ISDN in Belgium

Sepulchre, Olivier; Dinant, Jean-Marc

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Chapter 9

The Integrated Services Digital Network in Belgium - a Socially Non-Integrated Network?

J. M. Dinant & O. Sépulchre[1] (1994)

Introduction

During the course of 1993 the Belgian public operator sold some four hundred basic accesses to the Integrated Services Digital Network, or ISDN, thus bringing the total number of subscribers to just under a thousand.[2] During this same period the public operator carried out more than one hundred and thirty thousand new standard telephone installations. In other words, during 1993 for every thousand new connections to the telephone network, fewer than three per thousand were connected to the ISDN network.

Compared with this performance, the new range of portable global system mobile (GSM) telephones launched at the beginning of 1994 was able to boast having attained forty thousand subscribers in under a year. Yet during this same period the GSM network was having to put up with a none too attractive price[3] and only mediocre geographical coverage.

In parallel with this, it might worth examining the number of basic accesses in comparison with the spread of technologies that are competing with the ISDN.

End of year	ISDN basic accesses (2B+D)	DCS* Accesses (X-25)	Telephone connections
1989	25	8502	3711641
1990	112	9866	3912641
1991	267	12734	4096071
1992	628	15417	4264342
1993	989	17059	4395695

* DCS = digital cellular system

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1 Facultés Universitaires N-D de la Paix, Namur, Belgique, Centre de Recherches Informatique et Droit

2 These figures and those which follow are, unless otherwise specified, taken from the 1993 Statistics Year Book published by Belgacom.

3 See also on this subject: "Belgacom au top 5 des opérateurs GSM les plus chers" [Belgacom in the top five most expensive GSM operators] in Business & Telecom Europe, no 38, September 1994, pp 16ff.

In relative terms, we can see that ISDN's penetration has been more rapid than that enjoyed by the standard technologies. Yet in absolute terms, it is still clear that at the moment customers in Belgium are showing no marked preference for ISDN to the detriment of standard technologies.

How can this paradox be explained? Why has this universal network, which offers the majority of telecommunication services, which has been standardised at a pan-European level, and which is now available at an affordable price, not found the success that was being counted on in Belgium?

There are several temptations just laying in wait for those who would try to explain away this paradox.

The first would be to fall back on the retort of "technology". For a long time now we could have believed that every technical innovation followed a linear cycle comprising three successive phases: the innovation proper, which in the main takes place in a laboratory; its standardisation, during the course of which the various players agree on a certain number of parameters; and finally the distribution phase, which is the point at which new users corner a new technology. Therefore, its standardisation process[4] having ultimately succeeded and brilliantly so, we might regard ISDN as finally entering the distribution phase and see the current users as no more than an advance party for a huge squad of others coming up behind.

In co-operation with the public operator, we shall spell out the main reasons why the Euro-ISDN has failed to spread: the lack of terminals, lack of applications, excessively high cost of terminals, lack of compatibility, intermittent geographic coverage, etc.

In Belgium, this sort of explanation is at odds with the counter example of the GSM, which itself also suffers from high tariffs and incomplete geographical coverage, yet which has spread at a rate at least a hundred times faster than ISDN.

The second temptation is to think that any technological innovation in general, and ISDN in particular, develops in a cultural and social void. Within this framework, ISDN can only succeed in taking the lead thanks to the *ex nihilo* establishment of a new communications culture which, with one back-handed blow, will sweep away the heritage of tens of centuries of communication. Since the day before yesterday a number of players have been promising the appearance of a *global village* which will tomorrow be connected up to *multi-media information highways,*[5] thereby establishing the *convergence of today's media.*

The actual uses to which ISDN is being put in Belgium refute this hypothesis: file (28%) or data (17%) transfers, backup for rental lines (23%), fax and telephone transmissions (9%) form the lion's share of the applications currently using the new digital network.[6]

In an attempt to distance ourselves from these two temptations, we shall - in a manner which is, alas, all too rare - start with the *user*, and take as the major thrust of our

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Eurie 93 was a demonstration carried out simultaneously by every European operator during December 1993. The aim was to demonstrate the European connectivity of the ISDN network.

Metaphor dreamt up for the needs of Bill Clinton's Presidential campaign and largely relayed via the press and large-scale manufacturers of the technical back-up needed for this new convergence. Source: Business & Telecom, May 1992.

argument a decision algorithm we have observed during the course of several studies[7] carried out by the Computer Science and Law Research Centre at the University of Namur. Confronted with ISDN, the user of any new technology faces three successive questions:

I. Are you getting along OK?

II. What's the point of it all?

III. How much does it cost?

I. Firstly, we shall demonstrate that ISDN is built around and standardised on the basis of certain postulates which have been shaken by unforeseen "outsiders", and we shall look at the situation ISDN finds itself in compared with competing technologies.

II. We shall then focus on actual usages rather than on potential applications; we shall show what "pluses" could perhaps be gained by substituting an ISDN line for a line from a competing technology. Here we shall see what obstacles, other than technical ones, there are to switching to the Integrated Services Digital Network.

III. Finally, on the question of costs, we shall examine the elements that go to make up this cost, as well as hypothetical situations where ISDN would appear to be the most cost-effective answer compared with two competing technologies.

We shall conclude by examining what obstacles there are to the development of ISDN in Belgium, occasionally putting forward some thoughts on how these might be overcome.

K. Gregg, M. -N. Willcox, J.-E. Vekemans, J.M. Dinant, P. Gobin "*Innovation, normalisation, usages : le case du RNIS*", Services de la programmation de la Politique Scientifique, Namur, June 1993.

S. Deltenre, J.M. Dinant, O. Sepulchre, "Etude exploratoire en vue de la mise en oeuvre d'un programme d'appui scientifique de diffusion du RNIS", Namur, April 1994.

SEMAGROUP, "Euro-isdn: Social and Societal Impacts", October 1994, study conducted for DGXII A by the CRID in cooperation with various European partners.

I. Are you getting along OK?

The Technology Whirlwind

While the idea of an integrated pan-European network capable of supporting all pos services is quite old, the first work on standardising ISDN was in fact undertake 1982.

Faced with the increase in the means of communication, and bearing in mind the strat importance of a trans-European telecommunications network from an economic poi view, it was initially through a *political* initiative that the earliest work on ISDN undertaken. A number of experiments had already been carried out in Eu (particularly in the United Kingdom). The bases first set down for ISDN in 1982 those which have endured until now. They were published in the Consultative Comm on International Telegraph and Telephone (CCITT) Red Book in 1984. Let's rer ourselves of some of the principles:

- a digitalized through network
- one single point of access to all services
- two types of channel :
  * the B Channel with switching via a 64 kbps circuit capable of carrying the voi
  * a D Channel with switching via packets capable of being activated simultaneo with the B Channel,
- two types of access: basic access (144 kbps (2B+D)), and primary access (2 M (30B+D)),
- three categories of service : transport, tele-services, additional services.

Within the framework of what was technologically available in 1982, this new typ network was an innovation although it was none too clear which communication serv ISDN would be able to support. ISDN had been designed around certain expectatic believed to be well-founded - and the existing telephone network. It was out of question to replace the existing local cable, so the basic access (destined for the ger public) was therefore planned so as to be able to function using this local cable.

In this sense, ISDN is of course a natural evolution of the existing telephone netw Several outsiders were to appear to upset ISDN's linear course.

Appearance of the Micro Computer and Local Networks

The appearance in 1982 of the first IBM PC micro-computer and the first wav getting every company onto micro-computer was to unsettle the universal natur ISDN. During the companies' mad rush towards computerisation, several local networks (LANs) were spawned from 1985 onwards. Since the particular feature share is speeds in the order of 10 Mbps, this means ISDN, even in primary access m is not readily suited for connecting up this type of network. Several technical solut have now been found, however, particularly through 'routers'.

