PRELIMINARY STUDY OF ECONOMICS, MARKETS, AND POTENTIAL DEMAND FOR ISDN SERVICES

Prepared for:

DEPARTMENT OF COMMUNICATIONS

Ottawa, Canada

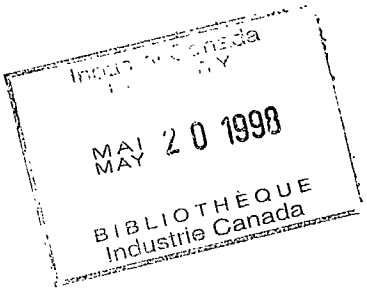
Prepared by:

COMMUNICATION SCIENCES RESEARCH CORPORATION

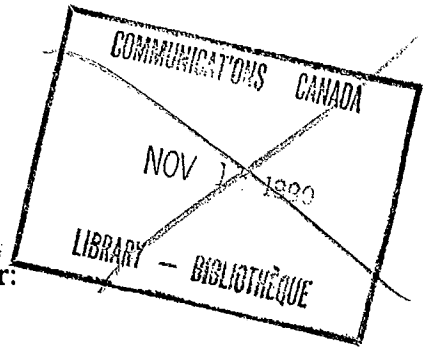
Ottawa, Canada

July, 1989

COMMUNICATION SCIENCES RESEARCH CORPORATION



Preliminary Study of Economics, Markets, and Potential Demand for ISDN Services



A report prepared for:

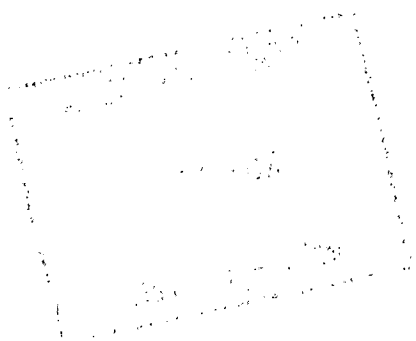
DEPARTMENT OF COMMUNICATIONS

Ottawa, Canada

Note to readers

A disclaimer is necessary and conventional in a report of this type. Accordingly:

The opinions expressed herein are those of the author and do not necessarily reflect the views of the Department of Communications



PREFACE

This report, prepared by Communication Sciences Research Corporation on behalf of the Department of Communications, is a different kind of a document from many that have preceded it on the subject of ISDN--the Integrated Services Digital Network. As the title reveals, the focus of the report is primarily on economics, applications, costs, benefits and other user issues, rather than on technology and other technically-oriented descriptions and discussions.

The report is different in other ways also, however. For example, as of the date of writing--e.g., mid-1989--a number of things have happened in the ISDN field, especially in the U.S., that allow us to report briefly on actual takeup of ISDN in a commercial sense, rather than trials. This is an important distinction to make at the outset because it represents, in fact, one of the particular reasons for the study. In other words, actual results, in real market situations, are a great deal more interesting than technological and market trials, because, simply, the latter are too often artificial with respect to real usage in the marketplace. This aspect, then, also differentiates the report from others that have been written in the past.

As a result of the above--and other orientations toward establishing a better understanding of what ISDN really is, separate from NT1s, NT2s, T-interfaces, U-interfaces, and all the other technical details usually described--very few if any diagrams, charts, interface descriptions and so on are included. Moreover, because it is a preliminary report, the situation existing today cannot be dealt with comprehensively. Instead, our direct and very conscious intention is to attempt to develop an "appreciation" for what is happening in the field, essentially as a first step to more comprehensive and exhaustive analyses including, eventually, market studies specifically directed toward Canada.

As the reader will see, we have attempted to make the report as easy to read and digest as possible--(except, perhaps, in the context that considerable familiarity with the subject matter is assumed, since we do not start at the beginning, explaining every detail of what ISDN is all about). More than likely, some of what we have to say will be controversial. However, if this stirs up more debate on what ISDN actually is in a market sense, and where it is headed, the report will have served its purpose.

We hope this will be the case.

ACKNOWLEDGEMENT

This study was carried out with valued assistance from Ken F. Luengo, Consulting Economist and an expert in telecommunications matters. Without Ken, it would have been a much more difficult project to accomplish, as he spent many hours collecting materials for the work only to find that, because of our particular and very special orientation to the subject, much of the material was ultimately of less value than we would have liked. Nevertheless, thorough searches had to be accomplished in order to identify what *was* of use--and for this and other reasons, including our many spirited discussions, we are most grateful to Ken.

It is also a pleasure to acknowledge the support and assistance of Doug MacEwen, Manager, Industry Structure Analysis, Telecommunications Policy Branch, Department of Communications. Doug was our departmental representative on the contract and as such deserves a great deal of thanks for assistance in getting the project started, support during its unfoldment, and patience while conclusions were being arrived at--many, of course, which came as a surprise to all of us. Thank you Doug; let us hope that the work and our joint efforts will stand the test of time.

CONTENTS

ILLUSTRATIONS

TABLES

I INTRODUCTION

The subject of ISDN, the Integrated Services Digital Network concept, is a fascinating one. Indeed, so much has now been written on it that one would think there is nothing left to say.

To the contrary, however, we have now, in this study project, had an opportunity to review an enormous amount of information on the subject, and in summary are abjectly astonished at how much time has been spent and how many words have been written that still assist users--i.e., potential buyers of this new technology--not one whit in establishing what ISDN really is and whether or not it makes sense.

It is important to understand that we are not alone in this type of criticism. Indeed, it is now recognized that such concern is widespread among the user or potential user community, and getting more so all the time. To quote, for example, one recent author:

> There has been a vast array of papers and articles on the subject [ISDN], yet they seem only to confuse the potential user.
>
> and
>
> It is difficult to get behind the technology, the hype, and the motherhood statements that proliferate the ISDN scene today, to identify the real business benefits that can be obtained...[1]*

and another author:

> ISDN is a Technology; Users Want Solutions, Not Technologies
>
> ---
>
> ISDN Relies on Vendor-Push Rather than Market-Pull
>
> ---
>
> Current ISDN Trials are Fishing Expeditions for the "Golden ISDN Application"
>
> ---
>
> ISDN is Basically a Voice Concept in an Era Increasingly Dominated by Data

---

* References are given at the end of the report.

and

ISDN for Data Comes Too Late for LAN Customers, Too Early for Everyone Else.[2]

These authors and others like them are voicing some of the concerns. At the same time, we find, most everyone who is knowledgeable of the status and impetus of ISDN, around the world, seem to subscribe to the view that "ISDN is coming," like it or not, simply because the telecommunications administrations want it to happen.

Background, Scope and Objectives of this Study

There is no possible way that this preliminary piece of work can deal comprehensively with these matters. The subject is entirely too broad, and as seen above it is already fraught with controversy. However, what we do believe we can do is put at least some of the aspects of ISDN, today, in a more appropriate and accurate context than they might have been presented in the past. In a sense, then, this is our basic, overriding objective.

In addition, there are some specific objectives we have in mind, some of which are listed below:

- To attempt to differentiate between the "hype" that many have mentioned, and the reality of ISDN that is actually being implemented;
- To identify where, to the extent possible, ISDN is being used, and what it is being used for;
- To address some of the issues identified by Falconer and McQuillan in the references cited above; and
- To suggest ways in which more information, of a substantive nature, can be obtained, in order to provide more legitimate and informed bases for decision-making in this still-new technological subject area.

In the Beginning...

Perhaps one of the greatest difficulties in attempting to write about the above kinds of issues, in a subject as broad as ISDN now is, is knowing where best to start. Essentially, however, there are two "beginnings" that are

relevant--first, the beginning of ISDN, and second, the beginning of our preliminary study of it. These are linked, of course, but they are separable as well, and we have come to the conclusion that, in order to not only make the report understandable but to give the reader a sense of our orientation toward the subject, some of this background is necessary.

ISDN

Our approach to the first of these follows these general lines:

1. ISDN is not new.*

2. ISDN is an evolutionary rather than a revolutionary concept.

3. ISDN is not *"the same as"* "digital," nor is "digital" necessarily the same as (i.e., synonymous with) "ISDN."

4. There are two ways in which ISDN may, conceivably, develop in North America, and most particularly the U.S.:

   (a) If telcos, of any stripe, decide it is to their economic advantage to implement it, or

   (b) If users decide that it is to their economic advantage to have it implemented.**

5. Item 4, we believe, may be different in at least some European countries, although this situation is by no means clear.

6. "Integration of services" is already happening to an enormous degree in the U.S.--perhaps, even, to a much greater degree than most people realize--yet *at the very same time,* ISDN, itself, is in place in only a very few locations--and there are even substantial questions as to whether it is 'really ISDN' in many of those locations.

---

* I.e., within the telephone industry. To users, of course, it *is* new.

** What we are trying to suggest here, at the outset, is our conviction that nothing but economics will, in the long run, be the deciding factor in these matters. In other words, grand ideas from a technologist's perspective of what can or could be done, theoretically, with "integrated voice and data" for example, will have little or nothing to do with how ISDN develops. Instead, users will decide whether integrating voice, data, image, full motion video, etc., makes sense to them, in specific, particular circumstances--or alternatively, telcos will do the same, from their own economic perspective.

7. Item 6 suggests that, somehow, a great contradiction is going on in the ISDN field. We suggest, however, that that is not at all the case. Instead, because people have not drawn clear enough pictures of what they are talking about in all cases--as a result of the fact, for example, that terms such as "integrated" and "digital" are used almost indiscriminately--what has happened in the field is that great clouds of confusion have arisen, despite technologist's attempts to be precise. We are overwhelmingly convinced that this has occurred because ISDN is a technologically-driven initiative rather than a market-driven one, and this confusion will continue to occur until technologists, also, address user issues appropriately.* A report such as the present one may not help this situation at all, of course, but our desire, at least, is to open the matter up, for close examination.

We will have much to say about these and other relevant issues in this report. Before we can begin, however, we need to elucidate somewhat more clearly our original objectives with the research, and how these have gradually changed somewhat, during the course of the undertaking.

Our Study

The research for this study began as a proposal to the Department of Communications to investigate, preliminarily, the following kinds of issues:

- What will ISDN do for users?
- What will it do that can't be done today?
- How much will it cost?
- What types of entities need it, and why do they need it?
- What is the relationship of ISDN to local area networks, wide area networks, value added networks, metropolitan area networks, etc.?
- Is it good for voice? and

* McQuillan's article, cited in Reference 2, has insightful comments to make on this point. Thus, we recommend it highly to readers of this report, also.

- What about 2B+D vs. 1B+D, vis-a-vis present usage patterns?*

What we have found, since we began the work, is that (a) questions such as these are not as easy to answer as we would have liked and (b) they cannot be addressed, adequately, without spending a substantial amount of time on the context of ISDN--that is, what is it, what is it not, and how does it fit into what is also going on in telecommunications, totally outside the domain of ISDN.

As we will see, gradually, these have become enormous issues. For example, does the fact that telecommunications systems are becoming digital at a very fast pace suggest, automatically, that ISDN is just the next step? (We think not--necessarily). Or, because digital transmission and switching have proved so successful in the network, it then follows that digitizing the local loop--i.e., the so-called 'last mile'--will also be successful? (Again, we think not--i.e., necessarily).

The Context--That is, What is ISDN, From Our Point of View?

Let us begin by suggesting that *digital telephony* is, by now, a fact. It was not always that way, of course. In fact until very recently, most participants in the industry, as well as most observers, assumed that it would be many, many years before North American networks were all-digital, because such an enormous amount of investment was already 'in the ground' in analog equipment, in both the U.S. and Canada.

As it has turned out, however, largely because of the U.S. position of encouraging and stimulating competition, including the breakup of AT&T, each of the interstate carriers in that country has been put in a position of modernizing its network entirely within the context of competition and market forces, rather than the traditional engineering of 'proving in' new systems economically, before they were installed. In other words, if AT&T, or MCI, or U.S. Sprint could see that for marketing reasons--i.e., either retaining or increasing market share--it made sense to replace perfectly good analog systems with digital ones, they would do it, in order to remain competitive.

This, of course, is what has happened. Each of these interexchange carriers, or IXCs as Americans refer to them, has digitized its network, or is in the process of digitizing it, almost totally. Moreover, each of these carriers has taken the further step of implementing another aspect of what is a prerequisite to ISDN, namely, conversion to the internationally agreed upon out-of-band signaling system known as SS#7. As we suggest, these two

* This list is a subset of the questions we proposed. The full list is given, as part of the Statement of Work for the project, at Appendix A.

elements--digitizing and SS7--are both prerequisites for ISDN. What we do not suggest, however, is that the carriers we mention, AT&T, MCI and U.S. Sprint, have made these moves primarily because of ISDN. Instead, they have made them for good and sound business reasons in their main line of business, that is, capturing (or retaining in the case of AT&T) market share in the long distance transmission of voice telephone calls--nothing fancy, just *plain old long distance telephone calls.*

We don't know, of course, if the above theory is precisely correct. We are confident enough of it, however, that we have essentially based this report and its conclusions around it, as a reasonable, effective, working hypothesis. What we are saying, in other words, is that yes, there is a "D" in ISDN, and it does indeed mean "Digital." But a digital network can be developed and put into place for many reasons, only one of which is the implementation of integrated services in an ISDN format. Indeed, when digital telephony was first introduced, in 1962, the motivation was not at all a "world-wide digital network system." Instead, it came about precisely because of sound, traditional, engineering-economic reasons, i.e., the proving-in of PCM-encoded digital voice signals over interoffice trunks, at distances in a range from about 20 to about 50 miles: not long distance links, and not very short ones either, but only for those precise, carefully engineered uses, in (usually) highly congested metropolitan areas.[3]

Now, what does this all mean, and where is it getting us? We answer as follows.

First, as we mention above, digitization of transmission and switching in long distance networks is proceeding at an extremely rapid pace in the United States.* Second, despite this fact, with extremely rare exceptions this digitization does not follow anything that could be called ISDN (as it is now universally accepted), because in order to be ISDN, 64 kbps clear channels must be used. As is now well known, digitization has taken place in North America using, virtually in its entirety, T1-based PCM encoding in which part of the bit stream is used for signaling and control, leaving only 56 kbps of "clear" transmission capacity. Of course, one of these formats can be converted to the other and vice versa (provided appropriate alternative accommodation is made for signaling--as in ISDN's primary rate format, or "23B+D," as it is called). At the present time, however, the networks are T1-based, and conversion to 64 kbps clear channel operation will only be made when it is necessary to do so, for market-based reasons.

