* (instead of dial-up that introduces delays to dial-up, to negotiate a connection, and to log in) that is instant access to Web or other Internet services (very important for health monitoring, security etc) and others [2].

The second factor *mentioned* above is an important social and economical issue of broadband. In a paper published in 1997, Robert W. Lucky, former Executive Director of the Communications Sciences Research Division at AT&T Bell Laboratories (1982-1992), examines the relations between social expectations and new telecommunications and Internet services: "What, indeed, does society want? It is a deeply important and elusive question. The history of telecommunications services in recent years does not fill us with optimism that we know what society wants, or even that we know how to go about finding an answer to this question. It is filled with market failures like the Picturephone. Even the successes like the World Wide Web, were unexpected…[…] Perhaps the ultimate truth is that there is no real answer of what society wants. Society does not know what it will want in the future" [7]. There are many examples of failures, successes and doubts of proposed applications {2}. In such applications both the private sector and the government may have to play a role. In the case of Minitel in France it was the government mandate and subsidy to "break the start-up barrier" [7].

About the role of private investment and of government action one observes: "For more than a decade, broadband in the last mile has been understood to be a key to maximizing the benefits of the communications and information infrastructure. Now, as then, there are multiple technologies and industries that can advance the infrastructure in general and broadband in particular, optical fiber systems continue to promise the most bandwidth, but at the highest cost and risk. Private investment is still viewed as an essential ingredient, but it continues to be inhibited by uncertainty about what consumers will buy and what business models will succeed. Today, as then, it is understood that government action (or inaction) has the potential to both inhibit and promote investment "[2].

The third factor mentioned refers to the links for homes and small enterprises. In USA " following roughly a decade of development and experimentation and a recent period of rapid growth, first-generation broadband services, using primarily cable modems and digital subscriber line (DSL), are available in many markets. This progress is offset by recent business failures and uncertainty about the pace of future investment - factors that in part reflect slow growth in subscriptions for broadband services. Today, dial-up connections over the public telephone network remain the dominant way homes and small businesses connect to the Internet or other online services. Broadband, though, not only provides higher-performance options for connecting to familiar Internet and other online services, but its capacity and "always-on" nature also enable new network-based activities. Together, these capabilities promise significant social and economic benefits" [2].

In the domain of **first-generation broadband services**, using DSL and coaxial cables, there is a race between these two technologies (only in 1998 that deployment began in earnest, though experimental broadband trials began in 1980s - in USA [2]).

The possibilities of brodband Internet are appreciated as follows: "Today's *residential broaddband capabilities, which are typified by several hundred kilobits per second to several megabits per second downstream and several hundreds of kilobits per second upstream*, support such applications as Web browsing, e-mail, messaging, games and audio download and streaming. These are possible with dial-up, but their performance and convenience are significantly improved with broadband. At downstream speeds of several tens of megabits per second, new applications are enabled, including streaming of high-quality video, such as MPEG-2 (a standard defined by the Moving Picture Experts Group) or high definition television HDTV), download of full-length (70 to 190-minute) audiovisual files in tens of minutes rather than hours, and rapid download of other large data files. Reaching this plateau would enable true television- personal computing convergence. With comparable upstream speeds, computer- mediated multimedia communications become possible, including distance education, telecommuting, and so forth. With FTTH (Fiber To The Home), a new performance plateau with gigabit speeds both up- and downstream would be reached. The applications that would take full advantage of this capacity remain to be seen" [2].

FTTH is not widely available at present. Investment in FTTH in USA has lagged other options because of costs and uncertainty about demand for its capabilities. At the same time, a variety of wireless options provide cost-effective alternatives to wirelines, or complementing wireline technologies.

In the american report [2] the following vision is presented concerning communication technology: *"In the long term, two last mile technologies will dominate: fiber for maximum performance and wireless for coverage and mobility*. Pervasive deployment of fiber-to-the-home (FTTH) and ultimately "fiber-to-the-desktop" are inevitable. Eager's benefits include not only enormous potential bandwidth but also longer service lifetime, upgradability and ability for rapid turn-on of new services that any format-transparent medium provides. In addition, unlike wireless, FTTH solutions are not constrained by spectrum availability or the rate at which regulatory processes can make spectrum available. Completion of the last mile bottleneck using these two technologies would also provide a remedy to the current economic leveling-off of both the telecommunications and computer industries."