Compression Algorithms

Digital compression techniques appeared towards the end of the 1980s, and their performance is constantly improving. These days an output of 8 kbps is enough to transmit a telephone conversation, with the result that ISDN's 64 kbps telephony output is, strictly speaking, an economic waste.

In the area of image transmission, 400% compressions are quite usual and prototypes enabling the transmission of film in real time using twisted pair telephonic cables have been recently introduced.[8]

Fibre Optic

The appearance and gradual coming of age of a new transmission aid - fibre optics - will within the space of a few years revolutionise the nominal outputs of transmission aids. Outputs of several gigabits per second are already a fact and the continuous progress being made in this field[9] [10] means we can look forward to the possibility of simultaneously transmitting close on a million telephone calls along one single glass fibre just a few microns thick before the year 2000. Some prototypes are now enabling speeds of 20 Gbps to be achieved. The fibre has other qualities which make it particularly attractive: a price which is constantly coming down, a sense of security, no parasites, etc.

Thus the advancement of one technology is being built up into a swirling technological development. While the ISDN network was designed around the postulate that the replacement of the local metallic cable could not be envisaged[11], the possibility of digitalizing the grid network and linking the exchanges up with each other with the help of fibre optics,[12] [13] together with the progress being made in compression technology, now means we can in the medium term foresee the day when an animated images transmission network might be set up using the current telephone cable system. This is the famous "video on demand", although nobody can say whether it will make use of the existing telephone network (with certain adjustments), a "narrow" band digital network

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8 HDSL (High-bit-rate Digital Subscriber Line) thus enables a bi-directional two Mbps transmission over a double pair. ADSL (Asymmetric Digital Subscriber Lines) enables 6 Mbps transmissions over the local cable and can thus be used as part of the video-on-demand system (Source : Coopers & Lybrand, ISDN Bottleneck Study, July 94).

9 Thus the Aurora network linking the University of Pennsylvania, the M.I.T. in Boston and IBM in Bellcore Morristown would currently already be operating at 1.3 Gigabits (Computer Networks and ISDN, Jan 1993). This can be compared with the outputs advanced by Alcatel in March 1991: "a B-ISDN switch (ATM) capable of establishing any number of virtual channel connections ... up to a total bandwidth of 150 Mbps (600 Mbps planned)." (Third IFIP WG 6.4 Conference on High Speed Networking, Berlin, March 1991)..There are two years between these two papers: what does 1995 have in store for us when we recall that Siemens is talking about prototypes achieving 20 Gbps?

10 Siemens has recently put forward silicone-based prototypes which have enabled outputs of more than 20 Gbps to be achieved (in Telecom International, Nov-Dec 1992, p.5)

11 See on this subject: Ph. Chaillet and D. Seret, ISDN, Technical description, Computer manuals, Masson, Paris, 1991

12 The distribution of the fibre is itself also on the increase. Figures published by Siemens in this respect are particularly interesting. One of its factories was producing 80,000 Kms of fibre in 1986 and 500,000 Kms in 1992. Siemens is about to invest 200,000 DM to bring this capacity up to 2,000,000 Kms a year. (Source: Siemens, International Telecom Report, Sept. 1992).

13 Likewise, 4,650 Kms of optic fibre was being used in Belgium at the end of 1993, ten times more than just five years earlier (356 Kms. end 1988). (Source: Statistics Yearbook, Belgacom).

such as ISDN, or a wide band network, either the current tele-distribution network or some new specific network.

The choice of a new network remains a delicate matter. Japan, for its part, has embarked on an FTTH (Fibre To The Home) strategy which is proving extremely costly (tens of billions per year). This ambition might well turn out to be premature. As indeed may the tens of kilometres of multi-mode fibre optics laid for the Winter Olympics in Chamonix : mono-mode optical fibres, more delicate to work with yet giving a better performance, will in all probability be the only type to be used in future. A number of experts believe that Europe is more likely to move towards an FFTB (Fibre To The Building) strategy, which represents an interesting compromise between FFTC (Fibre To The Curb).[14] This involves bringing an optical fibre into the premises of certain high volume "telecom" consumers, while other users will be happy with the standard metal cable.[15]

The Slowness and Progress of Standardisation

In contrast with these technology whirlwinds, standardisation is following a slow and methodical path. We could, as a first approach, look at the voluntarist process of standardising the Euro-ISDN as an example. The table below sets out the dates of a number of important events which have had a bearing on the activities of the Belgian operator.

1984	CCITT Red Book
1985-87	Prototypes and experiments carried out in Belgium
January 1988	Creation of the ETSI
1988	CCITT Blue Book
April 1989	First Memorandum of Understanding
April 1989	Introduction of first commercial ISDN operation in Belgium
29 June 1989	Launch of the national A-Line service
May 1992	Second Memorandum of Understanding
December 1993	Euro-ISDN launched
December 1995	Euro-ISDN will be accessible throughout Belgium

[14] According to our information, the laying of one meter of cable in a built-up area could cost up to a hundred ecus.

[15] See on this subject: BAUR H., "*Perspectives technologiques des télécommunications dans les années 1990*", Journal des télécommunications, Vol 59, VII-VIII, 1992.

Following the 1984 Red Book, the *Blue Book*[16] was published in 1988 by the CCITT. These recommendations were gradually taken up by ETSI.[17] In Europe two Protocols of Agreement[18] were entered into in 1989 and 1992 between the various European operators for the supply of a minimum shared ensemble of pan-European ISDN services. The second agreement was the one that allowed Euro-ISDN to be started in December 1993, when all European countries were linked by a visio-conference system via ISDN.

We would point out that this standardisation - initially world-wide, then European, and finally Belgian - constitutes a considerable undertaking. It is based on a communications process read-out structure : the ISORM model.[19] The development of this model has necessitated some seven thousand man hours/year but it is still a compromise. Around two thousand other models currently exist.[20] This ISORM model comprises no more than a read-out structure of the several thousand pages that make up the Red and Blue Books.

So far as ISDN is concerned, it is striking to note the speed at which technical standards, mainly established by electronics engineers, are spreading.[21] In the world of information technology it is rare to find extensive negotiations in which all the parties are consulted. A consortium of leaders in a specialist field develop a standard which, as a result of the very weight of the market shares those leaders represent, succeeds in achieving break-even point within a year or two. This was the case with IBM-compatible PCs, with the ESA and PCI bus, with PCMCIA connectors, with VESA local buses, etc.

One explanation might lie in the monopolistic nature of the national operators before this standardisation came into being. Since they had no competitors on their national market, they did not feel the need to enter into alliances with other partners in order rapidly to create standards so as to resist the competition and thus be able to engender loyalty in a fickle clientele.

After eleven years of intensive work, all European countries have, through the expedient of the ETSI and the MoU, reached an agreement on joint operational standards. A major market is thus opening up to a good number of European constructors. Normative security could only be born through complex, in-depth and slow consultation procedures, and ISDN today constitutes a technology that nobody, and with just cause, could in some areas regard as obsolete.

This normative inertia has allowed the development of alternative technologies, principally in the world of information technology networks. Frame Relay, FDDI, DQDB today constitute solid and standardised norms which allow high-performance information technology networks to be formed.

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16 The term "book" is a euphemism here since it is actually ten volumes divided into 61 parts.

17 European Telecommunications Standard Institute founded in 1988, operational since 1989.

18 MoU (Memorandum of Understanding): agreement between 26 operators in 20 European countries.

19 Open System Interconnection Reference Model: "The ISORM partition the problem [of communicating] into discrete layers and provide a conceptual framework for understanding the complex processes involved in computer communication", in J. Henshall & S. Shaw, "Osi Explained", Ellis Horwood Limited, Halsted Press, Chichester, 1989, p.12.