---

* It is occurring in Canada also, but not for quite the same reasons, since competition in long distance is not yet an accomplished fact.

Third, given the above, where does ISDN fit in, in today's present scheme of things? Our view, in brief, is that ISDN must be thought of almost exclusively, for the present, in terms of local loops. In fact, we feel strongly enough about this point that we are inclined to suggest a totally different concept from that espoused by the CCITT (where "end-to-end digital transmission" is a given), in which ISDN is defined simply by whether or not a loop is (a) digitized, and (b) digitized according to CCITT's ISDN standards.

If we examine this definition closely, a number of interesting elements emerge. First, of course, is the fact that by using the definition, ISDN lines in place can be "counted." Moreover, ISDN lines can be separated, clearly, from other lines that are also digitally encoded, but not according to CCITT standards--(i.e., CCITT standards for ISDN). Thirdly, as may be easily recognized, nothing in the definition suggests that end instruments themselves need to be digital devices--(although, of course, one would think that would be a reasonable and natural course to follow). Instead, a scenario in which analog instruments as well as digital ones are used at a facility, all connected through a digital PBX/NT1/NT2 device and then over ISDN lines to a telco central office, would be an entirely acceptable instance of ISDN use. [In this case, of course, the PBX/NT1/NT2 device would be responsible not only for interfacing with all digital instruments, but for performing the actual digitization of analog signals coming to it from analog instruments--(all, note, according to ISDN, 64 kbps clear channel requirements)--as well as digital-to-analog conversion in the reverse direction.]

Finally, it must be noted that, despite allowing for the situation described above, in which both analog and digital instruments are used at a site, only the digital instruments would be capable of participating in a true ISDN environment. In other words, what we are here trying to separate are those instances in which "ISDN-like" services are made available,* without using an ISDN channel to implement them. That this can be done has now been clearly demonstrated, and it is, in fact, one of the major elements that may put ISDN in an entirely different position, in North America, from what it was conceived to be originally.[4]

Summary

Recapping the discussion thus far, we suggest in this report that ISDN need not be thought of as end-to end digital transmission but only whether or not local loops are encoded according to CCITT ISDN standards, namely clear 64 kbps channels with at least one D channel operating at 16 kbps or appropriate multiples thereof. This description suggests, essentially by

* Calling party ID is a particular example of the above, but it is by no means the only example. This will be discussed in more detail, later in the report.

definition, that "islands" of ISDN will exist, just as individual local area network installations exist today. Interconnecting these "islands," then, becomes a separate subject--just as interconnecting LANs is a major, separate topic today.

In the remaining chapters in the report, we attempt to build on this description in a number of ways. First, in Chapter II we elucidate the best information we have currently been able to garner on who has actually "purchased" ISDN lines, and what they are using them for. As the reader will see, this discussion is confined totally to the U.S., for two simple reasons: (a) no ISDN lines at all have yet been "sold" in Canada;* and (b) in our opinion the likelihood of Canada following Europe as opposed to the U.S. in ISDN matters is virtually nil. Under these circumstances, whatever happens in ISDN in Europe is much less relevant than what happens in the U.S. This is a biased position, of course, but not an unreasonable one, for the purpose of the present report.

Chapter II also begins to address the issue of alternatives to ISDN. Here, we admit, we are on very preliminary ground, because this study has afforded neither enough time nor enough funding to thoroughly understand and thus describe to readers how all of the alternatives work. We do do our best, however, to put these and a number of additional key issues on the table.

Next, Chapter III of the report is concerned with futures. In this chapter we attempt, in an early and abbreviated manner, to shed light on what might come about in ISDN in the U.S. and Canada over the next five years or so. What we are able to do at this stage, of course, is based entirely on data assembled for this early project. The chapter does give insight beyond what is generally available, we believe, but as we also point out later, it is "expressly put forward as a preliminary view."

Finally, in Chapter IV we briefly discuss the crucial matter of additional required data in order to make informed and valid decisions on ISDN. Because this field is so new, especially in Canada, it stands to reason that sufficient research has clearly not yet been accomplished, especially on market and demand issues. We describe this fact. therefore, and suggest that much could be accomplished if appropriate resources are made available.

---

* According to news reports (e.g., Canadian Communications Reports, March 15, 1989), Canada's first commercial use of ISDN was scheduled to begin sometime in mid-1989 at Saint John Shipbuilding Ltd., Saint John, New Brunswick. More details on this project will, of course, become available over time. Unfortunately, however, they were not available in time to be included in this report.

II ISDN TODAY

We begin this chapter by describing briefly the method used to approach our work. As indicated in the Statement of Work (Appendix A), our first objective was to collect and use "readily available" materials to do the study. What this meant, in essence, was articles, papers, research documents, conference papers and proceedings, newsletters and so on, all of which, when combined, would yield good information on the specific topics at hand.

As we say, this is what we assumed would happen. Indeed, we did identify and collect an enormous amount of information. (The reference list and the bibliography give some of the details on this process). Unfortunately, however, far and away the majority of this information, especially conference proceedings and seminars it turns out, is devoted to "what ISDN will do for users in the abstract"--that is, it approaches the subject not from the practical point of view, with examples that are meaningful, but from the point of view that we are inclined to refer to as "technological niceties."

One example will suffice to illustrate our point. It is the scenario, often repeated, in which voice and data are needed and used by an individual, simultaneously, from his or her desk. Typically, this would involve talking on the telephone and using a terminal or personal computer at the same time, to, for example, reference a computer file relevant to the person being talked to. Alternatively, it is suggested, simultaneous voice and data would be required for the situation in which one participant in the conversation wanted to send the other participant a graphic image at the same time they were talking (say, a facsimile message), or interact with that person in real time with their respective computers while, again at the same time, talking with them verbally.

The implication of examples such as the above, when they are discussed in the context of ISDN, is that ISDN would be (and usually "will be"), the ideal and even compelling implementation vehicle for such things to occur. On the other hand, while it must be said that we have no quarrel with the notion that, theoretically, such activities could be carried out using ISDN technology, we do have grave reservations about two elements of the problem:

1. How often do such scenarios, or might such scenarios, really occur--i.e., in practical terms; and

2. Of those situations in which these kinds of examples are really practical, in a business sense, what proportion actually either require ISDN, or could be carried out in a real, significantly enhanced manner, using ISDN?

The answer to these questions is crucial, because they address the "market need" issue as opposed to the "technologically doable" issue. And again, unfortunately, we are compelled to report that the situation with ISDN is not as healthy as one might like it to be. Instead, instances of strong need for simultaneous voice and data are not as widespread as might be imagined, and where they do occur, the contribution of ISDN is considerably less than ISDN enthusiasts would have us believe.*

Considerably more will be said on these matters later in the report. Suffice it to say now, though, that they are central to the controversy surrounding ISDN at the present time. We know this because, after reviewing in depth virtually all the documents in the bibliography, not more than ten percent were really useful to our study (on market realities...etc.), and these turned out to be almost exclusively, newsletters--particularly, the *Probe ISDN Report*.5

This publication, we were pleased to find out, is sensitive to user issues, reports "less heartening" as well as "upbeat" news, reflects to a considerable degree realities in the marketplace--(although not always it should be noted)--and, in general, thus presents a considerably more balanced view of the situation facing ISDN today, than might otherwise be available. Actual "sales," for example, of ISDN lines (the local loops mentioned in Chapter 1), are reported to the degree that Probe is able to ascertain such information, and Table 1 illustrates one such tabulation, compiled and extracted from individual references in issues over the period January 15, 1988 to March 15, 1989.**

---

* This is not meant to be an inflammatory statement, although it could, no doubt, be interpreted that way. What we are trying to say, simply, is that discussions of new technology are not usually helped by introducing theoretical arguments; however, they are always helped by using practical illustrations, and this should be done more often than it apparently is today.

** *Probe ISDN Report* was a monthly publication through September 1988. Beginning in October it became a semimonthly publication; thus, some 17 issues are represented in the list in Table 1.

Table 1

Compilation of ISDN Sales, Taken from *Probe ISDN Report*, January 15, 1988-March 15, 1989

Date of Mention in Newsletter	Company	Number of Lines Reported/(Note)
January, 1988	Tenneco	-- (1)
	Shell	-- (1)
March	Commonwealth of Virginia	--
June	3M	-- (2)
July	AT&T Bell Labs	9500
August	Microcom	60
	U.S. Air Force (Mather AFB)	200
September	M.I.T.	--
	Univ. of Arizona	14,800 (3)
October	Motorola	--
November	Traveler's Insurance	12
December	City of Fresno	100
February, 1989	GSA (U.S. Gov't)	114,000

Notes

(1) Elsewhere, reported to be 5,000 each, or 6,000 for Shell
(2) Elsewhere reported to be 3,165
(3) Number of telephones = "several hundred"

Cumulative Number of Lines to Date

Quite obviously, a quick glance at Table 1 reveals that any attempt to get really solid numbers on ISDN lines in place, to date, is significantly hampered because so many gaps exist in presently published (or at least openly published) information. On the other hand, Table 1 does give significantly more information than we have seen elsewhere, and if the data are even reasonably reliable, they can be used to show a trend.

Now, we introduce the item that had the ISDN world buzzing during 1988, namely, the statement that "...by year end 1988 AT&T will have deployed almost 200,000 ISDN lines to commercial customers served via 54 RBOC COs..."[6] [i.e., Regional Bell Operating Company Central Offices]. Probe reported this statement as originating from "...a rather casual remark by [AT&T] Network System's VP of Marketing and Customer Operations, William Marx...,"[7] presumably at a press conference held sometime prior to March 15, 1988. From this information, it is possible to ascertain at least three additional pieces of data:

1. Examination of whether or not the 200,000 lines are correct as of last year;

2. If not, how close would the correct number be to 200,000; and

3. Are these actual ISDN lines, with digital telephones (or some other digital instrument) on the ends of them--or something else that so far we "don't know about?"

To find even partial answers to these questions it was necessary to probe further, so we decided to do a bit of investigating on our own. First, of course, we carefully reviewed all of the remaining issues of the newsletter we have been discussing, compiled the list in Table 1, and made note of the fact that, until the announcement of the GSA "sale" in the February 1, 1989 issue, Probe's year-end line count was just under 36,000, including (they said), trial as well as commercial lines.[8] Second, we reviewed all available copies of a second newsletter, *ISDN News*,[9] for corroborating evidence. And finally, not wishing to take either of these sources at face value, we made a few phone calls of our own--(i.e., again, after searching in vain for data on this subject virtually everywhere else).

Fortunately, this move provided us with the information we were seeking. Was 200,000 the correct number for lines in place at end-1988? No, unfortunately, it was not. Instead, the number was considerably less than 50,000--i.e., less than 1/4 of AT&T's announcement earlier in the year--and of those lines, at most half were actually in place.[10]

This exercise, minor though it was, was illustrative of the fact that in order to "...get behind the technology, the hype and the motherhood statements that proliferate the ISDN scene today..." (as quoted from Falconer earlier in the report), one must do some real digging, as well as questioning of what is reported. As we will see in a moment, this applies to usage as well as lines in place. For the time being, however, there is another element related to the counting problem that is also important.

CPE (i.e., Customer Premise Equipment)...Or, "Are Digital Telephones Actually Connected to these Digital Lines...?"

The answer to this question, we have found, is even more difficult to ascertain from readily available material than number of lines themselves. Again, however, enough bits of information are available (perhaps we should say 'scraps') to put this topic into a context of real controversy.

One further example will illustrate this point. In Probe's reporting of one particularly interesting instance of an ISDN sale, at the University of Arizona in Phoenix (see Table 1), they also mentioned that the University's purchase of digital *telephones* would be in the range of "several hundred." (Probe ISDN Report, September 13, 1988, p.4). However, in the same article it was revealed that the ISDN *'line sale'* to the University was some 14,800, perhaps even going to 17,000 eventually, and involved extensive installation of fibre optic systems throughout the campus.[11] What we are left with from these information items, is a massive "contradiction"--that is, if thousands of digital ISDN lines are to be installed but they do not have digital instruments to talk to, what, then, are these lines going to be used for? Perhaps we could answer this by saying, "Well, of course the D channel can still deliver calling number ID" [for example]..."it just wouldn't be delivered to an 'integrated' digital instrument. Furthermore, the other B channel [assuming installation is being carried out with 2B+D lines] can be used for data transmission--just as the CCITT had in mind when it agreed on the basic rate standard..."

Unfortunately, we believe very little, if any, of this scenario. Why? Because (as is now becoming almost universally accepted), data on ISDN is not what participants in the CCITT decision-making process thought it was going to be. Instead, data use on ISDN is almost nonexistent so far, for many, many reasons, at least some of which we describe in this report. For the moment, however, the basic problem for data users is that ISDN represents a technology that is, literally, both too little and too late. It is too little, because data use has leaped far ahead of basic rate ISDN capabilities, into the tens of megabits per second range, not tens of thousands of bits per second available over ISDN lines. Moreover, it is 'too late' because, at the other end of the speed range, sophisticated modems have made possible absolutely incredible use of "plain old analog telephone lines" for massive data communications

tasks--far beyond, in fact, a whole generation's worth of nay-sayers who (still, it is interesting to note) decry the 'fact' that "the telephone system is analog, so it can't transmit data efficiently."

This statement, of course, is utter nonsense, and it has been for many years. Instead, with sophisticated modems, enormous and even 'vast' amounts of data are transmitted daily, throughout the network, over both public and private (analog) telephone lines. If one has even the slightest doubt of this, all they need do is consider, carefully, the recent remarkable growth in facsimile machine sales and usage--all of which (or certainly most all of which) generates digital traffic that is destined for transmission between machines connected to analog telephone lines--thus requiring, of course, many analog/digital and digital/analog conversions along the way.

Returning, then, to the question of digital instruments connected to ISDN lines, we are left with a quandary:

> Either (a) the lines have been sold anticipating that digital instruments will follow some time in the future; (b) there is no intention on the user company's part to convert all of its present analog telephone sets to digital instruments; or (possibly) some combination of the above, say, a wait-and-see approach, looking to the possibility that other suppliers will be available before long for all or at least a large part of the required CPE (i.e., terminal equipment).