3. THE KNOWLEDGE SOCIETY AND BROADBAND INTERNET

The notion of Knowledge Society.

In 1986, based on the philosophical concept of the laws of tendencies, I prefigured a future society of knowledge [8, see note {3}], [9]. Only in the years 1990's the notion of Knowledge Society gained momentum due to the works of Peter Drucker and others. In the last 4-5 years the Knowledge Society was recognized as a new stage of the information era, respectively of the information society.

For the knowledge society, pioneering ideas were advanced, as mentioned before, by Peter Drucker [10] and apud [11, p.10]. It may be mentioned that for the developing countries he considered they will not be able to rely upon lower cost labour for their comparative advantage and they will need to excel in the application of knowledge [10] ; contributions were also made by Lundvall (1992) and others [11].

In a 'Report for the United Nations Commission on Science and Technology Development' [11], published in 1998, the notion of Knowledge Society is already very clear presented: "More recently the term 'knowledge society has been used to shift the emphasis from ICTs as 'drivers of change to a perspective where these technologies are regarded as tools which may provide a new potential for combining the information embedded in ICTs systems with the creative potential and knowledge embodied in people. ICTs are best considered as tools or facilitators which may substitute under certain conditions for other means of knowledge creation in innovative societies (OECD 1996a). These technologies do not create the transformations in society by themselves; they are designed and implemented by people in their social, economic and technological contexts" [11].

In this document, *knowledge society was already conceived as a society of innovation systems and of generalised learning* {4}.

Recently, Philippe Busquin, le comissaire européen pour la recherche, presented actions for the VI-th European frame-plan of research taking into account the objectives of knowledge society [12]. The new program **eEurope 2005** will establish actions for 're-skilling for the knowledge society' and for 'knowledge economy' [13].

The technological and functional vectors of the knowledge society.

In [1], [9] were defined the main vectors of the knowledge society as follows:

Technological vectors:

- Internet.
- Electronic book.
- Artificial Intelligence.
- Nanoelectronics.

Functional vectors:

- Knowledge management.
- E-learning.
- E-health.
- E-government
- E-economy.
- Deepening of fundamental knowledge.
- A system of innovation.
- Environmental protection and a sustainable society.

Etc.

The Internet for the knowledge society represents much more than for the information society of today. First, for the knowledge society the Internet must be extended to reach the entire population and broadband becomes an essential necessity. Secondly, new technical and functional advances like the semantic web, the GRID and the generalized knowledge network are already envisaged for the future knowledge society.

The semantic web.

For the knowledge exchange, the Internet is approaching the limits of its effectiveness (this does not depend on broadband Internet, as powerful as this may be, but on the way the information is considered, as data, information or knowledge). Knowledge is information, but it is mainly semantic information [1, pp.64-65] and "this requires a quantum leap in functionality - for looking for words in text to automatically identifying documents containing related concepts" [14]. The Internet will evolve then in a new information infrastructure that will support interaction with abstraction. This new Internet for the knowledge society was named *Interspace* by Bruce R. Schatz : "*Concept navigation* will become a standard function in the Interspace just as the *document browsing* is in the Internet" [14]. Bruce R. Schatz sees an evolution of the Global Information Infrastructure in three waves from Arpanet to Internet and Interspace as follows:

ARPANET	1965-1985	Data packets	e-mail
INTERNET	1985-2000	Objects (of information)	Document browsing
NTERSPACE	2000 - ---	Concepts	Concept navigation

Without entering here into technical details we shall cite B. R. Schatz [14]:

"….This second wave took a decade to peak in functionality, and it has continued during the past five years with the consolidation of document browsing technologies in commercial distribution.

The transition about to occur in the third wave will involve concept navigation, a radical new paradigm for network information retrieval, Concepts, which contain indexing and meaning for groups ~of objects, are useful for analyzing content and correlating knowledge. During this phase, information retrieval will move beyond searching individual repositories to analyzing heterogeneous data across sources and subjects.

Just as the telesophy[1] prototype led to Mosaic, the Interspace prototype will lead to a widely used system with standard protocols that support direct inter action with community knowledge. Each specialized community will maintain its own repositories, indexing these collections on their own machines. The Interspace will interconnect all these knowledge spaces, enabling switching across communities by navigating con cepts across repositories.
Within five years, **the Interspace will be** incorporated into the information infrastructure. Within a decade, concept navigation will he a ubiquitous commercial service on the global network.