20 Computer Network and ISDN Systems, Aug 1992, p. 233.

21 We are obviously thinking of the I.E.E.E. and in particular Ethernet, FDDI and DQDB local network standards.

Frame Relay is an extremely fast switching technique using packets assigned to replace the X-25. This network is not suitable for transmitting the voice.

Fibre Data Distributed Interface is a technique designed for local networks and enabling speeds of 100 Mbps thanks to the use of fibre optics. This performance can be compared with the 10 Mbps obtained using a metal cable. In a more recent version, FDDI II allows the voice to be carried.

Dual Queue Dual Bus is a standard that lets Mans (Metropolitan Area Networks) run at outputs in the order of 150 Mbps. The first Belgian MAN was inaugurated in Brussels in May 1993. The latest news is that two clients were to be connected up to this wide-band network.

Finally - last but not least - Asynchronous Transfer Mode (ATM) is a switching-by-packet, wide-band network technique which enables every type of data known so far to be carried : images, telephony, data, etc. A pilot project is currently being developed in Anvers by the firm Alcatel Bell.

The standardisation of ISDN is atypical: it precedes technological developments and is the outcome of an explicit will on the part of political authorities taking turns, it is true, with a number of major constructors. In short, an analysis of the players on the ISDN-standardisation stage and a comparison with the methods used to produce standards in associated sectors highlight the nature - which is as much political as it is technical - of the choices to be made.

It might therefore be considered that *"the ISDN in basic access mode is the result of a compromise between what it is possible to offer at a reasonable cost and what needs to be offered. This compromise is made all the more difficult [given that] technological expectations allow us to imagine a very wide variety of services and the fact that the requirements are virtually unknown".*[22]

Usage

We can classify the uses to which ISDN is put in accordance with a typology that replaces the end-user as participant in the socio-technical transformation. We could thus distinguish between applications where there is a new use being created (electronic mail for example), a substitution of uses (telebanking, for example), or even a similarity of use (access to the phone book via Minitel, for example). A new culture is beginning to take firm shape with the appearance of these new uses.

The offspring of tumultuous technology and systematic standardisation, usage has for a long time now (too long?) been, and indeed still is, the poor relation of ISDN. Whilst some have convinced themselves ISDN would usher in a new communications culture, a new era where *homo communicans*[23] would be the master[24] there is, so far as we know,

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22 Saillet Ph., Seret D. "RNIS, description technique" Masson, Paris 1991.

23 This expression is attributed to Philippe Breton who defends the thesis according to which Homo Communicans, plugged into information highways is *"a purely social being piloting his destiny in a rational way depending on external constraints rather than directed from the inside by values"* in *"L'utopie de la communication"*, Edts La Découverte/essais, Paris, 1992, pp. 94ff
This myth of information highways is still the subject of much debate. Some people even go so far as to talk about "intox": "Nobody appears to be taking any notice of the public's desires and wishes

no systematic study of the actual needs of residential users vis-à-vis ISDN, possibly because ISDN in Belgium has for some time now been presented more as a network of the future than as a natural evolution of the telephone network.[25]

The residential user has sometimes been seen as the spearhead for the penetration of this new communications culture into society. Videophony, tele-working, tele-buying have all been adopted by many residential users.

But these days usage is no longer in the hands of the speculators and the figures, modest it is true, yet nonetheless real, have taken the place of speculation and yesterday's dreams. The massive utilisation of multi-media heralding the imminent arrival of "info-highways" (information highways) constitutes no more than a marginal utilisation of the digital network. The use of a visiophone, for example, often spoken of as an improvement in communications *"is, other than for convivial exchanges ... . in actual fact more restricting for calls made to persons outside the family, whether in a domestic or a business setting".*[26]

On the hit parade of positive uses we find,[27] listed in order, telephony, file transfers, backup for rental lines and data transfers. In other words ISDN has not inaugurated a new culture but has simply enabled a very limited number of users of the analog telephone network or of rented digital lines to transfer traditional applications onto a digital network.

While there has been some new uses found, these are in the essentially technical sphere of specialists working with private networks where ISDN lines are used as backup or to cope with overflow situations. This new use involves using an ISDN line in parallel with a rental line. If the rental line develops a fault or gets overloaded, an automatic device is triggered which brings ISDN into service as a replacement or an "overflow" facility for the rental line. These lines are therefore used only relatively rarely and it goes without saying that there is no certainty that European operators in this market are making any return on the large investments they made nearly ten years ago.

What do we make of ten years of galloping innovation, of systematic standardisation and of uses which have remained virtually unchanged?

Firstly that ISDN is a technology that "works". What we mean by that is not the fact that it is spreading rapidly but the fact that it is technically focused and that the majority of Belgian companies and private individuals already have access to it. The question is no

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... this new project is directed at the general public who will ensure the profitability of this great orbital juke-box. It isn't enough to create the offer and accompany it with media hype so that demand continues. History will be the judge.". In Expertises des systèmes d'information, no. 174, p.249.

"A research project and a basic study of communication needs never yield very much. Apart from confrontation with a concrete communication subject, the needs are not expressed. There is, then, no possibility of looking into the whites of the population's eyes to find out what it wants if we do not propose any concrete solution". In "Expériment et demande sociale, l'expérimentation étatique dans la communication", IDATE, p.90.

26 K. Gregg, M. N. Willcox, J.E. Vekemans, J. M. Dinant, P. Gibon, *"Innovation, normalisation, usages: the case of the ISDN"*, Services de la programmation de la Politique Scientifique, Namur, June 1993.

Source: Business & Telecom, 1992

longer an existential one (to be or not to be = 2B or not 2B), the slogan "ISDN IS HERE, NOW" has become a technological reality in Belgium.

We note, then, that use of ISDN in Belgium is linked mainly to businesses and within the framework of traditional applications.

The following question is worth asking: What is the point of it all? Is ISDN, as some have been heard to mutter, an Innovation Subscribers Don't Need? This question is the subject of the following section.

II. What's the point of it all?

In this section we shall attempt, for certain applications, to identify the "plus factors" ISDN can bring. This attempt has allowed us to raise an apparently insolvable controversy about the notion of the word "application". This term is probably as ambiguous as the word "service".

This controversy is symptomatic of the "gap of knowledge" that separates technicians/ideas people from novice users. Technicians will talk about the transfer of images as being an application. Users feel that that term doesn't really mean a great deal and that it should be relocated within the panoply of uses that includes such things as tele-surveillance, telebuying, videophony, visio-conference, access to image banks, the transfer of medical images, teleworking, etc.

In fact we now find ourselves faced with two typologies which show two ways of grasping the technology: a) depending on the technical subject it is dealing with, but having no context, or b) depending on the use to which it is put in a given context. In the case of ISDN, this dichotomy explains the absence of any meaningful statistics, the public operator alone being capable of giving an order of magnitude for the number of bits carried or of indicating the applications with which it has been confronted, without being able to supply truly quantitative, reliable and systematic information about the nature of the data carried, and even less about the uses to which it is put.

In what follows we shall look at a number of standard "applications", as these are the ones most often seized on by users or described in the literature without any distinction being made between typologies of users or ideas people.

We have chosen to focus on the transformation of usages that ISDN can engender in these different applications.

1. Consultation of Data Bases

a) The Advantages of ISDN for this Application

So as to be in a position to evaluate the potential contribution ISDN might make, we feel it is important to distinguish between text data bases and image data bases.
Indeed, the technical qualities of ISDN (mainly speed for the application we are concerned with here) will not be perceived in the same way by a text data base as by an image data base user. If we roughly calculate the time needed for a text to be displayed on a screen compared with a graphic image (for example a photograph, a drawing, a

landscape, etc.) we realise that the latter are a hundred times slower in the case of an image transfer. While a waiting time of several seconds is acceptable for an interactive user, it is clear that waiting times of several tens of seconds are quite frankly unacceptable.

It is clear then that although data interrogation only makes use of text files, it would not appear to be an advantage to substitute an ISDN network for a DCS one or a modem connection.