From the data available to us at the present time, it is impossible to determine, indisputably, which of these scenarios is the correct one. One can, however, reason that there probably are a combination of reasons for lines exceeding instruments in many cases--and, moreover, questioning whether ISDN, 2B+D, basic rate lines are actually involved in many of the so-called 'sales.'

ISDN and Centrex

We have made this last statement for two reasons. First, as has now been quite widely reported, virtually all of the companies taking up ISDN so far--especially those such as Tenneco, Shell, and 3M that have ordered lines in the "low thousands"*--are large, and most often very large, Centrex customers. They have, thus, contracted for ISDN lines as part of long-term contracts for Centrex--that is, in order to maintain pricing for those services over periods as long as ten years. Since this is the case, it is reasonable to ask, "Was Centrex or was ISDN the primary motivation for these sales?"

---

* Again, Table 1 gives some of these details.

Second, of many other reported sales of ISDN, additional digging reveals that, instead of real, 'substantial,' commercial sales such as those in the thousands-of-lines category, actual takeup is in fact no more than additional 'trials,' disguised (if we may put it that way) as 'commercial sales.' To see this, we record in Table 2 an additional compilation, this time taken from *ISDN News*, the other newsletter we mentioned previously. Here, as is easily seen, many of the sales are in the 6-line to 25-line category, and since the companies represented are usually very large, this can only be reasonably interpreted as additional situations where users are willing to invest modest amounts of money to see whether or not something works--but are reluctant (if the evidence is valid) to commit themselves to any more than that, at the present time.

This, obviously, is a reasonable and propitious decision to make on these companies' part. In other words, because ISDN has had a good deal of trouble getting started, it seems only reasonable to invest a modest amount of money in attempting to find out what's involved--in terms, of course, of what new pieces of equipment are required, how much they cost now, how much they will cost in the future, etc., etc.--all, it must be recognized, in addition to answering the crucial question, "What will it do for us, and is it worth any new investment?"

What we see, then, from these data, is that there is a vast range of responses to ISDN already appearing in the marketplace. On the one hand, companies such as Tenneco, Shell and 3M (who are *"reported"* to have signed on for 3,000-5,000 basic rate lines) suggest an early adopter side of the picture, while other companies (e.g., Prime, DEC, Suntrust, Contel, Hayes, Microcom, Travelers, City of Fresno, Hershey, etc.) are more conservative in their approach, agreeing, yes, to try out a few lines (often, again, as part of a move to a new digital Centrex system), but only a few. Finally, there are the skeptics who--so far at least--want nothing at all to do with ISDN at the present time, and are adopting very much a wait and see attitude.

It should not be surprising that, for the time being, this latter is the largest group--but that is not our point. Our point is, that there must be another reason why a few companies have indeed chosen to buy on to large quantities of lines at the outset--and there is. If we look, for example, at the cases of Tenneco and Shell in more detail, we find the following:

> Southwestern Bell has already filed custom tariffs for ISDN Centrex for Tenneco and Shell Oil Company. For the most part, these tariffs itemize line card, base system, modem pool, line facilities and other charges generally associated with Centrex; *B and D-channels and ISDN in general are barely mentioned. In essence,*

Table 2

Compilation of ISDN Sales, Taken from *ISDN News*, August 3, 1988-March 1, 1989

Date of Mention in Newsletter	Company	Number of Lines Reported/(Note)
August 3, 1988	3M	3,165
	Tenneco	5,000
	Shell	5,000 (1)
	AT&T Technologies	1,000
	AT&T Network Systems	2,300
September 14	Rockwell	1,200
September 28	Prime Computer	25
	AT&T Network Systems	370
	DEC	6
	Suntrust	25
	Contel	50
	Hayes Microcomputer	10
October 12	WATS Marketing of America	--
October 26	American Transtech (AT&T subsidiary)	--
November 23	McDonald's	800
December 7	City of Fresno	--
December 21	Shell	6,000 (1)
March 1, 1989	Hershey	50

Note

(1) As indicated, Shell is reported as ordering both 5,000 and 6,000 lines. Correct number is unknown at this time.

the ISDN tariffs are long term volume discount Centrex agreements.[12] (Italics our own).

This article then goes on to say:

> The Southwestern Bell tariff philosophy is an example that is likely to be pursued in jurisdictions where Centrex and other selected services have been deregulated. Here the operating companies will be able to circumvent the public utility commissions by layering ISDN on top of the deregulated service tariffs that are subject to minimal review.
>
> In other areas, however, where detailed, cost-based tariffs are still the rule, carriers can be expected to file separate ISDN tariffs... As an example, Illinois Bell's ISDN tariff is like a "Chinese menu" from which a user can order a few B-channels or an entire panoply of ISDN channels and services. While it is generally expected that an ISDN line will be 1.2 to 1.5 times the cost of a non-ISDN line, pricing and availability will vary among operating companies. *If the user plans to make full time use of both B-channels these economies may be quite attractive.*[13] (Again, italics are our own).

In a sense, then, we have come full circle in assessing the rationale for at least some of the large ISDN orders to date, if, indeed, not all of them. That is, instead of ISDN being the primary motivation, or in fact even one of the primary motivating factors, it is seen that it (i.e., ISDN) was accepted by these user companies as part of an *especially attractive Centrex package* put forward by the local telephone company, on a deregulated basis. Since the possibility of doing this varies from jurisdiction to jurisdiction in the U.S., it stands to reason that large orders would congregate in those areas where more liberalized rules apply, and be less likely to occur where cost-based tariffs are required. Analysis of the data show, that this is indeed what has happened in the takeup of ISDN, to date.

1B+D vs. 2B+D

The next area of contention, not unreasonably, is "How are companies actually using ISDN, today?" To answer this question we first go back to an earlier scenario in which voice and data are actually required together, at a single desk or operator position, simultaneously. There are in fact many instances of this in the business world, including, probably, the majority of

uses of incoming WATS. In addition, virtually all of the earliest uses of computers and communications for, for example, online airline reservations, included some component of simultaneous voice and data--e.g., reservation booking agents themselves, of whom there are many in the airline industry.

What we see, then, is that simultaneous voice and data is not new. However, what must also be recognized is that these are special purpose situations--as are all telemarketing, reservations, teleshopping, and other similar activities--not general purpose, at-everyone's-office-desk situations. Furthermore, as a general rule the computers and networks being used for these applications are designed around the applications, and purpose-built for them. In other words, voice communication serves its function (e.g., to communicate with the public), data serves a separate purpose (data base access), and "never the twain shall meet."

It is into this domain and this context that ISDN has been thrust. And, quite naturally, companies are willing to accept the "extras" that it has to offer (such as, for example, provision of calling number ID), but are quite unwilling to give up what they already have by way of data communication solutions, unless ISDN can do it better, cheaper, or both.

So far, as we have said, this has not been the case. As a result, the bottom line of ISDN use to date, is 1B+D, not 2B+D. Why? Because, simply, all that companies are using it for, for the most part, is calling number ID, or ANI, Automatic Number Identification. This is good for telemarketers, of course, and according to most reports we have read they are enthusiastic about ISDN, or at least ISDN-equivalent services. However, again there is no need in these circumstances for a second B or bearer channel. Instead, voice comes in on one B channel, ANI is delivered via the D channel, and data use is carried out in the same way it has always been, i.e., via special purpose circuits and networks, regardless of the size and geographical scope of those networks.

What we are saying here, *it must be clearly noted*, is that there may, in the future, be a real, genuine use for two B channels and one D channel at everyone's desk. For the present, however, data users do not see a need (again, for the most part), to transmit data from their own premises, down a B channel into the telephone network, and then back again to their own computer. Instead, their logic is, connect the terminal to the computer directly, and use the telco-delivered ANI simply as an instantaneous and automatic look-up key to locate the caller's file in the online data base. This, obviously, is a legitimate and highly-desirable use of ISDN and ISDN-like services.[14] However, as we have described it does not require, nor can it use very well, 2B+D service. Why, then, should users be required to pay for a service they don't need?

NYNEX's 1B+D Tariff

In February of this year, glimmerings of an industry recognition of the situation described above began to appear. In an announcement in its February 15, 1989 issue, Probe reported the following:

> Restating its plans to introduce Basic Rate ISDN tariffs in 2Q89..., NYNEX [i.e., one of the seven Regional (Bell) Holding Companies or RHCs] released more information concerning the offering at a recent meeting... According to information in a recently completed market study by NYNEX subsidiary BIS Mackintosh, the RBOC will most likely offer 1B+D ISDN, rather than the CCITT standard 2B+D offering, in its Northeast region. The study also recommended some novel pricing policies, mostly under-cutting the rates offered by Illinois Bell last year and several customer-specific pricing arrangements currently in force by Southwestern Bell, Bell Atlantic and other RBOCs.
>
> The study was based on what current NYNEX customers said they would be willing to pay for ISDN services... From this information, BIS Mackintosh concluded that *NYNEX could serve 70% of its customers by deploying 1B+D.*[15] (Emphasis our own.)

From this news item it is easy to see that the 1B+D vs. 2B+D problem is widespread--that is, it exists not only for present users but (apparently) for potential ones as well. This, in our opinion, should give the industry much pause for reflection, because until these user needs and wants began to be apparent, virtually nothing was ever said by the industry itself, to suggest that 2B+D might be "overkill." On the contrary, everything was built around the notion that simultaneous voice and data would be required universally. Clearly, trends indicating that this is or will be the case have not yet materialized.

What we are saying, obviously, is that in the end it is users and market needs that drive the deployment of technological innovation, not the other way around. In those happy circumstances where the two forces mesh, as in the development of PCs, for example, both users and the technological world gain equally. When this is not quite the case, however, users have the final say, and it is up to industry, as has NYNEX, to adjust its products and services accordingly.

Alternatives to ISDN

We now come to perhaps the most intriguing part of all of the ISDN saga, namely, the fact that alternatives to ISDN exist for, if not all, certainly almost all, of the ISDN potential services currently identified. Simply put, not only is end-to-end ISDN in a state of flux at present, but individual line ISDN (of either its 2B+D or 23B+D variety) is also at risk, simply because, in the U.S. and Canada at least, there are other ways to provide these or equivalent services.

As we have seen in the case of 1B+D vs. 2B+D service, at least one telephone company (NYNEX in that case) has begun to ask the right questions of users, as well as attempting to understand real situations, and users' perspectives on new technology as it applies to them.

Similarly, the case of alternatives has caught peoples' attention and again at least one carrier has responded--this time MCI. A recent advertisement by this company tells the story far better than we can, so we reproduce this ad in its entirety on the following three pages. Note, here, that the ad does take up three full pages (at least in the versions we've seen),[16] and always starts and finishes on the right-hand (odd-numbered) page in the magazine. This means that MCI has taken great pains to catch every reader's attention, and introduce them to the fact that yes, if ISDN develops MCI will be ready--*"however,..."* if users are interested, they can get virtually the same thing as ISDN, without spending ISDN premium charges, without having to use all-digital local loops if they don't need or want them, without having to upgrade to digital instruments, etc., etc. In other words, the key element in assessing whether or not ISDN will make it in the marketplace, is whether or not there are effective alternatives, and we see from this illustration that there are--across the board. In fact, one of the earliest, consistent criticisms by users concerned the fact that ISDN did not appear to offer anything really new at all, that is, anything new that could not be accomplished already, including ANI, end-to-end digital, switched digital, etc. Perhaps more than anything, this has caused great consternation among ISDN advocates, and has led to comments such as those quoted earlier in this report.

Applications

All of the above appears, of course, to be explosive, and potentially very damaging to ISDN's case. In the area of applications, however, a great deal is being done to establish, for the future, situations that have at least a potential for success. In order to do this industry forces as well as users have banded together in the U.S., under the sponsorship of the National Institute of Science and Technology (formerly National Bureau of Standards, NBS) to identify and then develop applications specific to ISDN.

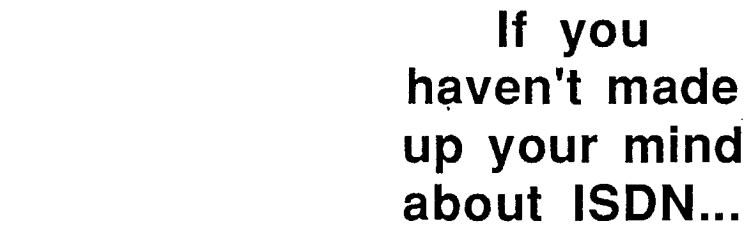


Figure 1 Recent Advertisement by MCI Communications Corporation (Note: in original ad, full page is black with above writing in white--and next page is the same).

now you
don't have to.

Figure 1 Recent Ad by MCI, continued (also, next page, ad concluded)

ISDN isn't an all or nothing proposition anymore.

Not if you choose MCI.®

We'll let you decide between ISDN and ISDN-equivalent services. So you'll have an opportunity to get all the benefits of ISDN, or take on ISDN-like services that require less of an investment but give you the same results.

MCI was built on the premise that our customers have the right to choose. MCI's Global Network continues to provide our customers with that option. Whether you need all ISDN has to offer, ISDN-equivalent services, or a combination of both, you can get started here.

Make the right choice. Your own.

MCI ISDN

MCI has integrated ISDN technology into all aspects of our network infrastructure. Right into our digital switches. Our network is fully CCS7, with digital transmission and intelligent data bases.

When you get ISDN from MCI, you get several things. Efficient, enhanced network access, improved network management capabilities, and new information services and functions, such as ANI.

All this is to ensure ISDN will provide economically justified solutions for your requirements.

In addition, we're working in cooperation with equipment vendors to make ISDN compatible with all types of CPE, to make your job easier.

Equivalent Services

If ISDN technology doesn't figure in your present plans, MCI has developed something that will. We've provided you, once again, with a choice by bringing you services that have ISDN-equivalent features.

They are MCI services available today that give you ISDN benefits without investing in the whole package. For example, we're the only company that will deliver ANI via inband signaling. And our Two-Way Access allows sharing inbound and outbound traffic on the same dedicated circuit.

The best part is that you can focus on specific ISDN-like services as you need them, while your plans for ISDN evolve.