1. B. Schatz, "Telesophy- A System for Manipulating the Knowledge of a Community," *Proc, IEEE Global Comm.* Conf (Globecom 87), IEEE Press, Piscat away, N.J., 1987, pp. 1181-1186."

Tim Berners-Lee who invented the Web in 1989, now director of the World Wide Web Consortium (W3C) and a researcher at the Laboratory for Computer Science at the Massachusetts Institute of Technology, was and is preoccupied the Web to carry more semantics. He and his co-authors wrote recently: "Semantic web agent keywords indicate terms whose semantics, or meaning, were defined for the agent through the Semantic Web. The Semantic Web is not a separate Web but an extension of the current one, in which information is given well-defined meaning, better enabling computers and people to work in cooperation. The first steps in weaving the Semantic Web into the structure of the existing Web are already under way. In the near future, these developments will usher in significant new functionality as machines become much better able to process and "understand" the data that they merely display at present. The essential property of the World Wide Web is its universality. The computers will find the meaning of semantic data by following hyperlinks to definitions of key terms and rules for reasoning about them logically. The resulting infrastructure will spur the development of automated Web services such as highly functional agents. Ordinary users will compose Semantic Web pages and add new definitions and rules using off-the-shelf software that will assist with semantic markup" [15] {5}.

The meaning of semantic data is to be found in ontologies: "An ontology is a collection of statements written in a language (such as RDF {6} that define the relations between concepts and specify logical rules for reasoning about them. Computers will "understand" the meaning of semantic data on a Web page by following links to specified ontologies " [15].

RDF (Resource Description Framework is a technology for expressing the meaning of terms and concepts in a form that computers can process: "RDF can use XML for its syntax and URIs to specify entities, concepts, properties and relations" [15]. URI (Universal Resource Identifier) "defines or specifies an entity, not necessarily by naming its location on the Web" [15].

Ontologies are already currently used by intelligent agents [16], [17] and in the technologies of natural language [18].

Agents will have a tremendous role in the Semantic Web: " The real power of the Semantic Web will be realized when people create many programs that collect Web content from diverse sources, process the information and exchange the results with other programs. The effectiveness of such software agents will increase exponentially as more machine-readable Web content and auto-mated services (including other agents) become available. The Semantic Web promotes this synergy: even agents that were not expressly designed to work together can transfer data among themselves when the data come with semantics" [15].

Concerning the intelligent agents, Gheorghe Tecuci, the creator of the Disciple system [19] observed recently on the future of personal agents: "The Disciple approach advocates the creation of a powerful learning agent shell that can be taught by a person to solve problems in a way that is similar to how that person would teach a student or an assistant. We think that the Disciple approach contributes directly to a new age in the software systems development process […]. In the mainframe computers age, the software systems were both built and used by computer science experts. In the current age of personal computers, these systems are still being built by computer science experts, but many of them (such as text processors, email programs, or Internet browsers) are now used by persons that have no formal computer education. *Continuing this trend, we think that the next age will be that of the personal agents*, where typical computer users will be able to both develop and use special types of software agents. The Disciple approach attempts to change the way intelligent agents are built, from "being programmed" by a knowledge engineer to "being taught" by a user who does not have prior knowledge engineering or computer science experience. This approach would allow a typical computer user, who is not a trained knowledge engineer, to build by himself an intelligent assistant as easily as he now uses a word processor to write a paper" [20].

The GRID

The concept of the **grid** [21], [22] was developed in 1998 by Ian Foster and Carl Kesselman (USA) to create a software capable to put together at work a very great number of computers distributed in the entire world, every user having the illusion he is working with only a machine.

The grid was conceived in the beginning for scientific computing, for some industries and lately for new Internet services: "Né dans le cenacle du calcul scientifique, le concept de 'grille' correspond à la faculté de mutualiser les ressources de traitement massif de l'information, et ce, a l'echelle de la planète. Cette technologie pourrait aussi constituer un moteur pour les services Internet, a la recherche d'un second souffle [21]."

Victor Alessandrini se demande: L'avenir d'Internet passera-t-il par les grilles ?