On the other hand, using ISDN to consult "image" data bases would be able considerably to reduce telecommunication times compared with other systems. The fact remains, then, that ISDN is the only public network which could at the moment enable image DPs[28] to be accessed at a reasonable cost. Modem transfers via the standard telephone network (STN) or the X-25 network are too slow, and high-speed digital lines are used on the basis of a fixed location which remains prohibitively expensive for a one-off use.

b) Impacts and Advantages linked to the Application

Irrespective of the telecommunications network used, the establishment of a data base encourages the persons making use of that service to change their practices. By allowing the user to access the information sought, data banks are in fact fulfilling the same functions as a catalogue, a phone book, a newspaper, etc.

However, the computerization of a data base, from the point of view of both consulting the data as well as keeping it updated, offers a number of advantages which will affect its adoption.

In the wake of the de-materialisation of data which (potentially) becomes accessible from terminals located some distance away, the user it no longer forced physically to travel to the site where the data is centralised. Taken to its limits, he no longer even needs to know where this data is stored. Similarly a data bank can also be updated from a distance via a terminal. It is instantaneous and can potentially be passed on to all the other users. If will suffice to quote the example of Minitel, which was originally designed to replace the phone book, to recognise the advantages of such a solution compared with a phone book printed on paper, which is virtually never up-to-date, and which is replaced in its entirety each year.

Thus, the data base, as a result of the advantages it offers, is taking the place of catalogues, the phone book, etc., to do the same job.

However, the introduction of such an application changes the organisational as well as the cultural construct to which it relates.
It is necessary, in fact, to acquire and choose the computer equipment and software required to operate a data base, and to decide on the location of the DP and the terminals. The personnel brought in to consult and update it will have to learn to use a terminal and the software. They will gradually have to assimilate a certain type of computer science culture.

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[28] Applications are multiple here: tele-buying, tele-surveillance, tele-maintenance, access to various catalogues, etc.

However, in spite of all the advantages shown above, this adaptation of know-h inferred by the introduction of a data base can act as a brake on its utilisation.

Indeed, a variety of factors are likely to hinder the adaptation of know-how:

a process of under-qualification: the evolution of the technological environment is *facto* bringing about the well-recognised symptom of operatives who were skilled earlier technologies now being under-qualified. Within the space of a few months t experience acquired over tens of years by hundreds of people (typography, printi and the annual organisation and dispatch of millions of telephone director throughout the whole country) becomes redundant;

a lack of training or the no more than mediocre quality of that training can render t user incapable of taking part in a re-training process. There is a risk of people feeli discouraged or suffering from stress as a result of this, and of there being significant social cost to pay (nervous disorders, depression, absenteeism, poor lev of service and end products, sabotage, bad atmosphere in the workplace, rival between staff who have re-trained for new qualifications and those who have n etc.)

the classic example of habitual computer science practice, the absence or inadequac of a computer culture appropriate for the socio-vocational categories involved or th age of the users;

over-high or under-estimated staff redeployment costs

a shortage of appropriate technical equipment, back-up, monitoring and technic skills.

One recurrent problem we have noted is the lack of public information as to the existenc of data bases. Irrespective of the network to which a data base is connected, or th number of potential users who could, in theory, be connected up, people need to be abl to be made aware of its existence.

For a data bank open to the general public (businesses or private individuals), ISDN i suffering cruelly from a derisory number of users and risks going round and round in vicious circle: no ISDN applications, therefore few subscribers; few subscribers an therefore no new ISDN applications being created, etc.

2. *Electronic Mail*

a) *The Advantages of ISDN for this Application*

For a short while now electronic mail has seen a strong growth in Europe which has been linked to the ease with which it can be implemented and its extremely low tariffs. It is sometimes used to transfer files.

In this case, ISDN's higher output compared with that of analog lines can thus be a cause for satisfaction amongst users, mainly where very large and/or very long files are being transferred over a distance, where the cost of the regular network can be a major drawback. The ISDN solution is also attractive for companies offering gateways into the electronic mail network, because the lines are busy for much shorter periods since transactions made via ISDN are going seven to eight times faster than via the STN. At the moment some DPs are offering double access if preferred.

With the basic utilisation of electronic mail, a 2400 bits per second modem is ample, particularly if the DP is in the same telephone area as the subscriber making the call. Some analysts, by the way, are forecasting an increase in sales of this type of modem between now and 1996.[29]

b) *Impacts linked with this Application*

As a result of the advantages it offers, electronic mail can take the place of letter mail or the fax for certain functions that have until now been fulfilled by these more traditional means of communication.

It will thus be the objectives pursued as well as the talking partner targeted who will determine which of these two means of transmission is chosen. We would point out that electronic mail offers certain advantages:

As with the fax, electronic mail enables relatively short messages to be sent, there are fewer constraints when it comes to format, choice of salutation, more informal messages, etc.

It offers a number of obvious advantages compared with the fax in that the documents received are already saved on a computerised back-up and can thus be retrieved using a word processor and sent back to the person sending the text via the same route. This method of transfer is ideal for two authors having to work on a joint text.

So far as authenticity is concerned, the source of the mail is more certain than it is in the case of the fax where it is the user himself who programs in the number he is calling from, together with his name or logo, which will appear on each page of the fax.

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29 See on this subject: "*High Speed Modem : the Forecast for 1994*", in Byte European Reseller, Aug. 1994, p.4.

As for security, electronic mail systems are generally accessed by a password. This does not necessarily offer greater protection, although it does reshuffle the cards so far as the confidentiality of mail within a company is concerned.

Communication via electronic mail also offers the advantage of speed - speed due to the dematerialization of the data backup which in turn gives a mail transfer speed which is a great deal faster than sending it by post.

This means of communication also avoids any disagreements due to letters being delayed or getting lost.

However, just as the case when data banks first came onto the scene (cf. above), the introduction of this type of computerised communication results in changes at both an organisational and a cultural level.

The Dps and terminals need to be selected, as too must the way they are distributed within the organisation, users have to be advised and trained, decisions have to be made about who can have access and by what means (password, for example). New problems with confidentiality can occur insofar as staff at the computer unit are empowered to see the contents of both incoming and outgoing messages. Management loses part of its powers in that it loses this control over the flow of information between the outside world and the company.

One of the essential brakes on the use of an electronic mail system, irrespective of the telecommunications network to which it is connected, lies with ignorance in the way it is handled. Only systematic training or cultural pressure can encourage staff to take the first step towards this new means of communication.

3. The EDI

a) The Advantages of ISDN for this Application

EDI, or Electronic Data Interchange, comprises the "transfer of data structured in accordance with pre-established standards of computer-to-computer messages by electronic means", *"in very formalised exchanges which allow the data exchanged to be processed immediately";*[30] items of information, data, having generally dealt with orders for and the dispatch and invoicing of products.

ISDN provides no decisive advantage if the transfers basically consist of texts which can be exchanged fairly rapidly. Only when the size of the transfers gets bigger could ISDN be envisaged and the development of an EDI encouraged.

b) Impacts linked with this Application

This technology brings with it a substitution of uses.
The EDI, all the while pursuing the same functions as a more traditional distribution procedure, offers certain advantages which will determine whether it is adopted or not.

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[30] Network no. 54, July-August 1992, "EDI et le chantier de la nouvelle entreprise", Anne Mayère, Marie-France Monnoyer, p.82; "Messageries professionnelles : en transit ou en sursis?", Dominique Boullier, p.59.

This is in practice a faster procedure than an exchange made by paper and telephone backup (invoicing and the receipt of orders, for example).

Being computerised and highly formalised, this procedure also avoids human error or delays in the processing of information.

The introduction of the EDI will result in organisational and cultural changes due to the need to respect the standards demanded by this system of computerised exchange, the doing away with all sorts of administrative jobs linked with data processing, and above all because in the medium term the EDI has the effect of doing away with the need for vendors to hold retail stock because the delivery times are noticeably shortened. The problem of stock is thus directly transferred to the manufacturer.