Customer Requirement	MCI ISDN	MCI ISDN-Equivalent Services
Integrated Access to Multiple Services	Primary Rate Interface	Digital Gateway
Shared Circuit Usage	Call-by-Call	Two-Way Access
Calling Number Delivery	D-Channel ANI	Inband ANI
Switched Data Transmission	Switched Digital Transmission	Switched 56 And Digital Reconfiguration Service™
Network Management	MCI INMS' ™ B-Channel Control	MCI INMS' Digital Reconfiguration Service

So make the choice that's best for your business. And we'll always make sure you have a choice to make.

MCI®

Let us show you.®

The mechanism for this has come by way of two committees of the North American ISDN Users Forum, "...a group initiated by the National Bureau of Standards, the Association of Data Communications Users (ADCU), Bellcore and the RBOCs, with the intent to define and develop ISDN applications..." (Probe ISDN Report, May 15, 1988, p.3). According to this report the group was formed in February 1988 and by May had some 300 members, of whom 138 were users, and 173 were vendors.

The two committees established by the Users Forum were the ISDN User's Workshop (IUW), "...made up of users whose main goal is to outline the types of applications that they feel ISDN should support..." and the ISDN Implementors Workshop or IIW, "...manufacturers and service providers who will work to develop specifications which support those applications and also ensure interoperability among ISDN offerings." (Ibid.). The report also goes on to indicate that NBS (i.e., now NIST) is to provide administrative support for both committees, that the first meeting of the IUW would be in June 1988, and that of the IIW in July.

Since those initial startup activities, these two committees have been meeting regularly, on about a 3-month basis in the case of the Users' committee. Reports have come along steadily, curiously, to indicate that user interest in the "Users' Committee" has substantially declined over time--e.g., one recent meeting was reported to have been attended by only 36 users out of a total of 320, the rest, obviously, being industry representatives.[17] The list of user-initiated potential applications has grown, however, as well as being "pruned down" by the deliberations of IIW committee members. In August, for example, the IIW was reported to have pared down the IUW's initial list of about 100 applications to five key ones, as follows:

- Universal Financial System Access: providing the necessary protocol conversion and gateway functions to allow users on multivendor networks access to specific financial databases;

- Incoming call management: identifying the caller's telephone number and automatically displaying the caller's records [e.g., ANI, etc.];

- Automatic call-back: allows users to store caller's numbers when lines are busy and then redial them;

- Encryption: end-to-end encryption of voice or data which would also support audio teleconferencing arrangements...;

- Addressing: establishment of an addressing scheme associated with service access points to identify origination

> and destination of information and allow services to be dynamically selected.[18]

As we indicate, these five were identified as key toward the end of last year. Since that time both committees have continued to operate, with several meetings each. However, many problems remain with all these applications, not least of which are the result of industry's seeming unwillingness to <u>really</u> provide "user-transparent ISDN"--the situation we describe next.

<u>Contrarier and Contrarier--The Problem of Alice in Wonderland</u>

> Further complicating the ISDN/Centrex sale is that for now, whoever supplies the central office will, by default, also provide the customer's terminals. *Northern Telecom's ISDN CPE works on Northern's ISDN COs, and the same is true with AT&T and Siemens.* There are reports that Fujitsu is the only ISDN CPE vendor making terminals that are transparent to the various COs. Thus in the early days customers of ISDN Centrex must be willing to accept a limited range of alternative CPE suppliers. So much for universal standards![19] (Italics our own).

So much indeed, we say, for the above quotation is discussing the fact--(quite ironic it seems)--that <u>regardless</u> of the enormous amount of discussion of standards vis-a-vis ISDN, perhaps the most crucial part of standards of all, to a user that is, is being able to plug any legitimate device into the wall socket and having it work. After all, this has been the hallmark of telecommunications for decades--at least, within a country--and in North America's case in both Canada and the U.S., together. Now, however, right in the midst of lip-service agreements that standards are crucial, three of, if not the three, most important manufacturers continue to provide their ISDN equipment with proprietary protocols, completely negating users' freedom to choose what most suits their needs.

Of course, it might always be remarked that this is precisely the method IBM used originally to gain such a foothold in its computer and communication network base--i.e., proprietary protocols, its own terminals, SNA (Systems Network Architecture), and so on. On the other hand, it can also be remarked that opening the market to others--that is, not only other manufacturers but more importantly software developers--gained IBM a great deal more than it could possibly have accomplished itself in the case of the PC. With proprietary approaches, therefore, there are definitely two sides to

the question, and our own view is that ISDN is, each day, jeopardizing its existence even more, without compatible, universally acceptable standards for central office, PBX, and customer premise equipment. Presumably this will come eventually, but until it does, our suggestion is that users will continue to be unimpressed and unmoved with ISDN technology.*

Summary

We have discussed a large number of issues in this chapter, but as we indicated at the beginning of our report, all we can hope to do in this preliminary review is touch on important topics, not explore them in depth or in detail. Indeed, we have now seen many, very large and comprehensive studies devoted to this important topic, but of course they are proprietary, and not available to the general public except, in some cases, for very large fees. The purpose this report is intended to serve, therefore, is to introduce some of the crucial user-related problems and opportunities of ISDN to a wider audience, in order to put its development in a better, more balanced context than it has been in the past. Further studies, as we describe later, will need to be devoted to specific cost and pricing concepts--particularly in the specific, Canadian context--as well as to more detailed and explicit analyses of ISDN and its alternatives, "more real" applications as they begin to evolve from IUW and IIW committee deliberations as well as active users, and many other so-far-unresolved issues, including standards. In the meantime, we turn in the next chapter to a very early, (very risky in fact), attempt at forecasting. This step was not required in our statement of work, it should be noted, but our inclination is to say, if we were reading this report, what would we want to read? Thus we are willing to go out on a limb somewhat, on the basis of what we know now. However, it should not be assumed that this is a thorough analysis, and it is expressly put forward as a preliminary view.

---

* It may be noted in passing that although the quotation at the beginning of this section is from May 1988, in May 1989, one year later, virtually nothing had changed on these matters. Interested readers may wish to explore this further by reviewing Michael Finneran's article, "ISDN Won't Sell Without Standards," in the May 1989 issue of *Business Communications Review*.[20]

III ISDN IN THE U.S. AND CANADA IN THE EARLY- TO MID-1990s: A PRELIMINARY VIEW

One of the lessons we have learned since we began studying the growth of new technology is that often, products and services take longer to grow and develop than one expects. Particularly, it seems, this is true in those instances in which "connectivity" of one sort or another is involved.

Unfortunately, of course, connectivity is what telecommunications is built on. What this means, therefore, is that just as the value of any one individual telephone increases as the number of parties its owner can connect with increases, just so does the value of an individual device stay low, if there are few others with whom to communicate.

In connection with this phenomenon, for many years analysts and others have talked about reaching a point of 'critical mass' in connectivity situations. Unfortunately, critical mass is a hard concept to quantify, track, validate, and verify, so we are not enamoured with it. On the other hand it is equally true that, *without some type of incentive that makes sense to an individual user,* growth cannot occur at all.

We have spent many years studying these types of problems, and over the course of this time have collected and catalogued the growth of many new services, all the way from the telegraph and telephone in the 1860s and 1870s to facsimile, television, VCRs, microwave ovens, LANs and data communications in more recent times--among many other products and services. Some of these, such as television, computers, VCRs and personal computers, grew extremely rapidly in their early days, while others grew considerably more modestly, but still steadily, such as the telephone.

There is no need to go into great detail on these matters in this report. It is instructive, however, in the context of ISDN, to examine what has happened in certain cases, and what has clearly not happened in other cases.

Figures 2-11 review briefly some of these data.[21] In the first chart, television, we see that after the Second World War there was an incredible pent-up demand for such a service--the technology was ready, business was ready, and consumers were ready. As a result, television grew at what was at that time an unprecedented rate, reaching between 25 and 30 million receivers in use in the United States in the short span of eight years from the beginning of full service, to over 40 million sets in use within 12 years. As well, this was such a rapid increase that by that time, 1958, relative saturation had already begun, and growth had declined to just over 5%/year between 1958 and 1968.

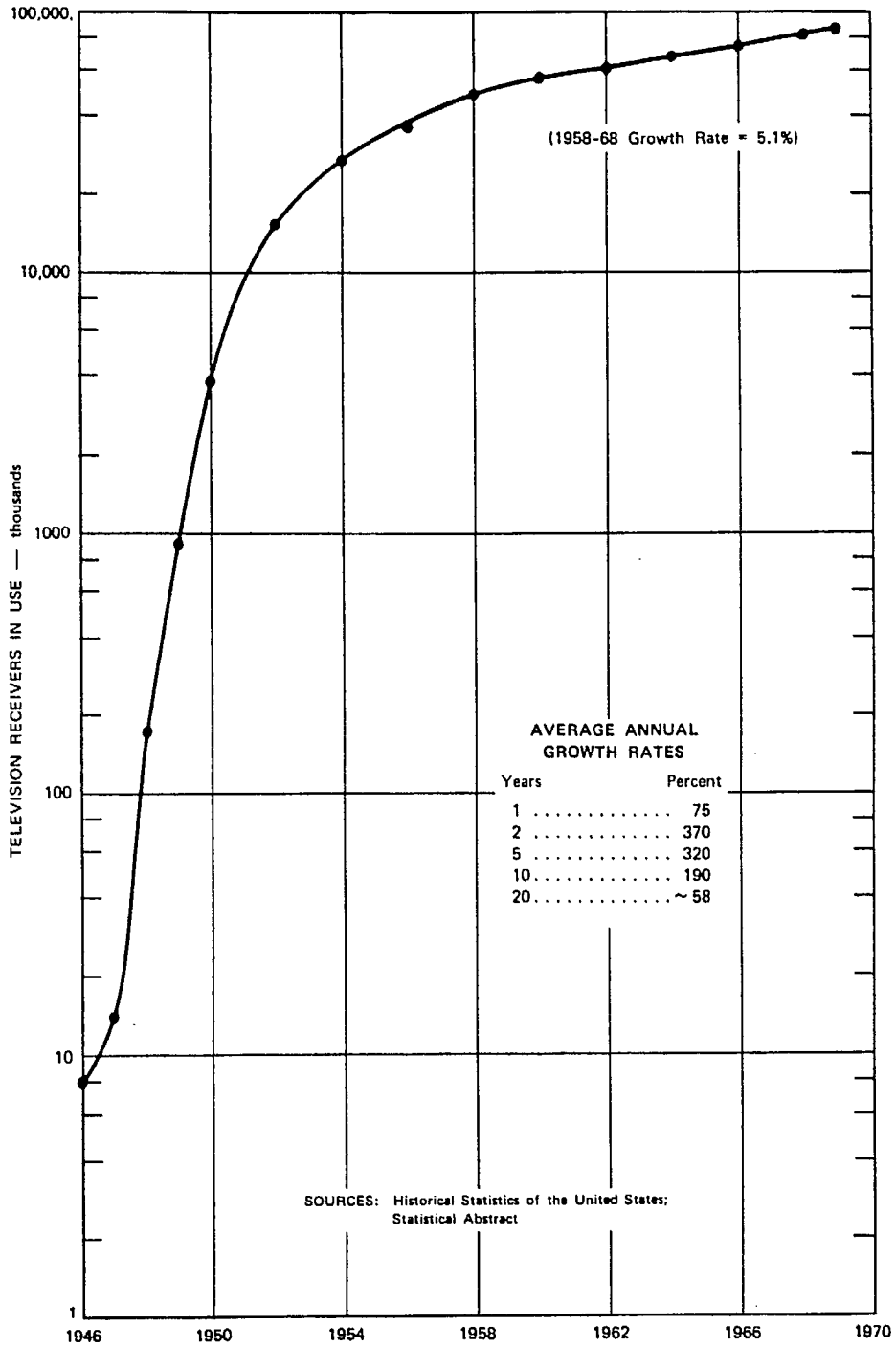


Figure 2 Growth of Television in the United States

By contrast, telephone service in its early days (Figure 3) grew much more modestly, averaging 50 percent per year over its first ten years vs television's almost 200%/year over ten years, and telegraph service (Figure 4) grew even more slowly, averaging some 13%/year over its first ten years of service.

Interestingly enough, automobiles and computers (Figures 5 and 6) match reasonably closely with telephones and television at their 10-year stages, averaging 50%/year over ten years and 210% over ten years, respectively. And in more recent times (Figures 7-11), VCRs, cable television, pay television, personal computers and local area network revenues show similar patterns.

As might be expected, however, not all new products and services are accepted in the real world quite so enthusiastically as these have been. (Figure 4 hints at the problem, since telegrams have been on a consistent and steady decline for over forty years and are still continuing their downward trend--since so many other means of communication, particularly the telephone, are quicker, easier to use, more effective, more efficient and cheaper.) On the other hand, especially in recent times (i.e., nominally the last twenty years), some new products and services have not even gotten off the ground in the marketplace, despite hundreds of millions of dollars being spent on them.

In this context it is perhaps inevitable that we would suggest Picturephone® as the classic case. After what is reported to have been an expenditure of at least $500 million, if not more, including a great deal of market research and market testing, this service was brought to the public in 1970 and thereafter very quickly abandoned, simply because, even after all the research, no one wanted it. Picturephone, though, is by no means the only example of such failures. On the contrary, the world has now seen a very large number of such situations, including Prestel in the United Kingdom, Bildschirmtext in the Federal Republic of Germany, Telidon in Canada, Federal Express's ZapMail as well as other services in the United States, and many more. All of these, without exception, have had enormous amounts of money poured into them, often by telephone companies and telephone administrations. What we see, therefore, is that such institutions are by no means invincible. Instead, one might suggest, they are all the more vulnerable because they are often *less* able to cope with the vagaries of the market and the unresponsiveness of consumers when they don't get what they want--i.e., less able to cope than other firms and institutions, in more competitive industries.

Be that as it may, though, it is the telephone industry that has brought us to where we are now with ISDN, and it is that industry that needs to sell the concept more effectively and more realistically if it is to develop at all.