Il présente la situation dans l'Europe: "Le logiciel chef d'orchestre capable de faire travailler ensemble ces puissants ordinateurs d`une manière étroitement couplées est une <grille (grid en anglais)> en cours de developpement dans le cadre d'Eurogrid. Ce projet, démarré en 2000 et financé par la Commission européeenne, réunit des centres de ressources informatiques nationaux pour la recherche (notamment celui du CNRS en France), et des industriels […]. Une grille de calcul transnationale a déjà été créé en Europe pour fédérer des centres de calcul dans six pays (Allemagne, Grande-Bretagne, France, Suisse, Norvège et Pologne). et des applications scientifiques tres gourmandes en temps de calcul (meteo, biochimie, astrophysique..) sont actuellement développées sur cette grille. Quelle est sa principale fonction? Gérer l'ensemble des ressources heterogenes du reseau à l'aide de logiciels d'intermédiation ou middlewares de telle sorte que chaque utilisateur ait l'illusion d'avoir affaire à un système informatique unique. Datagrid, autre projet européen en cours de d'éploiement, est piloté par le CERN (Centre européen de recherche nucléaire). I'l s'agit cette fois de réaliser une grille capable d'analyser la marée de données (10 petaoctets (10^{15}) par an, soit environ 20 millions de CD-ROM) du nouvel accélérateur de particules, le Large Hadron Collider (LHC), dont la mise en service est prevue en 2005. Datagrid, qui sera accessible par environ 10000 chercheurs mobilisera quelques sites informatiques centraux et des centaines de grappes de PC… "[21].

The future of the grid or the grids will be perhaps at global level. Then it could become a new powerful Internet and Web.

It seems that the american project GLOBUS of Ian Foster and Carl Kesserlman is very promising for realising the concept of the grid [21], [22]. Still the GRID is a project of which success depends on finding key applications {8}.

A more detailed treatment of the GRID may be found in [22]. The main problem is to have an operating system for the grid: "Internet-scale operating system (ISOS) to provide the necessary “glue” to link the processing and storage capabilities of millions of independent computers.[…] Although …an Internet-scale operating system does not yet exist—developers have already produced a number
of Internet-scale, or peer-to-peer, applications that attempt to tap the vast array of underutilized machines available through the Internet" [22] {9}.

The combination of the GRID with the Semantic Web technology will give a very potentially powerful Internet/Web. If so, the "Internet remains an immense untapped resource" [22].

Concerning the *economical problems of the GRID* a series of ideas are very valuable [22]: "A virtual payment system encourages users to provide resources and cheaper computer than the users could own privately. An Internet-scale operating system (ISOS) coordinates all the participating computers and pays them for their work. When [somebody] gets back on her PC, the work for the network is automatically suspended. Her laptop stores backup copies of encrypted fragments of other users' files. The laptop is connected only occasionally, but that suffices. The cost of ISOS resources to end users will converge to a fraction of the cost of owning the hardware. Ideally, this fraction will be large enough to encourage owners to participate and small enough to make many Internet-scale applications economically feasible. **A typical PC owner might see the system as a barter economy in which he gets free services, in exchange for processor time and disk space''.**

Knowledge as a network

Both the semantic web and the grid will have a great impact on the knowledge structure of the society. Tim Berners-Lee and co-authors [15] see a *new evolution of knowledge due to the semantic web* because this "is not 'merely' the tool for conducting individual tasks […]. In addition, if properly designed, *the Semantic Web can assist the evolution of human knowledge,* as […] simply by a URI (Universal Resource Identifier) lets anyone express new concepts that they invent with minimal effort. Its unifying logical language will enable these concepts to be progressively linked into a universal Web. This structure will open up the knowledge"[15].

Due to the grid technology, knowledge may become available like energy in an electric grid: "La nouvelle technologie des grilles est susceptible d'entrainer une profonde transformation socio-economique, comparable à celle declenchée par l'émergence des reseaux electriques *(electric grid* en anglais) au début du XXe siècle" [21].