4. "Multi-media" Applications

Let's take as an example the installation of complementary multi-media terminal at a tourist information centre. Where these terminals involve the transfer of graphic files (photographs of places to visit with a recorded voice commentary) filed on a DP and requiring the use of telecommunication facilities, ISDN can offer a decisive advantage when it comes to speed of consultation and updating.

The telematic terminal, accessible at any hour of the day or night, offers a more flexible service. Indeed, tourist information centres generally work to a timetable which is not always compatible with tourists' leisure hours, particularly at the weekend. And if a tourist information centre decides to keep its premises accessible at the weekend, it will need to pay its staff at a higher rate than it pays them for weekday working.

On the other hand, the information requested from staff at tourist information centres is very uniform and repetitive and a computer can easily and tirelessly reply to this type of request, leaving the staff to devote themselves to less routine tasks.

One such experiment has already been attempted by the Belgian Office for the Promotion of Tourism. The speed of ISDN caught the attention of the partners involved : the tourist can be dealt with rapidly by the terminal and if there are several people forming a queue in front of the terminal there is less chance of their leaving, discouraged by the time they have to spend waiting their turn.

This experiment also showed, however, that access to such terminals was the focus of attention from curious onlookers rather than tourists keen to obtain information. A number of youngsters were also interested in what might have appeared to them to be a new type of video game. This same phenomenon is also being observed with similar experiments in museums.

However, any multi-media experiment will need to involve a choice between connecting the terminal equipment to a central DP or to a system without a network connection, particularly one relying on a CD-ROM. In the above instance, a CD-ROM distributed free of charge or stored in "stand alone" terminals, can supply photographs enhanced by a commentary. The disadvantage of this solution lies in the update time, although this is offset by an extremely attractive price.

5. *File Transfers*

When transferring large files ISDN would appear to be a network that can offer an attractive cost/output ratio.

In some institutions in Belgium this system of making transfers via digital networks is allowing control processes to be introduced in the shape of electronic signatures. The person transmitting the file sends an electronic signature to the recipient, who then sends back an electronic signature in reply. There is no validation of the transfer except when the signatures match.

Certain specific accessories are currently enabling some B channels to be used simultaneously by a variety of synchronization techniques. Thus three basic accesses, being six B channels, will give an actual output of 384 kbps.

In Belgium one major trade union is using ISDN to forward its members' subscriptions to its bank. It should be noted that it was pressure from the bank that encouraged this trade union to take the plunge and use ISDN.

One Civil Service department decided to substitute ISDN for rental lines linking their own offices together with their headquarters in Brussels with 22 other offices scattered throughout Belgium. ISDN allows the 22 offices to transfer files and to consult the data base in Brussels. Persons using these applications appreciate the speed of ISDN compared with the original rental lines.

In the case in point, the financial advantages of ISDN compared with analog rental lines prove themselves for the zonal and inter-zonal calls in question. The main motivation for switching to ISDN was financial.

6. *Teleworking*

This is perhaps the application about which most has been written. Teleworking involves linking up a person working at a distance in his own home with his company's offices. This concept is attractive because it offers a number of advantages: reduction in traffic (and thus in pollution and traffic jams), reduction in stress for workers who are able to stagger their work, advantages for family life, etc.

On the reverse side of the coin, however, it increases workers' vulnerability and isolation, and this could lie at the root of the hostility some trade unions are showing towards teleworking.

Typically speaking, teleworking equipment will incorporate a data terminal and a (video)phone link. ISDN can be extremely attractive because it allows this multi-media link to be made using two B channels. Here the concept of integration works in its favour.

In this respect an experiment carried out by British Telecom serves as an interesting example. Over the course of several months some twenty or so volunteers worked from home with the aid of equipment specially designed for that purpose. These were female telephone operators whose jobs entailed explaining how certain devices worked to

customers who phoned into a helpline in London. The calls were automatically diverted to the teleworkers without the knowledge of the caller.

This experiment was a success, although that is not to say it gives teleworking a blank cheque without any nuances for teleworking. This experiment was carried out under excellent conditions and was intelligently designed by the employer. All the teleworkers were volunteers. Throughout the duration of the experiment a videophone system was installed in the cafeteria of the London offices so the teleworkers were able to retain visual and sound contact with their former colleagues during their coffee break. The teleworkers had frequent visio-phonic contact with their team leader. The teleworkers' levels of satisfaction had, incidentally, dropped considerably during the time this contact was not possible for technical reasons. We further noted that this experiment was carried out in a setting with close cultural links with the telecommunications business and that certain problems, such as fear of the technology, or even inaptitude of using certain telecommunications equipment, were conspicuous by their absence.

The success of this full-scale experiment seems to us to be explained by the fact that it only resulted in minimum disruption of pre-existing relationships and human contact within the company. In other words, respect for pre-existing human relationships on the part of a new type of network appeared to us to be a factor in making that network more acceptable.

7. Conclusions

These days numerous organisations in Belgium are using a number of applications which use a telecommunications network. In many cases ISDN can in technical terms be substituted for the network used, whether this be a switched telephonic network, a DCS X-25, or rental lines.

In many cases the impacts of and brakes on the utilisation of these applications are basically due to the specific nature of the applications rather than the telecommunications network itself.

The reorganisation of work at tourist information centres forecast the introduction of telematic terminals, either connected to ISDN or to some other telecommunications network.

The choice of an electronic signature system between a trade union and the bank to take care of paying unemployment benefits results from the networking of data transfer telecommunications between these two centres, whether or not this is an integrated services digital network.

The lack of training, of information, the type of computer culture liable to hinder the adaptation of the know-how needed for the appropriation of an application are not influenced in any decisive way by the telecommunications network to which the application is connected, irrespective of what form it takes.

However, ISDN's current weak distribution in Belgium is enough to rule out large-scale public applications requiring a users' connection (private individuals or businesses).

While the modification of uses inferred or passed on by ISDN does raise important non-technical problems, the Belgian ISDN is nonetheless a network which, in many cases, is allowing the opportunity for existing applications to be improved or new applications to be introduced, particularly in the multi-media sector. The financial advantages the user can derive from the digital network will be decisive in persuading him to take this step.

In the following section we shall look at specific cases where the digital network can be shown to be particularly attractive from a financial point of view.

III. How much does it cost?

1. Introduction

We have seen from the foregoing that the Integrated Services Digital Network can, from a technical point of view, be substituted for a whole range of existing networks. The aim of this chapter is to examine the economic feasibility of that, in other words the profitability of such a project. Our economic approach is two-fold.

The first section aims firstly to break down and explain the costing structure of a communication network, and secondly to compare the cost of using ISDN with the cost of using the STN following a similar pattern. In this section we shall also touch on aspects linked to the use and tariff structures of DCSs (Data Communication Services).

In the second section, we shall compare the cost of using a variety of telecommunication systems for a number of "typical user profiles".

We have chosen to concentrate our analysis on *basic accesses (2B+D)*, on the grounds that at the moment there are very few primary accesses in Belgium[31] and the fact that the cost of installing and subscribing to a primary access in Belgium is prohibitive. Unless otherwise specified, the figures quoted are in all cases understood to be exclusive of VAT.

2. Items to be taken into account when costing the use of telecommunications networks

a) Installation Costs or one-off Connection Fees

These cover the cost of implementing a transmission medium connecting a socket at the user's premises with the public network. In Belgium these costs are regulated and fixed, whatever the volume and nature of the work carried out. This is one of the main features of a universal service.

[31] By the end of 1993, ten or so primary accesses were operational in Belgium, 20% of which was destined for Belgacom.