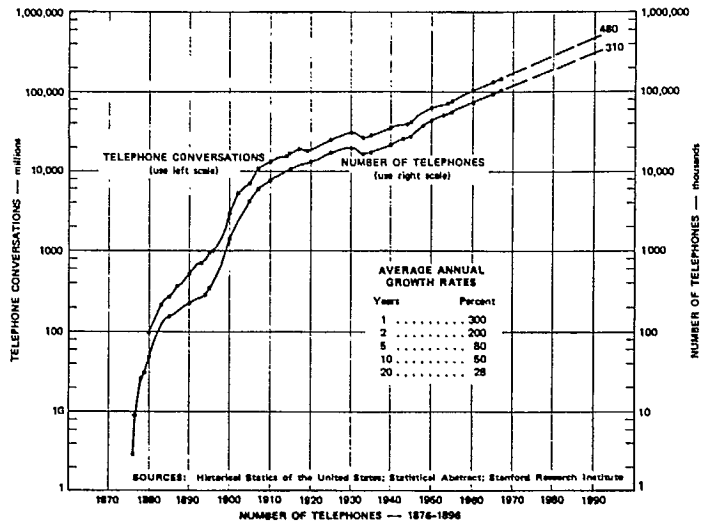


Figure 3 U.S. Telephone Growth, 1876-1970

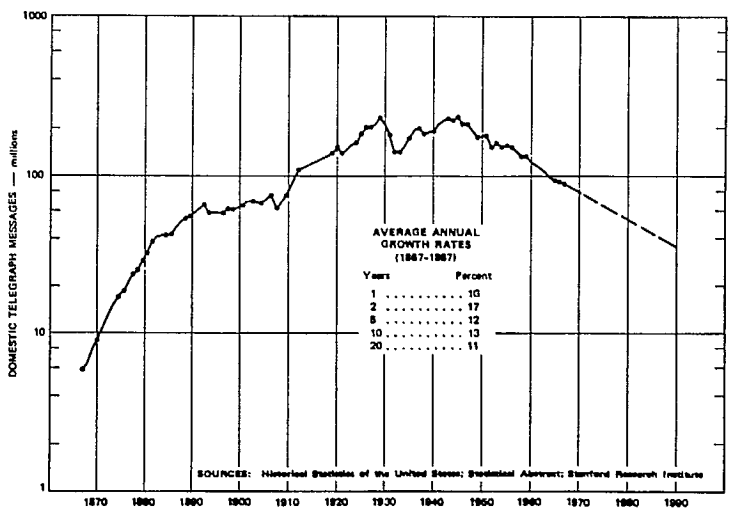


Figure 4 U.S. Telegraph Growth, 1867-1970

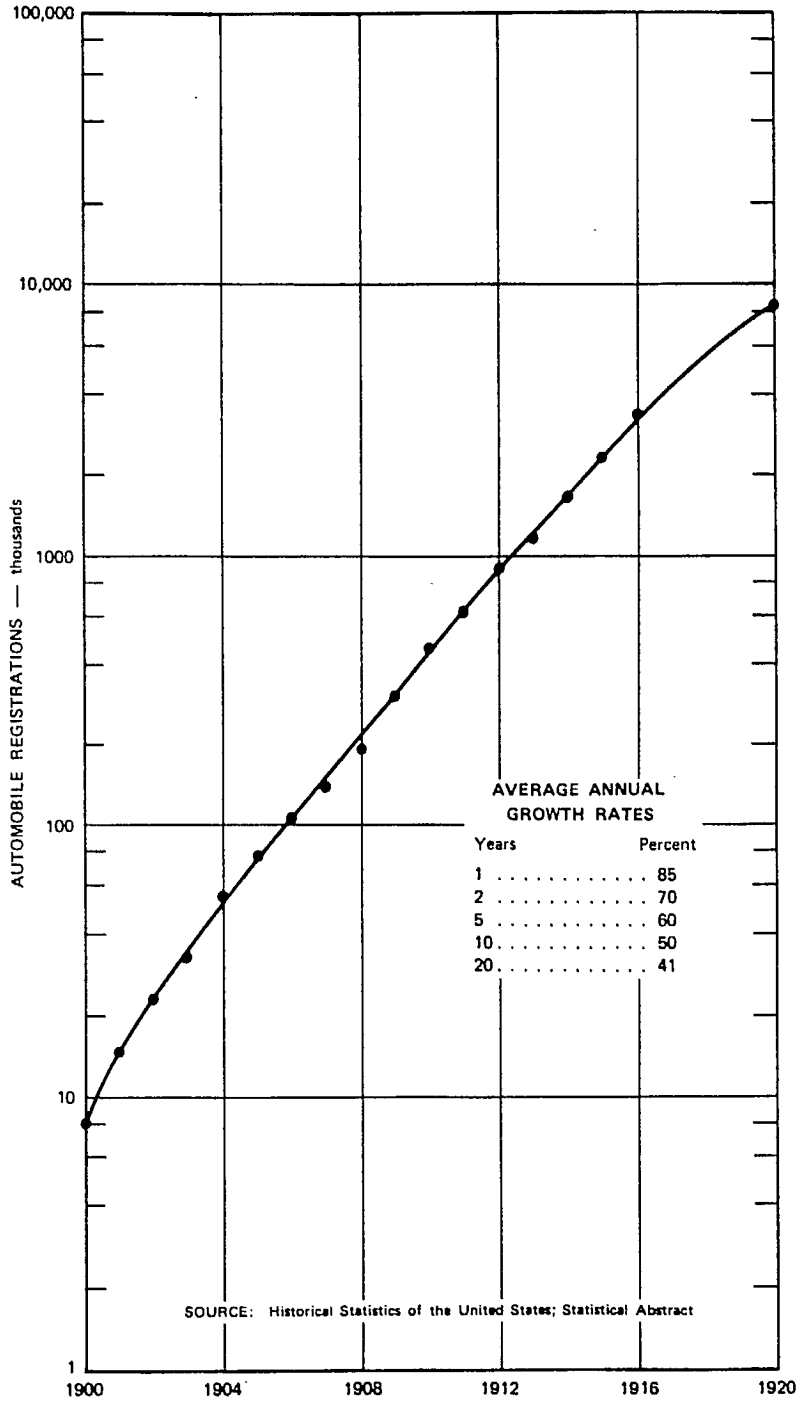


Figure 5 Early Growth of the Automobile in the United States

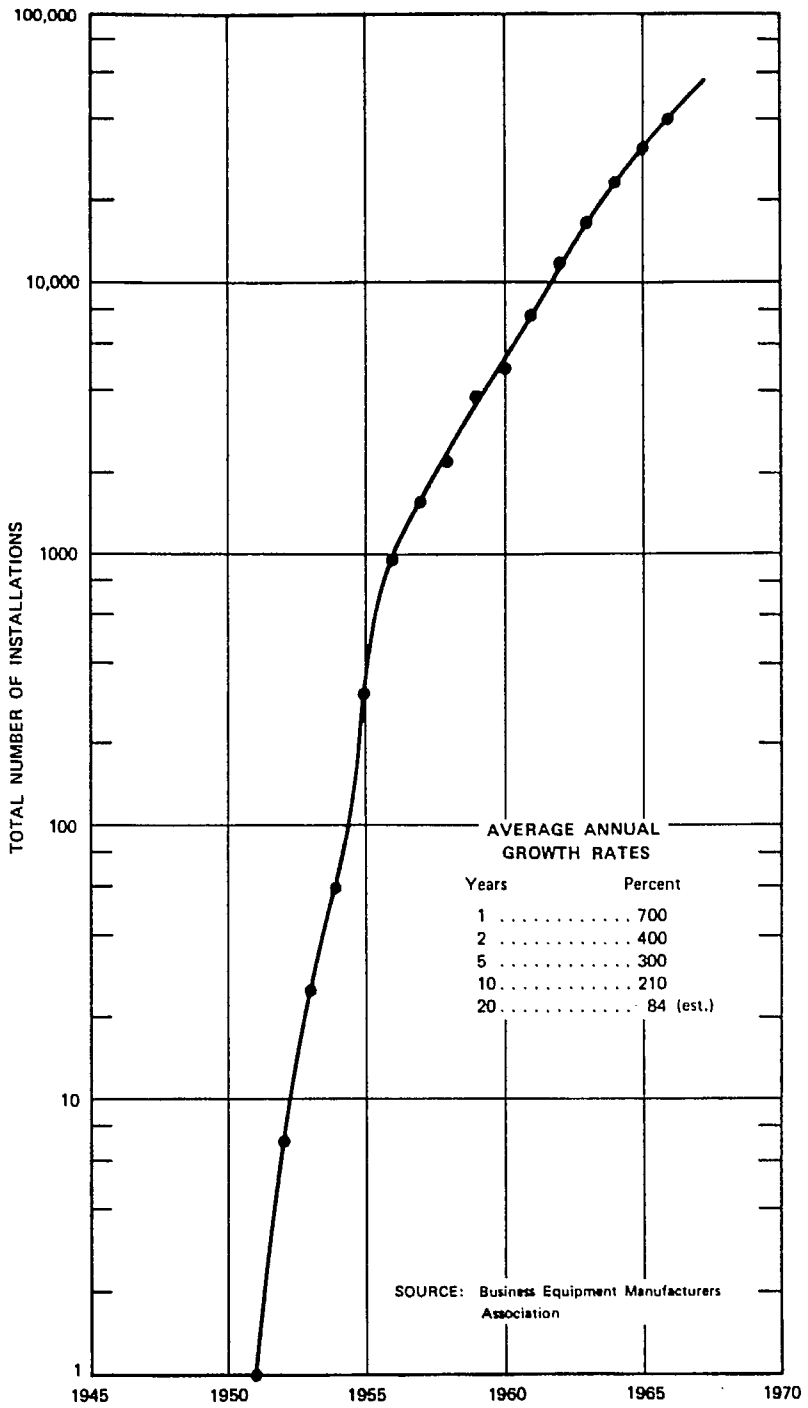


Figure 6 Early Growth of Computers in the United States

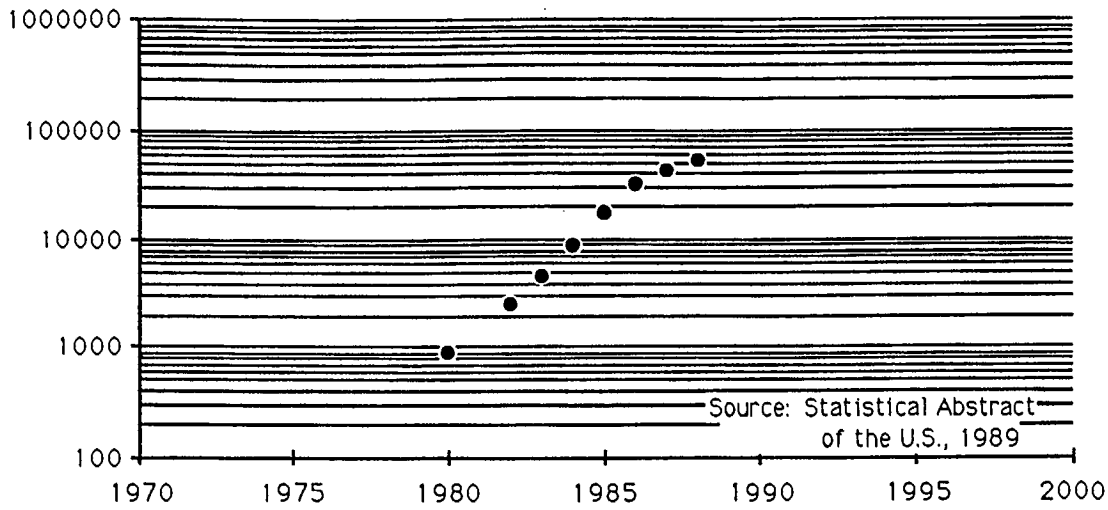


Figure 7 U.S. Households with Video Cassette Recorders, 1980-1988
(In thousands)

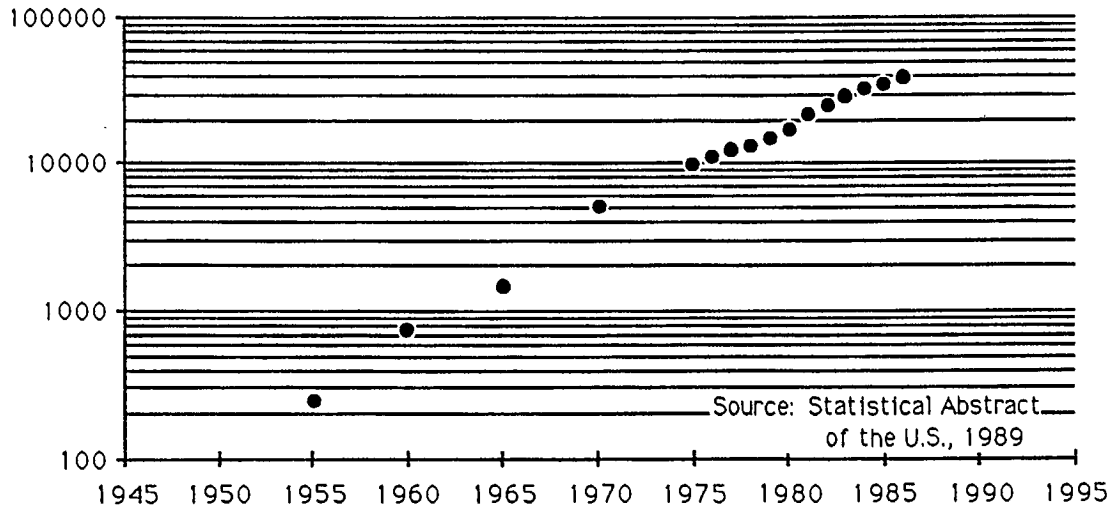


Figure 8 U.S. Cable Television Subscribers, 1955-1987
(In thousands)