Knowledge becomes more and more a network. I'll quote here from [3, p.26] a very beautiful explanation of this: "Knowledge is not a specific bit of know-how but a network that evolves over time. The definition of knowledge is also changing. It is no longer just what is stored in our brains, nor just what is written in books or amassed in libraries. Knowledge has become a fluid "state of the moment" in which *the Web itself has become a fundamental part of that knowledge*. Doctors will not be chosen purely on the basis of their experience, the number of books in their reference library or how much equipment is available in the hospitals where they practice. Instead, that choice might be biased by what access they have to the network of global medical knowledge. Even our own illness (with appropiate privacy concerns taken into account) could become a part of this Web of knowledge to benefit others with similar problems."

Building a knowledge network available to all and for all domains of human endeavour is already a possible perspective.

4. FINAL CONSIDERATIONS

In the mentioned American report [2] the acknowledged aim is "reaching all Americans" with Broadband Internet.

In the action plan *eEurope 2005* of the European Commission [13] one of the main objectives is the widespread availability and use of broadband Internet by 2005. The tendency is evidently for broadband to reach all europeans. A particular attention is given to attain 'full exploitation of broadband networks by the research community'. Also to speed up the transition to digital television.

For Romania, also, the broadband is necessary. We need a step by step procedure, beginning perhaps with DSL technologies on the existing lines and to use more and more optical fiber and coaxial cables for the backbone network, and also the wireless technologies at convenient levels. There is also necessary to create good conditions for the formation of clusters of consumers.

The final aim should be the Knowledge Society. This society will be a society of intelligence, both human and artificial, comprising all the social levels by the use of broadband networks.

There are *laws of becoming* expressed by *tendencies of becoming*. These are ontological laws, with the meaning of the philosophical term of ontology, and not with the significance that the ontology notion has for the information technologies of language processing (lexical ontology), of intelligent agents or of the semantic web. This was already very well observed by Tim Berners-Lee and co-authors [15]: "…the third basic component of the Semantic Web, [are] collections of information called ontologies. In philosophy, an ontology is a theory about the nature of existence, of what types of things exist; ontology as a discipline studies such theories. Artificial-intelligence and Web researchers have coopted the term for their own jargon, and for them an ontology is a document or file that formally defines the relations among terms. The most typical kind of ontology for the Web has a taxonomy and a set of inference rules".

Tendencies of becoming are a specific form of manifestation of the laws of nature, of existence in general. It is very difficult to *understand* such laws in the frame of the structural science of today. For this is necessary to extend the science to an integrative science - a science which comprises structural, phenomenological and social (groups, in general under the form of networks) phenomena - in a unitary way, perhaps under the general frame of the theory of categories and functors [24], [25].

Yet the traces of the laws of tendencies may be seen in the structural realm of science and technologies in many and important cases, still they reflect perhaps deep phenomenological tendencies. I would like to mention such laws as:

- **Moore's law and its extension** ("The ratio of performance to cost of computers continues to grow rapidly (a phenomenon closely related to Moore's law, which says that the number of transistors on an integrated circuit doubles every 18 months), and communications rates should grow at a similar pace. To keep pace with processor speed, disk size, and so on, communications should become 10 times faster every 5 years. In some situations, such as local area networks or long-haul fiber optic circuits, speed improvements have been consistent with processor improvements. But in the residential market, it has taken a very long time to surpass dial-up speeds, and there are fears that motivation will be lacking for the service providers to invest in a way that will provide ongoing improvements in speed. Broadband deployment may stall at a speed that is an improvement over dial-up but which does not keep pace with what is needed thus acting as a brake on the computer industry. Similarly, operators of other segments of the network (i.e., backbone Internet service providers [ISPs] and long-haul data carriers) may view the last mile is a potential bottleneck to growth in their traffic volume and revenue" [2]).

Although there are such complaints concerning the extension of the Moore Law in the communications and Broadband Internet domains, yet the Moore Law, respected by the electronic circuitry for the equipments of these domains and the increasing demands of the knowledge society will bring a very sensible growth of performances and applications.

- **Metcalfe's law** (This law states that the value, or the impact, or the efficiency of a network is "n" squared, with "n" being the number of nodes of the network. The square of the number of nodes is roughly the number of possible connections (n(n-1)/2)).
- **Networks laws** (after Barabasi and others, laws put in evidence in the last 3-4 years [25], referring to the structure of self-organized networks in nature, physics, biology, Internet, Web, economy, social life, all being submitted to the same general properties).
- **Kurzweil's laws** ([26], namely: I}. The law of accelerating returns - i.e. of valuable products of the process - that states that the time interval between salient events

grows shorter as time passes; II}. If the chaos is increasing, the time interval between two salient events becomes longer as time passes).