STN TARIFFS (as from 1.1.94)	Excluding VAT
Connection taxes	
One-off payment for making an STN access available:	3,500 Francs

The one-off payment for connecting up a basic access to an existing line is payable by anybody wishing to be connected up to Belgacom's ISDN network by making use of an infrastructure which has already been installed (NT1 socket (Network Termination), line to the network) but not used until that time. The cost of this is 3,500 Francs for switching via single circuits.

If someone wishing to have ISDN access has no network connection infrastructure at all, or if he wants an additional line, the connection cost is 5,900 Francs (instead of 3,500 Francs) for a circuit-switched basic access. In this case the installation costs cover:

laying the cable between the applicant's premises and the nearest Belgacom exchange;
installing ISDN's so-called NT1 socket in the subscriber's premises
filing an ISDN card for the applicant in the Belgacom exchange[32]

To the one-off payment for making ISDN access available a sum of 500 Francs is added.

EURO-ISDN TARIFFS (w.e.f. 01.01.1994)	Excluding VAT
Connection charges	
One-off payment for making available:	
- one basic access (BA), (circuit-switched):	
to an existing line	3,500 Francs
to a new line	5,900 Francs
- one primary access (PRA) (in accordance with hourly rate)	
- First system (to 01/04/93)	421,850 Francs
- Additional system (same infrastructure as first system)	81,915 Francs
- Conversion of an existing R2 system	81,915 Francs
- One-off payment to modify additional circuit-switching services	500 Francs

[32] The Belgacom exchange must be a digital one.

It will be clearly seen, then, that the cost of connecting up to the ISDN network are these days entirely comparable with the cost of a standard telephone installation. This straightaway constitutes an argument in favour of ISDN.

Furthermore, ISDN enables up to eight devices to be connected to a single connection (on the S bus from the NT1 in fact). Two of these can be used simultaneously. The installation cost for connecting up eight devices[33] is therefore paid only once. Therefore, if on one single line which has been allocated a single number there happen to be a fax and a telephone, the network is sufficiently "intelligent" to activate either the fax or the telephone(s), depending on the type of equipment used by the caller. Every subscriber has two B channels, and it is also possible for A caller to send a fax via one channel whilst at the same time talking by telephone on the other. We could thus imagine the scenario whereby two correspondents exchange views by telephone via the first channel while at the same time simultaneously using the other to access a DP providing tourist information.

In June 1992, for a circuit-switched basic access these installation costs were still 12,500 Francs excluding VAT. We note, therefore, a willingness on the part of Belgacom to levy reasonable tariffs so as to make ISDN offer competitive compared with other public networks.

This phenomenon is not that remarkable for the connection costs of a primary access, since the installation cost here is 391,625 Francs. This sum might seem surprising given that it makes possible a transfer capacity fifteen times greater than a basic access yet only at a cost which is more than 60 times higher. Primary accesses, after a long period of stagnation (only around twenty or so since 1987), appear to have been making spectacular progress of late (more than two hundred primary accesses sold by the end of March 1994), mainly for connecting up to I-PABXs.

b) Subscriber Costs

There is a fixed and recurring rental fee irrespective of the amount of use the network gets, payable in return for the user's right to access the public network. In Belgium this rental fee is at the moment paid every other month, although it is soon to be calculated and collected monthly.

STN TARIFFS (w.e.f. 01.01.94)	Excluding VAT
Rental Fee (per two month period)	
- for a zone comprising fewer than 25,000 subscribers	350 Francs
- for a zone comprising between 25,000 and 99,999 subscribers	375 Francs
- for a zone comprising more than 100,000 subscribers	400 Francs

33 The HLC enables identification of the type of device the caller is speaking to so as to avoid their being "triggered" with each call.

The following is a list of services made accessible through the payment of the basic rental fee:

- Calling Line Identification Presentation (CLIP)
- Connected Line Identification Presentation (COLP)
- User-user signalling
- Terminal portability
- Sub-addressing

The subscriber must pay to access the following additional services:

- call by call CLIR
- call by call COLR
- multiple numbers (8 maximum)
- direct selection by PRA (per 100 numbers)
- direct selection by BA (per 10 numbers)
- closed user group in circuit switching
- secret number
- non-transmission on the network (= permanent CLIR or COLP)
- call waiting signal

We note that this type of additional service is entirely particular to the public ISDN network, even though some exchanges do supply the internal section of a private network with some of the services outlined above.

Rental Fees (per two month period) (w.e.f. 01.01.94)	**Excluding VAT**
Rental Fee for basic subscription	
- for a basic access (BA) (with circuit switching):	2,100 Francs
- for a basic access (BA) (with circuit and packet switching):	8,350 Francs
- for a primary access (PRA)	391,625 Francs
Additional subscription rental fee	
Multiple numbers (8 max.)	150 F
Direct selection by PRA (per 100 numbers)	720 F
Direct selection by BA (per 10 numbers)	500 F
Closed group with circuit switching (per group and per line)	150 F
Secret number	174 F
Non-transmission of number on the network	250 F
Indication of call waiting	150 F
Password	43 F
Information on fixed prices	250 F
Restriction	250 F

c) Utilisation Cost

There is a rental fee which is proportional to the amount of use the user makes of the line. In Belgium this cost is invoiced for on the basis of a unit. One unit equals 5 Belgian Francs. The duration of the unit depends on the time of day the call is made and the distance involved. There is a tariff structure based on duration. Unlike the case with the DCS network, the actual volume of data therefore has no impact on the cost of the call.

EURO-ISDN TARIFFS per Fixed Price Unit (w.e.f. 01.01.94)	Excluding VAT
Fixed Prices:	
- phone call (back-up service: speaking or 3.1 kHz audio)	5F/FPU
- call in 64 kbit/s (back-up service: 64 kbit/s)	2F
- national call	1 F per 1/5 FPU
- European call	5 F/FPU
- intercontinental call	7 F/FPU
- attempt to call	0.5 F

The following table shows the times allowed against one fixed price unit (5 Francs ex VAT), depending on the distance and the time of day the call is made. These times apply to both ISDN and the STN.

Time For One Fixed Price Unit (5 Francs Exc. VAT)			
	Zonal calls (DCZ)	Short distance Inter-zonal calls (DCI/A)	Long distance interzonal calls (DCI/B)
From 09.00 to 12.00 hrs and 13.30 to 1700 hours (red rate)	240 "	150"	40"
From 0800 to 0900 hours, from 12.00 hours to 13.30 hours, and 1700 to 1830 hours (yellow rate)	360 "	180 "	50 "
From 1830 to 0800 hours, also at weekends and bank holidays (black rate)	720"	360"	100"

The fixing of prices for both types of network is identical (except for international calls) and are based on duration. The ISDN network is particularly attractive for the limited transfer of large files, such as graphics files for example. Indeed the high outputs that can be achieved with ISDN lines (64 kbps for an ISDN B channel versus +/- 10 kbps using the traditional analog network) enable bulky files to be transferred faster and therefore more cheaply.

We have carried out some simulations with regard to these file transfers. These have demonstrated that ISDN is particularly useful for companies making long distance, red rate, interzonal transfers. These same simulations have allowed us to go further still and note that while the time of day at which the transfer is made is important (i.e. red, yellow or black rate), the most decisive factor in the cost difference between the STN and ISDN is the distance between the two points of transfer (zonal, short-distance interzonal, long-distance interzonal communication).

It is shown, then, that firms for which ISDN might be an attractive proposition will primarily be those making long-distance interzonal file transfers.

Surveys carried out with users have shown that even in situations where the entire capacity of the network is not used on a daily basis or even regularly, using ISDN can be justified by the simple fact that it does not monopolise a line for too long when sending large files.

d) The Cost of acquiring the Equipment

Here we shall restrict ourselves to showing the cost of certain key items.