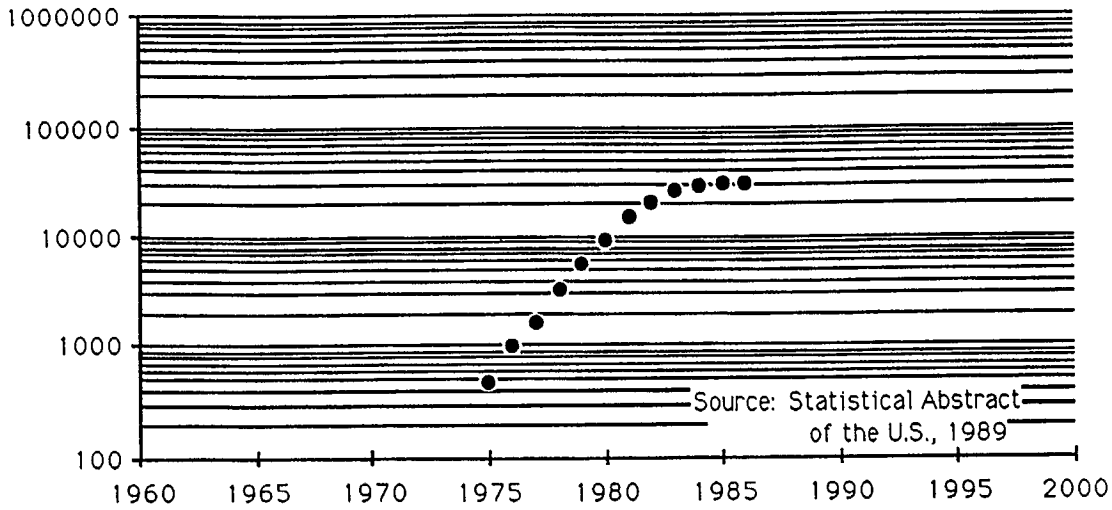


Figure 9 U.S. Pay Cable Subscribers, 1975-1987
(Thousands)

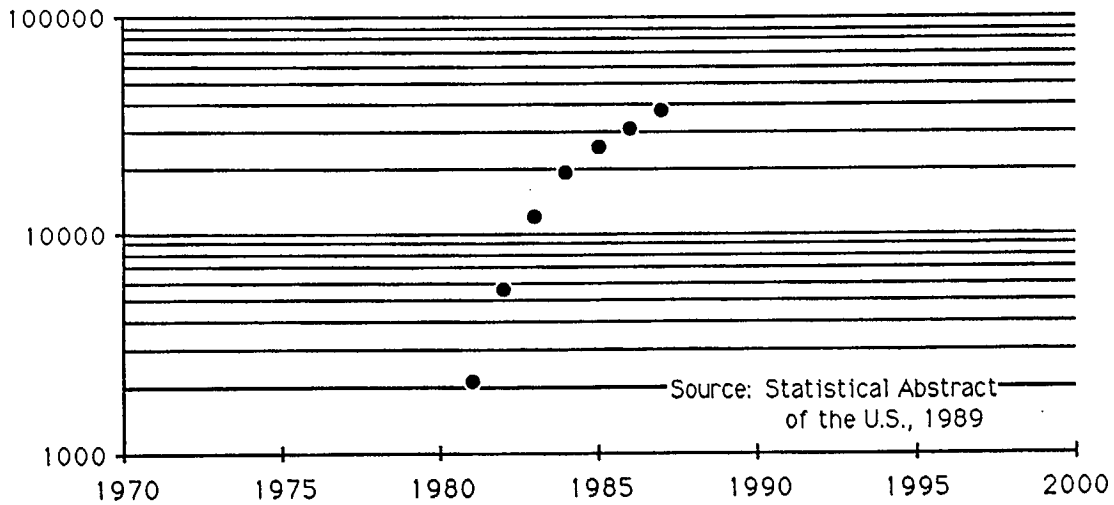


Figure 10 Personal Computers in Use, 1981-1987
(Thousands)

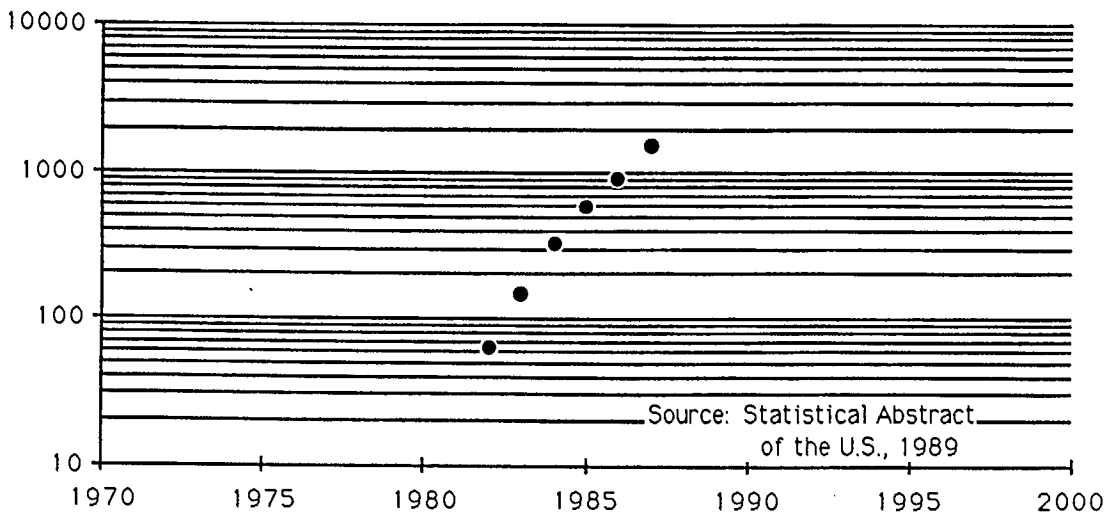


Figure 11 Local Area Network Revenues, 1982-1987
(Millions of dollars)

We say this because, quite obviously, users today are not enamoured with technology (if they ever were), and it will thus take concrete applications, priced below what people are paying now, for real growth to occur.

The reader may remember, for example, that we emphasized in the last chapter a particular quotation that read.

> "...it is generally expected that an ISDN line will be 1.2 to 1.5 times the cost of a non-ISDN line... *If the user plans to make full time use of both B-channels these economies may be quite attractive.*"[22] (As before, italics are our own).

However, both B-channels are not being used, as we have seen, and these economies are thus not being realised, leading to the obvious conclusion that users would be well advised to think carefully about spending extra money (20% to 50% more than their present lines, according to the above and many other reports), unless they are convinced that those expenditures are giving them at least one hundred percent, or more, in extra benefits. (Bear in mind, of course, that we are here discussing only incremental line costs. In addition to these, NT1, NT2, terminal and other costs must be added, increasing the 1.2-1.5 factor substantially.)

Moreover, there is, again, the problem of competition among service offerings. If, for example, MCI or some other carrier offers in-band ANI over analog or T1 channels--and that is exactly what the user wants and needs, nothing more, nothing less--it is unlikely that that service would not be very competitive with ISDN, and, quite possibly, much cheaper.

Similarly, the notion that a single plug in the wall will save users from having to run additional wiring and cabling for their computational needs, is falling short of expectations, because (amazingly enough), users don't seem to be concerned about more wires, especially if networking software and other "handy items" come with it.* This suggests that having 64 kbps available from the same plug as the telephone, may not be as exciting to users as the CCITT thought it would be.

---

* Note again, in this context, that Figure 11 showed local area network (LAN) revenue reaching $1.5 billion in the U.S. in 1987, from only $62 million 5 years earlier. This is a very substantial growth rate, and it is continuing now, unabated.

Then, there is the problem of T1 and T3. These services, high-speed and very high-speed digital connections respectively,* have been growing at enormous rates in the U.S. as well as Canada,** because as digital services exactly comparable to what the telephone industry itself uses, they can be used for both voice and data, interchangeably, and with intelligent multiplexers users' flexibility in setting up networks has been enhanced many fold. Moreover, in contrast to ISDN, T1 and T3 are less expensive than previous analog alternatives, by very wide margins. It is thus not surprising that they have developed rapidly in the marketplace of large, sophisticated users--that is, the very same audience that ISDN was assumed, originally, to be especially attractive to, most often via Centrex.

Medium and Small-Sized Buyers and (Perhaps) Residence Markets

Finally, we come to the question of whether or not it really is the large users who should be targeted, or whether ISDN is really for medium and small users. In this context we have been particularly taken with the previously cited article by Michael Finneran (Ref. 20). This author has, in times past, been very bullish on ISDN, and he still is to quite an extent. (See, for example, "ISDN: A Time for Faith,"[23] as well as the beginning of the article we are discussing now). Nevertheless, he is also having to come to grips with the fact that the concept is not catching hold as dynamically and dramatically as he might have hoped it would, and is recognizing the same issues we have been discussing in this report. As a result he is writing very well these days, and we are inclined, since we can't at all say it any better, to relay several recent paragraphs, as follows:

> **If ISDN's So Smart, Why Ain't We Rich?**
>
> While we can get many of ISDN's capabilities in digital PBX's and T1 muxes, we can't put these expensive devices in everyone's home or office. Since ISDN will be deployed in the public network, its capabilities will be available anywhere there is access to the public network. Digital PBXs and T1 networks will provide communications capability for large business or government organizations, while ISDN will support intra- and

---

* T1 operates at 1.544 megabits per second and accommodates 24 voice channels encoded at 64 kbps each. T3 is equivalent to 28 T1s, or 672 voice channels.

** T3 is not yet available in Canada. T1 is, however; Megaroute and Megastream are Telecom Canada's high-speed digital services, while CNCP calls its equivalent services Mach III and, to a certain extent, Econovoice.

extra-company communication, as well as the possibility of business to residence digital connectivity.

In this sense, ISDN really will provide something that does not exist today--a universally available, general-purpose, software-controlled, high-speed digital transmission system. The bad news is that ISDN poses a nasty marketing problem: It is very hard to explain why anyone needs a universally available, general-purpose, software-controlled, high-speed digital transmission system--particularly since people seem to be living their lives quite well without one.

The most interesting comment I have heard recently on this problem was in a speech by Dr. Michael Hammer, formerly of MIT: The hallmark of an important new technology is that it provides a solution to a problem that you didn't know you had.

ISDN will give us the ability to do something that we could not do before, and on a very large scale. But how do you sell somebody something that they don't know they need?

The first step in selling ISDN to a corporate telecommunications manager is to recognize that the buyer is technically knowledgeable and informed. Today's ISDN marketing typically deals with hazy application concepts rather than hard facts. It's a mistake to assume everyone sees the logic of ISDN's design, agrees with the approach and is now concerned only with finding applications.

The sales pitch has to be logical and *intellectually satisfying*. [Emphasis our own]. The potential buyer has to be able to justify ISDN on a business--not just a technical--basis. ISDN visionaries have leapfrogged the logical arguments and gone straight for the emotional appeal. Why is ISDN better than buying a PBX or a T1 multiplexer? If ISDN is going to be cheaper, which components are going to be cheaper? Since the answers to those questions are hard to find, ISDN marketers have not been able to take most of the buying community with them.

A small number of users have caught on to the ISDN idea, but most have bought on the basis of some important, short-term benefits. The greatest interest in ISDN comes from Centrex users who want to put enhanced station equipment on their Centrex systems just like they can on a PBX.

> These users are not buying "ISDN," they are buying digital hold buttons. The fact that the hold buttons use an internationally defined protocol does not mean a whole lot... The user is buying the "what," not the "how."
>
> ISDN visionaries have distanced themselves from the buying community. They now have to go back to corporate telecommunications buyers and convince them that something important is going on and they should get involved.

We have taken the liberty to reproduce this very long quotation because it's important, and it's current. After all, as we have said, Finneran has been and still is a strong supporter of ISDN, in contrast to many who have been critical for some time. What is significant about the quote, therefore, is that the problems ISDN exhibits today can no longer be ignored. It is, in other words, not "a time for faith" anymore, but a time for hard facts and concrete results. These, as he carefully chronicles, have been lacking up to now.

Moreover, the author touches on that most crucial of all issues, that is, whether or not there is any need for a "universally-available, general-purpose, software-controlled, high-speed digital transmission system." As we have seen, facsimile growth and development proves that there are widespread, common-user applications of "data transmission" (as opposed to voice transmission). What is equally true, however, is that the ubiquity, ease of use, and flexibility of the dial-up network, regardless of it being analog, is far more important to the vast population of telecommunications subscribers, than the fact that the fax's digital pulses need to be converted to analog at some point in the transmission. Users, in other words, don't care about such technical details, "as long as the thing works," fits into their budget, and is easy to operate.

Summary

The unavoidable conclusion of these matters, unfortunately, is that ISDN is going to be a very hard sell over the next five years. After that, of course, it is anybody's guess at this time because (a) prices may be cut dramatically, (b) standards may be established to allow full interoperability of equipment, (c) Group IV fax may turn out to be much less expensive than it is now, and in fact overtake Group III on many efficiency bases, not just cost-per-transmission, (d) shared-screen teleconferencing may prove to be more attractive than present indicators suggest, or (e) any number of other influences.

.Our view, however, is considerably more modest at this time, simply because the technology is not being demanded by the marketplace. Our opinion, in other words, is colored very strongly by the notion that, if ISDN is so good, indicators, at least, should by now be available to suggest as much. The fact that such indicators are not there in large number, as yet, suggests a conservative future for the technology, at least at the present time.

IV FUTURE RESEARCH

This chapter is very short, but that is because we have very little left to say of an expansive nature. The chapter is important though because it stresses, emphatically, the need for further research.

Over and over in this report, as the reader will by now fully appreciate, we have emphasized the preliminary nature of this work. The study is not an insignificant one and our intent is not to denigrate it in any way. Yet it must be recognized that Canadian content is essentially non-existent, many things have been left up in the air, and no primary research at all was carried out to reach the conclusions we have reached. Thus we may, quite logically, be totally wrong in our analysis.

The way to solve this problem is to structure a large, significant, and substantial research project on the subject, to come to grips with questions we have raised, and questions we have not raised but are still applicable. For example, what about the unique nature of telecommunications as it is carried out today in Canada? Will this change over time and become more like the U.S. in terms of competitive products and services, or will very much a monopoly situation prevail for many years? Whichever way this turns, will users in Canada respond similarly to those in the U.S., or will they react differently? Is Bell Canada's hinted-at tariff rate of 2.0 times a conventional analog line a better proposal for pricing than that occurring in the U.S.? What about the possibility of special pricing arrangements on a competitive basis, as has occurred in some jurisdictions in the U.S.? What about T1 and T3 in Canada? What about SS7? Will Rogers and CNCP offer ISDN also, or will they instead offer "ISDN-like" services, as has MCI?

These and many other questions are absolutely crucial to the development of ISDN in Canada. Indeed, government agencies at both the federal and provincial level need this kind of information, as well as federally and provincially chartered telephone companies and others. As Finneran says, "...ISDN is recognized as one of the most important technological developments in the telecommunications field today,..."[25] and as such it should be treated carefully and responsibly. Analyses such as the present one are a start, but only a start. We suggest, therefore, that much more work needs to be done.