The first law of Kurzweil may be seen, in general, as a law of accelerating history and of increasing order; the second law is of the decelerating of history and of increasing disorder. We are now listening perhaps to the first law, due especially to the Moore law, but we are at the same time endangered by the second law if the Knowledge Society will not succeed to attain a sustainable society.

I hope that the Knowledge Society will advance so quickly to maintain the first law in function and to prohibit the possible second law. This might be the historical role of the Knowledge Society and we must act in a hurry in the following years of this century to provide the future of society and of its consciousness. Then the society of consciousness might follow, and don't forget that consciousness is also a form of information!

NOTES

{1} In the telecommunication domain there are some classes of bandwidth:

- **Narrow bandwidth**, for telegraph and telephone (voice and data) communications on paired-wires, of two types,

- *Single open-wire pair* that may be used for carrier telephony up to 150 kHz (it may carry 12 multiplexed voice channels of ~ 4 kHz with single-side band, the available band of the line being used, for instance, for direct transmission in the 40-88 kHz range, and for the inverse transmission in the 100-148 kHz), and

-*Pair wires in a cable*, every pair of the cable having the possibility to be used up to 500 kHz (with 24 voice channels as before).

For narrowband data transmissions the bandwidth is sufficient, with corresponding modems, as it was observed: "Of course, we keep learning to live with such limitations and, to a significant extent, to "best" them. For example, approximately 25 years ago the best modems could only push data across the best phone line at 110 to 300 bits per second, a laughable rate by today's standards. But although the twisted pair infrastructure has remained the same (and actually aged) innovative people have figured out how to use increasing available processing power to 1200, 2400, 4800, 9600, 14400, 28800, and finally 53000 bits per second.

If we move to a fully digital connection [without using a modem (MOdulator/DEModulator) to convert the digital 1's and 0's into audio tones for their trip across the phone network, we can use *ISDN (Integrated Services Digital Network)* to get up to 128000 bits per second over a common configuration. And if we look at the newest last mile technology now gaining in popularity, *DSL (Digital Subscriber Line)* and its variants, then speeds of megabits per second are possible. Another technology, cable TV Internet service, can offer 10 megabits per second service today (although your PC is unlikely to be able to use but a fraction of that overall capacity)" [3, p.82].

- **Large bandwidth,** beginning with DSL technology: "Specifically, DSL (Digital Subscriber Line) technology is working to change the copper access rules, enabling existing twisted pair wires to carry data at up to 8 million bits per second! This magic is accomplished by sending

256 signals simultaneously over the wire, each at a different frequency (ranging from 4 kilohertz to 1 megahertz), with each signal carrying part of the information. Fast, specialised processors […] enable these ADSL modems to perform the complex math required to separate the signal on the transmitting end and to reconstruct the data stream at the receiver. DSL is still an emerging technology, even as some forward-looking phone companies are beginning to implement it to keep the cable TV and wireless folks from taking over the broadband access pipes" [3, p.84]. Most cable TV systems have the ability to provide as much as 10 megabits per second of data to subscribers.
Coaxial cable technology for land and undersea with a total band of transmission in the Mhz range (supporting, for instance, up to 600 voice channels).

For video transmissions are used both large bandwidth and compression of data: "In 1989 a group of imaging and data processing experts got together with the goal of creating a standard for digitizing and compressing multimedia information for use by computers; thus MPEG-1 was born (Moving Pictures Experts Group, version 1). This technique enabled video to be digitized into a comparatively small data stream of only 1.5 megabits per second (about 100 times less than uncompressed digitized video). One trade-off was quality; MPEG-1 video was comparable to that of a standard VHS= VCR. But that was "good enough"; MPEG-1 became the standard that fired up multimedia CD-ROMS, and it also enabled the first practical uses of (small pieces of) video on the Internet. Of course, putting this in perspective, MPEG-1 video would fill up a floppy disk each second, and this 1,5 megabits per second is still far faster than a typical modem. But, of course, this was just the beginning.
In 1992 MPEG-2 came out, generalizing the standard so that it could work over a broad spectrum of media (CD-ROMs, satellite links) etc.), and allowing various quality trade-offs, letting the content developer balance quality against the disk space and bandwidth available. Of course, there's no such thing as a free lunch-quality high enough to satisfy broadcast applications still requires 4 to 6 megabits per second.
Both MPEG-1 and MPEG-2 encoding are based on breaking an image up into tiny squares for digitizing and compression, but neither format knows anything about an image's composition. […] To combat this, a concerted effort by TV, computer, and telecommunications companies began work in 1997 on a new standad, MPEG-4, which begins its encoding with any objects that are defined by the director or the artist who created the image, Those objects retain their identity even after the image is decoded. This has a great deal of potential value (For more in- depth information on MPEG technology, see www.cselt.it/rnpeg and www.mpegiorg/MPEG/)" [3, pp.72-74].