ISDN card to adapt into a computer (software included): from 10,000 to 70,000 Francs
ISDN telephone: around 10,000 F
Group III fax: around 25,000 F
Group IV fax, which enables faxes to be sent at 64 kbits/seconds: over 200,000.

e) Cost of maintaining the Equipment

Even though these costs form an integral part of the cost of using a telecommunications network, due to their highly variable nature and size, we shall not quantify them.

f) Other Costs

At this point we would like to draw the reader's attention to a whole host of costs which only rarely form part of the sums when trying to assess whether it would be profitable to change from one telecommunications network to another. Indeed it seems to us that the costs of training personnel in using a new type of network must be included in any ISDN business plan.

When calculating the cost of training the following must be included:

direct cost of the training itself, i.e. payment for teachers, drawing up syllabi, printing the syllabi, hire of lecture rooms, transport and accommodation costs, hire of or depreciation against teaching materials, etc.

indirect cost of training, i.e. loss of earnings due to absence of workers during training period, probable reduction in productivity when the new technology is used, increased stress levels, etc.

post-training costs, i.e. introduction of an appropriate "hot-line" service to help users, monitoring the performance of agents using the new network, additional training sessions to plug any gaps in the original training schedule, etc.

3. *A Comparative Analysis of the ways different Telecommunications Networks are used by several typical User Profiles.*

The tariff structures for the different public telecommunications networks are complicated. The number of parameters to be taken into consideration is such that it becomes very difficult to determine in any absolute way whether any one solution is economically more advantageous than the others. This is why we have concentrated on a comparative study between three typical user profiles: this choice is not, of course, entirely random and the aim has been to use the cases in point to explain where a connection to the ISDN network would be financially beneficial. We shall therefore look at the following cases:

a private residential user

a lawyer

– a designer

a) The Private Residential User

Example

- he uses his telephone around five hours a month.
- his invoice covering the cost of using the phone and the line rental fee (payable every other month) is 3,000 F.

In the case of a residential user who only uses his telephone to make telephone calls, clearly ISDN cannot be attractive in terms of cost reductions. In fact, the tariff structure *for using* the telephone with both the STN and ISDN is identical (5 francs ex. VAT per fixed rate unit price), and therefore there are no gains to be made here. ISDN is even disadvantageous given the line rental fee he has to pay every two months : 2,100 F (for two independent B channels, which are in fact two telephone lines) as opposed to only 700 Francs for a residential user in a zone having fewer than 25,000 subscribers.

Thus instead of paying 3,000 Francs every two months, a residential user following the same telephone communications pattern but using ISDN instead of the STN will have to pay a total every two months of 4,400 Francs. To this we must add the consideration that the cost of connecting up to the circuit- switched ISDN is 5,900 Francs for an initial installation and only 3,500 F for connecting up to the standard STN.

Consequently the decision as to whether this typical user should opt for ISDN can only lie with criteria other than that of a reduction in costs.

At this level the subjective usefulness of the panoply of additional services offered by ISDN might in some cases constitute a decisive argument. The type of partner the user will be called on to be in contact with might also be a determining factor.

b) The Young Lawyer

Example

- uses his phone around 20 hours a month (about an hour a day)
- he consults the "Justel" data base for around two hours a month (eight times at an average fifteen minutes a time). Calls are made during the red rate period and are typically long-distance interzonal
- he has a *dedicated* fax line which he uses to send around 100 pages a month

As with the residential user, no reduction is possible on the cost of using the system to make phone calls. On the other hand, since two standard lines are being used the

difference between the total monthly rental fee payable for the two traditional connections and the total for ISDN line rental charge is now only 700 F instead of 1,400 F.

So far as the cost of consulting the data base is concerned, it can be considered that two thirds of the time used is spent in researching and reading documents and one third on the sending or receiving of data as the case may be. The costs associated with researching and reading (two thirds of the time) cannot be reduced any further by using one telecommunications network rather than another, although in contrast the costs involved in making transfers via the network itself (one third of the time) an be reduced. If he were using the STN, then consulting the data base in the way described above would cost 1,800 F.

Using ISDN would thus reduce between six and eight fold the time needed to transfer items of information and data using the network and this would bring down the overall cost of consultations to around 1,300 F. As we have pointed out in section 1, it is clear that using ISDN does not, compared with the STN, allow large sums to be saved on the cost of consulting data bases because the time needed for certain operations cannot be reduced. This is all the more true when the files being exchanged are only small and therefore only involve very short transfer times (which is often the case if the data base being consulted is a "text" data base). The difference in cost (500 F) as a result of using ISDN instead of the STN to consult data bases does not therefore offset the additional 700 F rental fee payable every two months for using this network. ISDN thus appears to offer few advantages for this type of operation.

In fact, with this pattern of use the lawyer would be much better off using a network with a packet-switch facility such as the DCS. Indeed, he would be able to take advantage of this network's tariff structure which is calculated on a pro rata basis of:

the volume of information sent (number of data packets)[34]
how long the call lasts.[35]

This system is particularly advantageous for somebody who consults text data bases. When a text data base is called up, it is usual to remain connected for quite a long time (a quarter or an hour if not longer) while searching for the data required and then only repatriating data making up small files (typically resumes of the literature). Given the extended connection time, such a procedure would prove costly if it were done using a network where the tariff reflected the time spent on the line, such as ISDN or the STN; in contrast, because of the small amount of information circulating when data exchanges are made, the DCS network, thanks to the way its tariffs are structured, enables very low user costs to be achieved.

Finally, with regards to sending faxes, using a Group IV fax machine with ISDN would allow transmissions to be made about eight times faster than with a standard (9,600 bps) fax. The prohibitive cost of "Group IV" faxes compared with "Group III" type fax machines (currently used with the STN) does not justify investing in ISDN from a financial point of view.

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34 One packet is made up of 10 segments and represents a size of 512 Kbytes.
35 Costs linked to how long the call lasts are very low for the DCS network.

c) The Designer

Example

- he uses his phone for around 12 hours a month
- 15 times a month he sends a 1 megabyte graphics file to a printer based in another neighbouring telephone zone (application of the neighbouring interzonal tariff (=DCI/A). Ten of these are sent during the red rate period and five during the yellow rate period
- he has a dedicated "fax" line which he uses to send about fifteen or so pages a month.

The designer clearly uses his computer more than the lawyer: he consults and retrieves graphics files on a regular basis and regularly sends draft designs and "mock-ups" to a printer with whom he works. This, incidentally, justifies the use of one line for his computer. The two other lines are for the phone and the fax. In the case in point, he is using three connections to the network and the rental fee he has to pay is *at least as high* as that of ISDN.

When sending graphics files, their transfer via a modem (9,00 bps) using the STN needs almost a quarter of an hour per file sent at a monthly call cost of around 1,500 F. Using ISDN and taking advantage of its high speed transmissions would mean each file could be sent in scarcely more than two minutes at a monthly call cost of plus or minus 250 F. This proves the case of what we have been arguing earlier: i.e. that ISDN is financially advantageous when used to transfer bigger files such as graphics files.

As for the fax, it is clear that our designer has even less interest than the lawyer in opting for a Group IV fax (and thus for ISDN) since he sends very few faxes except for the purchase of equipment that might be beneficial to him.

4. Conclusions to the Financial Section

The economic advantages of ISDN are two-fold

1. Seen from the aspect of services integration, the payment *of one single* rental fee every two months means:

   a telecommunications infrastructure can be made available which enables any type of transfer or communication to be made (telephone, fax, visio-conference, EDI, BDD, etc.). The same cannot be said of other infrastructures (the DCS, for example, which is dedicated to data transfers, etc.)

up to eight devices can be connected, two of which can be used simultaneously.

2. The speed at which ISDN allows data to be transferred is a particularly useful tool for sending and/or consulting large files (graphics files, for example) compared with the performance of transfers made via other means such as the standard telephone network. To sum up, our analyses show that:

   the more distant the points of transfer, the greater the ISDN economies there are to be made compared with other networks.

   the greater the proportion of transfers made during the highest tariff period (the red rate), the more marked the difference in transfer costs between ISDN and the STN.

   the bulkier the files transferred, the greater the savings on the telecommunications costs generated by the use of ISDN.