It is not our purpose nor is this the place to describe in detail such a research plan. What seems reasonably clear, however, is that it should have multiple sponsorship. Only in this way can both regulators and industry be assured that all factors are considered, all points of view are expressed,

analyses are carefully done, and projections are made that have high credibility. This in our view will give ISDN a much better start in Canada than it is having so far in the U.S., and thus will be worth many times over the cost of the research.

REFERENCES

1. Falconer, R.M., The user's view of ISDN, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

2. McQuillan, John, What's Wrong with ISDN?, *Business Communications Review* (hereinafter referred to as *BCR*), January-February 1987.

3. Bellamy, John, *Digital Telephony*, John Wiley & Sons, New York, 1982. This book, in our opinion, is one of the very best available in this subject area. We recommend it highly, as well as its revised edition, to be published next year (1990).

4. Particularly important here is the fact that MCI and others are approaching users with alternatives to ISDN, as we discuss in more detail in Chapter II.

5. *ISDN Report*, Probe Research Inc., Three Wing Drive, Suite 240, Cedar Knolls, New Jersey, U.S.A.

6. Probe ISDN Report, March 15, 1988, p. 1.

7. ibid., p. 2.

8. ibid., January 1, 1989, p. 3.

9. *ISDN News*, Phillips Publishing Inc., 7811 Montrose Road, Potomac Maryland, U.S.A.

10. Private communication, AT&T.

11. Probe ISDN Report, September 13, 1988, p. 4.

12. Johnston, Mary A., ISDN Migration Strategies, *BCR*, May-June 1988, p. 44.

13. ibid., p. 45.

14. When we say "legitimate" here, we are referring to legitimate in the marketing and user need sense only. There are many questions about whether calling number ID is legitimate in a *public interest sense*, and this is becoming a major issue. (See, for example, "The Dark Side of Calling Line ID," in *BCR*, September-October, 1988, p. 6, as well as other recent articles and news items on this topic).

15. Probe ISDN Report, February 15, 1989, pp. 1-2.

16. e.g., *BCR*, May 1989, pp. 19-21.

17. Probe ISDN Report, February 15, 1989, p. 2

18. ibid., August 15, 1988, p. 2.

19. Knight, Fred S., Market Forces Affecting ISDN, *BCR*, May-June 1988, p. 38.

20. Finneran, Michael, ISDN Won't Sell Without Standards, *BCR*, May 1989, pp. 74-78.

21. Figures 2-6 are taken from Hough, R.W., et al., *A Study of Trends in the Demand for Information Transfer*, Stanford Research Institute, Menlo Park, California, February 1970. Sources for Figures 7-11 are noted on the figures.

22. Johnston, op. cit., p. 45.

23. Finneran, Michael F., ISDN : A Time for Faith, *BCR*, January-February 1988, pp. 40-42.

24. Finneran, op. cit. (Ref. 20), pp. 76-77.

25. ibid., p. 74.

BIBLIOGRAPHY

As readers will know by now, we have in this report concentrated on only a few sources to derive real, actual, "market-oriented" information on ISDN. As is also widely known, however, this subject area has been treated by many writers over the last few years and many conferences and seminars on the subject have been sponsored. There is thus a good deal of bibliographic material available, despite the fact that it generally reflects little on actual use.

To approach this problem systematically we first went to the Department of Communications (DOC) library, sat down with DOBIS, the Canada-wide government sponsored online reference system, and asked for everything in the system on "ISDN." Understandably and appropriately, out came a long list!

We have decided, for purposes of completeness in this report, to reproduce this original, abbreviated list in its entirety, just to show how extensive has been the attention paid to this subject matter. Note, here, that the intention is not to put this forward as a substitute for conventional bibliographic citations but as a supplement to those citations. In the course of our work we examined virtually all of these references, and made use of many of them for detailed study. Unfortunately, as we have said earlier, other sources proved to be much more valuable for our work, but the search process was worthwhile nonetheless.

The remainder of the bibliography gives, to the best of our ability, a broad range of sources including but not limited to those from the DOBIS file. Especially important here are articles and news items from trade publications such as *Business Communications Review, Telephony, Telecommunications* and other trade journals, *Business Week, Time* and so on and, finally, newsletters such as *ISDN Report* and *ISDN News* that we have used extensively in our report. Hopefully, reference to at least some of this material will be of additional value to our readers, as it has been to us.

Part I

ABBREVIATED LISTING ON SUBJECT "ISDN," FROM DOBIS SEARCH

```
Searching
Titles and Keywords
  1      ISDN SYST// COMPUT NETW
  2      ISDN                                                              3
  3      ISDN// INTEGRATED SERVICES DIGITAL NETWORKS
  4      ISDN// INTERFACING WITH
  5      ISDN// INTRODUCTION TO
  6      ISDN// ITIDN
  7      ISDN// SPECIAL ISSUE ON
  8      ISDN// SPECIAL ITIDN
  9      ISDN AN EXECUTIVE OVERVIEW// STRATEGIC PERSPECTIVE ON
 10      ISDN AN INTENSIVE PROBE USER SEMINAR NOVEMBER 14 15 1984 NEW YORK// NE
 11      ISDN : an introduction / William Stallings                        1
 12      ISDN AND IBM// PBX COMPUTER INTERFACES THE IMPACT OF CPI DMI
 13      ISDN AND ITS IMPACT ON INFORMATION TECHNOLOGY 14 16 JANUARY 1985 VENU
 14      ISDN AND MOBILE COMMUNICATIONS SINGAPORE 14 17 MAY 1985 JOINTLY ORGAN
Enter line number from above or code from below
f
t new term    f forward
i new file    b backwrd
                          d detail


Searching
Titles and Keywords
  1      ISDN AND MOBILE COMMUNICATIONS SINGAPORE 14 17 MAY 1985 JOINTLY ORGAN
  2      ISDN BASIC ACCESS INTERFACE LOCATED AT REFERENCE POINTS S AND T// INFO
  3      ISDN (Boston, Mass.)                                              1
  4      ISDN/broadband networks for the future 86 : proceedings : papers pr /  2
  5      ISDN COMMUNICATION SYSTEM// ISDN IN THE OFFICE HICOM TECHNOLOGY AND AP
  6      ISDN COMMUNICATIONS INFORMATION SYSTEMS CRITICAL PATH SERVICE// INTERF
  7      ISDN CONCEPTS AND ISSUES IN THE US AND IN JAPAN MASANAO TANASE// INTEG
  8      ISDN D CHANNEL// PERIPHERALS FOR THE
  9      ISDN, das diensteintegrierende digitale Nachrichtennetz           1
 10      ISDN, das diensteintegrierende digitale Nachrichtennetz. English  1
 11      ISDN, das diensteintegrierende digitale Nachrichtennetz : Konzept,  /  1
 12      ISDN DESIGN AND PLANNING PROCEEDINGS OF THE FIFTH ITC SEMINAR HELD AT
 13      ISDN DETERMINANTS OF CORPORATE MARKET GROWTH A STRATEGIC ANALYSIS// NE
 14      ISDN DM CERNI// CCITT MICROFORM ORGANIZATION US PARTICIPATION AND STUD
Enter line number from above or code from below
2
t new term    f forward
i new file    b backwrd
```

```
Searching
Titles and Keywords
  1      ISDN DM CERNI// CCITT MICROFORM ORGANIZATION US PARTICIPATION AND STUD
  2      ISDN DM CERNI// CCITT ORGANIZATION US PARTICIPATION AND STUDIES TOWARD
  3      ISDN EDITED BY WILLIAM STALLINGS// TUTORIAL INTEGRATED SERVICES DIGITA
  4      ISDN ERA PROCEEDINGS OF THE IFIP TC6 FIRST INTERNATIONAL CONFERENCE O
  5      ISDN ERA TEL AVIV ISRAEL 4 5 MARCH 1985 EDITED BY Y PERRY// DATA COMMU
  6      ISDN EUROPE 86 NOVEMBER 5 7 1986 EWTCC CONGRESS CENTRE BASEL SWITZERL
  7      ISDN Europe 86 : papers presented at First Pan European Conference  /  1
  8      ISDN FIELD TRIALS WORLDWIDE INSTRUCTOR J MCCANN// IT 2
  9      ISDN FIELD TRIALS WRITTEN BY HARVEY BLUSTAIN// FIBER OPTICS BROADBAND
 10      ISDN FIRST REPORT// IN THE MATTER OF INTEGRATED SERVICES DIGITAL NETWO
 11      ISDN G DICENET TRANSLATED BY DAVID OLIVER// DESIGN AND PROSPECTS FOR T
 12      ISDN handbook and buyers guide                                        1
 13      ISDN handbook & buyers guide                                          1
 14      ISDN IMPLEMENTATION IN THE CANADIAN TELECOMMUNICATIONS SYSTEM FINAL R
Enter line number from above or code from below
f
t new term    f forward
i new file    b backwrd
                          d detail
```

```
Searching
Titles and Keywords
  1      ISDN IMPLEMENTATION IN THE CANADIAN TELECOMMUNICATIONS SYSTEM FINAL R
  2      Das ISDN in der Einf"uhrung : Vortr"age der ITG-Fachtagung vom 22.  /  1
  3      ISDN IN NORTH AMERICA PROCEEDINGS OF THE REGIONAL CONFERENCE OF THE I
  4      I.S.D.N. in the information marketplace                               1
  5      ISDN in the information marketplace / Robert K. Heldman               1
  6      ISDN in the office, HICOM : technology and applications of the HICO /  1
  7      ISDN in the real world / by Ian Angus                                 1
  8      ISDN information sourcebook                                           1
  9      ISDN ISDN EUROPE 86 NOVEMBER 5 7 1986 EWTCC CONGRESS CENTRE BASEL SWI
 10      ISDN JOHN LANE// INTEGRATED SERVICES DIGITAL NETWORK
 11      ISDN KOMPONENTEN STANDARDISIERUNG EINSATZMOGLICHKEITEN NUTZEN UND KRI
 12      ISDN markets                                                          1
 13      ISDN MARKETS INSTRUCTOR J MCCANN// IC 1
 14      ISDN MICROFORM AN APPROACH TO NETWORK EVOLUTION BY SIN YUN COLMAN HO
Enter line number from above or code from below
t new term    f forward
i new file    b backwrd
```

```
Searching                                   GETE006
Titles and Keywords                         No input made
  1      ISDN MARKETS INSTRUCTOR J MCCANN// IC 1
  2      ISDN MICROFORM AN APPROACH TO NETWORK EVOLUTION BY SIN YUN COLMAN HO
  3      ISDN--networks for the future 85                                    1
  4      ISDN NETWORKS PRODUCTS AND SERVICES ROBERT K HELDMAN// TELECOMMUNICATI
  5      ISDN OSI PROTOCOLS KEITH KNIGHTSON MARC HORNBEEK// CONFORMANCE TESTING
  6      ISDN PBX CENTREX INSTRUCTOR D CAMPBELL// IT 4
  7      ISDN ... proceedings                                                1
  8      ISDN realistic expectations : economics, revenue, forecasting, tari /  1
  9      ISDN SERIAL COMMUNICATIONS CONTROLLER// VLSI ARCHITECTURE FOR A MULTI
 10      ISDN SERIAL COMMUNICATIONS CONTROLLER MICROFORM BY RANDY KUN// VLSI AR
 11      ISDN SERVICES ON RADIO FREQUENCY SPECTRUM INTERCONNECTION REQUIREMENT
 12      ISDN : special issue / guest editors: R. Andrew Pickens, Donald J.  /  1
 13      ISDN : special section                                              1
 14      ISDN standards                                                      1
Enter line number from above or code from below
f
t new term    f forward
i new file    b backwrd
                                   d detail
```

```
Searching
Titles and Keywords
  1      ISDN standards                                                      1
  2      ISDN STANDARDS INSTRUCTOR JR MORAN JG REED// IC 2
  3      ISDN strategies                                                     1
  4      ISDN SWITCHING NODE IMPLEMENTATION// DISTRIBUTION OF PROTOCOL FUNCTION
  5      ISDN SWITCHING NODE IMPLEMENTATION MICROFORM BY JAMES DOBLE// DISTRIBU
  6      ISDN SYSTEMS// COMPUTER NETWORKS AND
  7      ISDN terminal standards reference manual / T.G. Fellows ... [et al.]   1
  8      ISDN : the implementation begins : communications systems & services   1
  9      ISDN, the integrated services digital network : concepts, methods,  /  1
 10      ISDN THE OMNICOM INSTITUTE// INTEGRATED SERVICES DIGITAL NETWORKS
 11      ISDN, the transition years                                          1
 12      ISDN TRANSMISSION FIBER OPTICS SWITCHING TERMINALS// REALISTIC APPROAC
 13      ISDN--user needs vs. vendor capabilities--is there a match? : Septe /  1
 14      ISDN USING FIBER OPTICS MICROFORM BY HOWARD LORNE PELL// DYNAMIC BANDW
Enter line number from above or code from below
2
t new term    f forward
i new file    b backwrd
```

```
Searching
Titles and Keywords
 1      ISDN USING FIBER OPTICS MICROFORM BY HOWARD LORNE PELL// DYNAMIC BANDW
 2      ISDN, volume 1, Europe : proceedings of the international conferenc /  1
 3      ISDN : volume 2, USA : proceedings of the conference held in San Fr /  1
 4      ISDN with Broadband Communications Conference : November 13 & 14, 1 /  1
 5      ISDN WORKSHOP INTUG PROCEEDINGS 29 OCTOBER 1984 COLOGNE G RUSSELL PIP
 6      ISDN 85 proceedings : papers presented at the First International I /  1
 7      ISDN 87 DALLAS TEXAS SEPTEMBER 15 17 1987 EDITED BY IRWIN DORROS SPON
 8      ISDN 87 : proceedings of the conference held in London, June 1987      1
 9      ISDN 88 : proceedings of the international conference held in Londo /  1
10      ISDNS// DISCUSSION PAPER ON INTEGRATED SERVICES DIGITAL NETWORKS
11      ISDN'86 : supplement to the proceedings
12      ISDO report                                                            1
13      ISDOC bulletin                                                         1
14      ISDOS/PRISE Review Meeting : August 1983                               1
Enter line number from above or code from below
2
t new term    f forward
i new file    b backwrd
                                    d detail
```

Part II

BIBLIOGRAPHIC CITATIONS

Allen, Peter, INTUG View of ISDN, paper presented at ISDN Europe 86, Information Gatekeepers, Inc., Boston, 1986.