Fiber-optic cables:"Glass fiber is amazing stuff. Light goes in at one end and, with a bit of attenuation comes out the other. And fiber can carry far more data than an equivalent length bit of wire. Also, when you bundle a bunch of wires together the different wires signals can interfere with each other, but by contrast fibers are very 'closed- mouth' -nothing escapes to interfere with adjacent fibers (or to be 'snooped' by an eavesdropper,) It turns out that mice and other rodents are far less enamored of fiber bundles than they are of our old copper standbys; there are fewer gnawed fiber cables! So, why not replace all the copper twisted pairs with fiber; *we'd all have virtually limitless bandwidth*! The answer, of course, is cost. First and foremost, replacing existing cable with new fiber cables is 'extraordinarily expensive and disruptive-not so much because of the cost of the fiber- but because of the labor involved"[3, pp.83-84].

Radio FM and TV **:** "Broadcasting in the form of radio and television has been in place for many decades. While radio and TV have very large bandwidths and may make use of digital signal transmission, none of these services fits today's common understanding of broadband. This is in part because, unlike the more general purpose generally Internet-based broadband offerings of today, they integrate physical- and higher-layer functionality. That is, the services are aimed at particular types of communication or content (e.g., broadcast radio or television), much as the public telephone network has been designed to support a particular set of voice communications services, and they have emerged, evolved, and coexisted in self-contained fashion. Some proposed applications are data centric, however, and may play a role complementary to the digital communications services discussed in this report. Since the 1980s, direct broadcast satellite has used satellite transmission to provide many channels of service over very wide areas, and this technology has been further developed to provide two-way broadband service delivery"[2].

- **Ultrawideband,** of 500 Mhz when the microwave carrier frequencies are either 4 or 6 GHz, and of 1000 Mhz for 11 GHz carrier frequency. The 11 GHz frequency bands are used for distances up to 400 km, and 4 GHz and 6 GHz for distances up to 6400 km [4]. For a microwave system, "a total of 1860 message channels are combined to form the modulating signals. The bandwidth of this overall group is on the order of 8 MHz" [4]. As it is known for microwave communication, signals are transmitted line of sight between relay stations, 30 to 50 km apart. **Wireless ultrawideband** is now in preparation for broadband Internet and digital communication. It opens the possibility for a common global standard that will finally allow wireless devices to work anywhere in the world [5].

{2} One of the rerason for success and growth of the web was that "the browser was *free* and could be easily downloaded anywhere in the world" [7].Concerning the Picturephone Robert W. Lucky observes that it " might have become popular, too, had it been mailed free to a large percentage of the population in the United States. On the other hand, would the Web have taken off if it had been conceived by a commercial company and the browsers sold for $199?" [7].Other failures or almost failures are described in [2]: "For example, ISDN, which was implemented slowly and was perceived as having significant shortcomings, has been adopted by only a modest number of users. The failure of the much-anticipated Iridium satellite telephone service underscored concerns about the financial risk of bold infrastructure investments."
Regarding broadband services Robert W. Lucky is asking: "If the infrastructure is upgraded to video capability, will services grow to fill the bandwidth? If so, how quickly will that happen? These questions are not mere philosophical whimsies but serious matters of national economics. The dilemma for the infrastructure provider is whether the enormous investment required to upgrade the bandwidth can be justified on the basis of return" [7].