IV. Conclusions and Recommendations

The Spread of ISDN in Belgium

In Belgium a three-way development can be observed.

Firstly, large companies (non-residential users constitute +/- 75% of subscribers to the Belgian public operator) are taking advantage of this new type of network by substituting it for their existing ones. This is happening without too many problems because the bigger companies (particularly multi-nationals) have a highly-developed telecom culture and technical competence in line with that culture. Within this framework, ISDN can provide a "plus" essentially in terms of profitability, without modifying to any great extent the way work is organised or the technical qualifications of the users. ISDN is, then, an essentially technical problem dealt with by company technicians. The applications we find in this sector are principally: file transfers, local network inter-connections, GIV fax, video-conference, rental line backup.

The migration to the ISDN network of existing applications using traditional networks is characteristic of a first wave ISDN distribution in France and Germany. This is particularly evident with bigger companies.

A second development is affecting small and medium sized enterprises. Outside of Belgium these currently comprise a growth market for ISDN. In France, Numéris is the network used by half of all new SMEs. Low volume consumers of rental lines, local network interconnections or videoconference facilities, they have waited for reasonable prices and for standards to stabilise in respect of both the equipment and the network itself.

The use of ISDN will spread in these sorts of company, mainly for long distance file transfers. The needs are immense. They cover not only actual clients but also others for whom ISDN would until now have been unthinkable on the grounds of cost. They concern not only exchanges between SMEs themselves, but also exchanges between SMEs and their major suppliers and SMEs and public bodies. As to this latter sector, we feel these could play a motor role in the spread of ISDN. For example, it is clear that the

chance of using ISDN to access plans being dealt with by the Land Register could have a "multiplicator" effect on the number of connections to the network (lawyers, architects, town planning services, property agencies, etc.)

These SME's often have little in the way of computer culture and are thus at the mercy of consultants who are fortunately becoming more and more numerous. For an SME, the decisive argument is to have a "plug and play" solution. At this level one can only try to encourage the public operator to itself supply this type of equipment, as it has always done for other types of terminal, i.e. telephones and telefax. This would enable SMEs to have one single talking partner and thus the certainty of having one global solution that works. One such solution (codec + ISDN telephone + connection) would need to have to be sold by Belgacom at a price of 30,000 FB ex VAT.

The third wave of applications concerns those that are accessible to the general public. Here we have found a real "knowledge gap" separating users and the staff at outlets selling ISDN equipment. The ISDN market has thus tended to remain a niche market targeting the initiated.

Advantages and Drawbacks to the Spread of ISDN

ISDN is a universal network insofar as it enables several applications which would otherwise need different networks to function simultaneously: telephony, visiophony, file transfer, EDI, access to text, image or multi-media data banks, electronic mail, videoconference - these are just some of the applications the Integrated System Digital Network can today support in Belgium.

ISDN offers certain specific features that are likely to have a number of effects at a number of levels (technical, financial and social) and which could equally make them easier to adopt. ISDN is the only public network in Belgium which currently provides access to multimedia Dps to a wide public of residential and vocational users.

ISDN network offers the chance to save on time thanks to the speed of its output and the integration of data, services and applications. This time saving is naturally leading to a growing number of satisfied network users, to efficiencies in the services offered and the way work is organised, if not reorganised.

Several elements have for some time now hindered the spread of the ISDN network in Belgium. Obstacles were originally technical (lack of standardisation, geographical coverage restricted to major towns, scarcity of operational terminal equipment in Belgium, etc), and financial (very high statutory connection and running costs, complicated standards requiring assistance from scarce and therefore expensive specialists, the astronomical price of terminal equipment (codec, TA's, GIV fax, telephone, I-PABX, etc.)

Today these obstacles have disappeared or are en route to disappearing: Euro-standards have set down the main technical features of the terminals and ISDN connections; Belgacom has reduced its tariffs by 50% thus bringing them into line with the X-25 network and STN: geographical coverage will soon be 100% and already covers 80% of Belgian territory; the cost of terminal equipment (except Group IV fax machines) has now achieved a competitive level. New forms of resistance are, however, being felt and we shall be detailing the more important of these below.

Development of a Knowledge Gap

The ambiguity surrounding the term 'application' bears clear witness to this gap separating engineers/ideas men from end-users. The user does not buy a technology for itself but so he can use it in a way that is of benefit to him. He is not capable of imagining what it might be used to do except by making focused comparisons with pre-existing uses, and unfortunately in Belgium it is still quite rare for ISDN to be presented in a non-technical way. One office recently told us (in the context of the launch of an important telematic project), that it had chosen the only firm which had (more or less) covered what it was looking for.

Belgacom's exclusively technical presentation of ISDN is not there to help change this state of affairs. An advertisement showing a fibre optic "in action" is certainly not a good vector for distributing a new network. A cable fitted with an RJ-45 plug (signifying (for those who might not have understood): A-LINE) is developing the technical integration argument which, as we have seen, is not a decisive one.

We can only ask ourselves what percentage of potential users would have the technical culture needed to understand

a) that the illustration in the advertisement is a fibre optic
b) that the fibre optic means that both voice and image can be transferred etc.

In contrast with this, Deutsche Telekom's advertising literature shows dozens of users using ISDN for traditional applications in their business settings.

> *Several telematic projects have come to nought in Belgium because they made no attempt to integrate themselves into an existing sociability but instead, via a new technology, tried to create a new type of Utopian sociability.*

This is a bit as if the ideas people behind "Bancontact" had developed their whole process not based on the patterns of use shown by the client at the counter of the branch of his bank but instead on a new type of mysterious network that was a little bit of this, a little bit of that, thereby trying to inculcate in the client, in addition to accepting a machine in the place of a person, a new type of concept in his relationship with the bank. Of course, we could reasonably believe that the multiplication of electronic payment terminals has modified the cultural perception of the bank, although we feel it is very difficult to believe this cultural change could have been foreseen, programmed by the network's technical ideas men.

> *The user of a network always assesses it by comparing it with existing patterns of use.*

A technology, however seductive it might be, never constructs a new type of sociability by itself. It is not very likely that we shall reach the stage of modifying in any deliberate way the secular practices to be found surrounding inter-museum loans of works of art.

On the other hand, it is likely that the introduction of a multi-media DP for loans of works of art based on a description including a photo and various coordinates has every chance of failing if those responsible for the project do not first concern themselves with the type of practice in place for inter-museum loans.

Innovative experiments which attempt to create a new type of network must first be made the subject of an exhaustive study of what is already in place, of the user's real needs and practices, and attempt to show that there is a kind of 'given' sociability that any new network will at all times need to respect or develop.

Experiments attempting to substitute one type of technical network (e.g. ISDN) for another (e.g. X-25) can work on the basis of a technical and financial profitability study.

Today ISDN represents the fruit of ten or more years of trying. It is at the moment technically adapted to multiple telecommunications applications and is financially profitable in many cases in point. With just a thousand subscribers in Belgium it is still cruelly under-used. It will not succeed in seducing millions of subscribers away from Belgacom's various networks unless it emerges from the technical field where it has remained confined for so long so it can be transformed by the different types of human networks that are liable to want to tame it.

At the dawn of the 20th century, a number of technical innovations are running into distribution problems. As with all ecological problems, these innovations cannot be understood except through a multidisciplinary approach. Designed by engineers and marketed by technicians, the Belgian ISDN has not known how to create true convergence between standardised technical innovation, commercial marketing and social adoption. An Integrated Services Digital Network, ISDN today appears to have missed the social integration train. A number of urgent steps, principally on the question of marketing and training, must be taken so that ISDN does not become a network which is socially non-integrated.