{3} The implicated text from [8] is the following: "Today, the micro-electronic and informational revolution appears to be fully coincident with the lawfulness of society's historical becoming. This technological revolution amplifies the opportunities of knowing, of giving man more leisure for creative, cultural and spiritual activity, in other words it promotes the essential factors of historical becoming. Those who cannot see the link between the microelectronic and informational revolution and the trend of historical becoming are not abreast of the times. And those who oppose this revolution leave the course of historical becoming. And yet, this revolution is not to be absolutized, for it should be accompanied by other changes as well. Hence we cannot concentrate exclusively upon it, but on a broader context within which it can play the chief role for a certain historical period.
The trend of historical becoming (II) appears to be ***the tendency towards a society of knowledge****, creation and civilization, towards a global society and towards an interstellar society, then towards a cosmic act in keeping with the existential tendency of the universe (I). Nearer to us, as a result of the micro- electronic and informational revolution, of a new industrial revolution, are the prospects of an inforniationally oriented society…"*

It was a vision, of that moment, following a philosophy developed by the author in the years 1980, a vision with roots in the electronic and informatic reality, that later will be named information society.

{4} From [11]: "The concept of a national innovation system refers to the processes of technological institutional capability building and policy-making that enable effective choices to be made and implemented. The concept is closely associated with the notion of *social capability building* in the sense that it encompasses the social, political and economic features of the institutional context in which learning takes place. Learning processes are important features of the innovation process. For example

as Bengt-Ake Lundvall puts it, *the most fundamental resource in the modern economy is knowledge and, accordingly,*[...] *the most important process (of economic development) is learning…learning is predominantly an interactive and, therefore, a socially embodied process which cannot be understood without taking into consideration its institutional and cultural context (Lundvall 1992).*
The national innovation system (National innovation systems have been discussed by Abramovitz(1986); Freeman (19870; Lundvall (1992); and Nelson (1993) apud).
It is perhaps interesting to mention that the author of this paper introduced in 1974* the notion of the 'mode of innovation' as an important sub-system of society at equality with the 'mode of production', the 'mode of managemnent' and the 'mode of social-cultural life'. (* Mihai Drăgănescu, *Revoluţia ştiinţifică-tehnică şi modul de inovare al unei societăţi* (The scientific-technical revolution and the mode of innovation of a society), in a volume of 1974 and republished in the author's volume *Sistem şi civilizaţie* (System and Civilsation) , Editura politică, Bucureşti, 1976).

{5}For the Semantic Web are used two technologies: the known eXtensible Markup Language (XML) and the Resource Description Framework (RDF). "XML allows users to add arbitrary structure to their documents but says nothing about what the structures mean" [15] (see Jon Bosak and Tim Bray, *XML and the Second-Generation Web*, Scientific American, May 1999). **RDF:** Resource Description provides the technology for expressing the meaning of terms and concepts in a form that computers can readily process. RDF can use XML for its syntax and URIs to specify entities, concepts, properties and relations" [15]. **URI:** Universal Resource Identifier. URLs are the most familiar known type of URI. "A URI defines or specifies an entity, not necessarily by naming its location on the Web" [15].
" Human language thrives when using the same term to mean somewhat different things, […]Using a different URI for each specific concept solves that problem"[15].

{6}Globus becomes, it seems, a de facto standard for the grid technologies (http://www.globus.org ; see also http://www.gridforum.org , http://www.eurogrid.org and http://eu-datagrid.web.cern.ch/eu-datagrid . V. Alessandrini is asking himself: "La revolution annoncée par le paradigme de Grid aura-t-elle lieu ? Les grilles ne risquent-elles rester dans le serail du calcul scientifique ? L'espoir de voir la technologie decoller pour atteindre le public repose sur un pari : la decouverte de quelques << applications cles>> (killer applications) susceptibles d'emballer le marché, comme le furent les tableurs pour les PC dans les années 1980 ou les navigateurs Web pour Internet dans les années 1990.

{7} " An operating system provides a virtual computing environment in which programs operate as if they were in sole possession of the computer. It shields programmers from the painful details of memory and disk allocation, communication protocols, scheduling of myriad processes, and interfaces to devices for data input and output. An operating system greatly simplifies the development of new computer programs. Similarly, an Internet-scale operating system would simplify the development of new distributed applications. IN PRINCIPLE, the basic facilities of the ISOS—resource allocation, scheduling and communication—are sufficient to construct a wide variety of applications" [22].

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