Angus, Ian, ISDN in the Real World: Articles from Telecom Systems and Strategies 1985-1988, Angus Telemanagement Group, Pickering, Ontario, 1988.

AT&T: The Making of a Comeback, *Business Week*, January 18, 1988.

Bader, Edgar, Data Transmission via Combined ISDN- and PSTN-Systems, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Berera, Edoardo and Pierre Jardin, Interconnection of LANs & PBXs in an ISDN Environment, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Bohacek, Peter K. and Alan J. Mindlin, New Services & Opportunities with ISDN, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Bolger, Thomas E., The Controversies Surrounding ISDN, *Computer Networks and ISDN Systems*, 15, (1988), 27-30.

Borthich, Sandra, Slow Sales for High Speed Modems, *Business Communications Review*, May-June 1988.

Brown, David, The Integrated Services Private Network, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Campbell, D., IT-4 ISDN/PBX/Centrex, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Canadian ISDN Trial Begins, *Business Communications Review*, January-February 1988, p. 4.

Chang, Charles and David Hitchcock, The VANS Handbook, Online Publications, London, 1987.

Chu, N.N.Y. and J.D. Allen, Automatic Call Distribution in an ISDN Environment, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Commercial ISDN Debuts in Major Project, *Canadian Communications Reports*, March 15, 1989, p. 4.

Communications Canada, ISDN Canada: Report on ISDN Implementation in Canada, Department of Communications, Ottawa, March 1989.

Communications Canada, ISDN Terminal Standards Reference Manual, Department of Communications, Ottawa, 1987.

Cooper, M.D. The Impact of ISDN on Local Area Networks, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Das, S., D. Upp, J. Vij and J. Yanosy, Interworking of Analog and ISDN Networks in Office Environments, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Davies, D.R.H., Local and Area Networks and ISDN, paper presented at IEE conference on The ISDN and its Impact on Information Technology, London, UK, January 1985.

Davis, Ian G., ISDN - Why Bother?, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

Dawson, G., Standards for Interactive Services on Wideband Cable Systems, paper presented at IEE conference on The ISDN and its Impact on Information Technology, London, UK, January 1985.

Dittberner Associates Inc., ISDN Realistic Expectations: Economics, Revenue, Forecasting, Tariffs, Field Trials, Dittberner Associates, Bethesda MD, 1987.

Dulfer, John E., When Does Fiber Make Sense?, *Business Communications Review*, February 1989.

Fahey, Garry, The Private ISDN, *Communications International*, June 1988.

Falconer, R.M., The User's View of ISDN, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

Feather, Frank, Tomorrow's Telecom Market, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Fibronics Offers FDDI Backbone, *Business Communications Review*, February 1989.

Fike, Robert L., ISDN Trials in the Bell Operating Companies, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Finneran, Michael F, ISDN Won't Sell Without Standards, *Business Communications Review*, May 1989.

Finneran, Michael F., ISDN: A Time for Faith, *Business Communications Review*, January-February 1988.

Finneran, Michael F., Modems March On, *Business Communications Review*, May-June 1988.

First Steps for Residential Fiber, *Business Communications Review*, January-February 1988, p. 3.

Gimpelson, Lester A., An ISDN Approach to Integrated Corporate Networks, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Goeller, Lee, Comparing PBXs for Voice/Data Integration, *Business Communications Review*, May-June 1988.

Goerner, Paul, Ken Shoji and Kaoru Yano, An Approach to Evolving ISDN Aiming at Business Communications, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Goldner, Ernst-Heinrich and Paul Kuhn, Integration of Voice and Data in the Local Area, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Green, Harold W., ISDN, Bridging the Gap, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Halter, Jorg, Does ISDN Also Offer the User Advantages?, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Hamer, David G. and Ian Davis, Integrated Services Digital Networks (ISDN): The Impact on Information Technology, paper presented at IEE conference on The ISDN and its Impact on Information Technology, London, UK, January 1985.

Held, Jeff, Simple Solutions Evade Net Management Providers, *Business Communications Review*, May 1989.

Henriet, Dominique, PBXs & LANs in ISDN Context, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Hills, Michael T., Pricing Changes for Virtual Network Services, *Business Communications Review*, February 1989.

Hochvert, Daniel, ISDNs Are Not Built in a Vacuum, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Hoflinger, Jurgen, A New Generation Of ISDN Terminals, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Houldsworth, J., ISDN, The ISO View of Bearer Services, paper presented at IEE conference on The ISDN and its Impact on Information Technology, London, UK, January 1985.

How to Fulfill Your Local Communication Needs, *Telecommunications*, September 1987.

ICA and SW Bell to Sponsor ISDN Showcase, *Business Communications Review*, February 1989, p. 14.

Information Technology Association of Canada, Discussion Paper on Integrated Services Digital Networks (ISDN's), Toronto, April 1988.

Integration with Wide Area Networks, *Telecommunications*, September 1987.

International Communications Association, ISDN: You Know What it is. Now See What it Can Do., advertisement in *Business Communications Review*, February 1989, p. 89.

Irmer, Theodor, International Standards for Worldwide Communication, paper presented at Siemens conference on ISDN in the Office, Berlin, 1985.

ISDN's Multiple Cost and Learning Curves, *Business Communications Review*, July-August 1988, p. 14.

ISDN...User Needs vs. Vendor Capabilities...Is There a Match?, papers presented at a conference sponsored by Probe Research Inc., San Francisco, September 1985.

Johnson, Peter, ISDN - The North American Experience, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

Johnston, Mary A., ISDN Migration Strategies, *Business Communications Review*, May-June 1988.

Kella, Jehuda, Introducing ISDN into an Existing Telecommunication System - A Case Study, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Knight, Fred S., How Fast is Technology Really Moving?, *Business Communications Review*, May 1989, p. 6.

Knight, Fred S., Market Forces Affecting ISDN, *Business Communications Review*, May-June 1988.

Knight, Fred S., Plans and Dreams for Next Generation Switches, *Business Communications Review*, January-February 1988.

Knight, Fred S., The Dark Side of Calling Line ID, *Business Communications Review*, September-October 1988, p. 6.

Kuehn, Richard A., Perspective on Telecom '87, *Business Communications Review*, January-February 1988.

Lane, John, *The Integrated Services Digital Network*, NCC Publications, Manchester, England, 1987.

Lawton, Raymond W. Telecommunications Modernization Issues and Approaches for Regulators, The National Regulatory Research Institute, Columbus, Ohio, January 1988.

Marchetti, Caesare, Darwin and the Future of ISDN, in Traffic Engineering for ISDN Design and Planning, Elsevier (North Holland), Amsterdam, 1988.

Massey, Peter, ISPBX Capabilities and Directions in the UK Market, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

McQuillan, John, ISDN vs. LANs for Local Data Connectivity, *Business Communications Review*, January-February 1988.

McQuillan, John, What's Wrong with ISDN?, *Business Communications Review*, January-February 1987.

Meng, Brita, The Ethernet Solution, *Macworld*, January 1988.

Nicholas, D.E., The Digital Future and ISDN - A Customer Perspective of the European Situation, paper presented at IEE conference on The ISDN and its Impact on Information Technology, London, UK, January 1985.

O'Brien, Brad, ISDN: Users think it's a distant prospect. Wrong., *Data Communications*, December 1985.

Phillips, Kenneth L., ISDN's Built-In Problems, *Telecommunications*, October 1987.

Private Lines Still Key to Data Nets, *Business Communications Review*, May 1989, p. 12.

Ralph, Bonnie, ISDN and Centrex, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

Remortel, J. Van, Private ISDN: Terminals, Terminal Adapters and Services - A Necessary Complement of Public ISDN, paper presented at ISDN Europe 86, Information Gatekeepers, Inc., Boston, 1986.

Remy, Jerome and Jean-Pierre Temime, Will the Demand Meet the Technical Promise?, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Ronayne, John, ISDN, The Story So Far, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

Ronayne, John, *The Integrated Services Digital Network: from concept to application*, John Wiley & Sons, New York, 1988.

Rossi, Bruno and Domenico Serafini, Emerging Telematic Services & Their Impact on the ISDN, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Rudd, Susan E., ISDN - Market Needs - A Data Communications View, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Rutkowski, Anthony M., *Integrated Services Digital Networks*, Artech House, Dedham MA, 1985.

Seraj, Jila, The Impact of Service Mixtures on the ISDN D-Channel Performance, in Traffic Engineering for ISDN Design and Planning, Elsevier (North Holland), Amsterdam, 1988.

Siemens Transmission Systems, Announcing an end to separate ZBTSI and B8ZS networks, advertisement appearing in *Business Communications Review,* February 1989.

Simonson, R.D., The Applications Potential of ISDN, paper presented at ISDN/Broadband Networks for the Future 86, Information Gatekeepers, Inc., Boston, 1986.

Stallings, William, *ISDN: An Introduction,* MacMillan, New York, 1987

Tanase, Masanao, Behind the Telephone Debates - 5, Integrated Services Digital Networks (ISDN): Concepts and Issues in the U.S. and in Japan, Harvard University Program on Information Resources Policy, Cambridge MA, 1985.

Tang, Victor, ISDN: New Vistas in Information Processing, paper presented at Bellcore Seminar, Dallas, Texas, March 12, 1986.

The Importance of SS7, in Toth, Victor J., FCC Delivers Bad News for 800 Service and SS7, *Business Communications Review,* May 1989, p. 69.

Tyler, Peter, ISDN : The User Expectations, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

U.S. Bureau of the Census, *Statistical Abstract of the United States: 1989,* (109th edition), Washington, DC, 1989.

Valet, I., Communication Architecture for Satellite Systems, Basis for ISDN, paper presented at First International Conference on Data Communications in the ISDN Era, Elsevier (North Holland), Amsterdam, 1985.

Valovic, Tom, Fourteen Things You Should Know About ISDN, *Telecommunications,* December 1987.

Valovic, Tom, Will ISDN Replace LANs? *Telecommunications,* September 1987.

Volle, Michel, Drawing on the Videotex Experience: Elements Applicable to ISDN Tariffs, Applications & Regulations, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Vytopil, Jan, David Gailey and Georges Lathouwers, ISDN : The Confusion of the Potential User, paper presented at ISDN 87, Online Publications, Pinner, Middlesex, UK, 1987.

Wheatley, Jeffery J., ISDN : An Economist's View, paper presented at ISDN 88, Online Publications, Pinner, Middlesex, UK, 1988.

APPENDIX A

Statement of Work

Statement of Work

Preliminary Study of ISDN (Integrated Services Digital Network), Concentrating on Market, Economics and User-Oriented Issues

Background

Over the past two years, approximately, the subject of ISDN has become very current in the telecommunications industry. As is by now quite well known, this new initiative is not, in fact, really 'new' at all, since it has been under development within the industry for many years. However, in a sense, word of ISDN's existence had not penetrated to the "outside world" until very recently, principally because virtually all of the work required to make ISDN happen has been of a highly technical nature, involving concept development, choosing among many technical possibilities for implementation, engineering design and development, and above all standards setting by international bodies charged with those tasks, particularly CCITT.

In the last few years, this emphasis on technical matters has gradually begun to shift. Specifically, potential users have begun to ask questions such as, "What will ISDN do for me that I can't do now?" "What will it cost?" "If it costs more than what I pay now, why should I invest in new facilities and equipment just to stay 'current with technology' ?" "What will happen to private lines?" "Where are the 'golden applications' promised for this new digital world?" and many other, clearly market and use-oriented questions. This change of emphasis has led to a great deal of confusion as to what ISDN really is, how it fits into users' present plans for telecommunications use, what its relationship is to other innovations in communications deriving, principally, from the computer as opposed to the telecommunications industry, and what its status will be over both short term and long term time scales.

Rationale for the Study

The purpose of this study is to provide a preliminary view of these matters based on information readily available in the literature and on the basis of contacts within the industry. The objective is not, it should be noted, to do substantive original research at this time, but to bring together, analyze and report on the substantial amount of information beginning to become available on market, economics, use, applications, and potential user response to ISDN, as it is presently constituted. Very important in this context are issues such as the extent to which networks in North America, and in particular Canada of course, have become and are continuing to become digitized; U.S. experience vis-a-vis costs of ISDN; anticipated Canadian tariffs and rollout schedules, to the extent that such information becomes available during the course of the study; economics of and technical capabilities of ISDN as contrasted with, for example, computer-based local and wide area networks; how fibre fits into the picture; and other key, market-oriented variables.

Task Description

The task description for the project is essentially, as stated above, to perform a preliminary, desk-research-based study of ISDN concentrating on economics, market, and user-oriented questions as contrasted with purely (or primarily) technically-oriented matters. The work shall include addressing such questions as the following, based, again, on information available in the open literature and other readily available sources:

- What will ISDN do for users?
- What will it do that can't be done today?
- How much will it cost?
- What types of entities and organizations need it?
- Why do they need it?
- What is the relationship of ISDN to local area networks, wide area networks, value added networks, metropolitan area networks, etc.?
- Is it good for voice?
- What about 2B + D vs. 1B + D, vis-a-vis present usage patterns?
- Response of users/potential users at the present time.
- Growth rate over last year (in U.S. in particular).
- What organizations are buying now?
- Why are they buying?
- Economics of buying into ISDN as contrasted, particularly, with staying with present systems, networks, and so on.

HD
9696
C62
P74
1989

PRELIMINARY STUDY OF ECONOMICS, MARKETS AND POTENTIAL DEMAND FOR ISDN SERVICES

DATE	NAME OF BORROWER NOM DE L'EMPRUNTEUR

Government of Canada
Department of Communications
CIRCULATION RECORD

Gouvernement du Canada
Ministère des Communications
FICHE DE CIRCULATION
06-96
279

HD
9696
C62
P74
1989

PRELIMINARY STUDY OF ECONOMICS, MARKETS AND POTENTIAL DEMAND FOR ISDN SERVICES

DATE	NAME OF BORROWER NOM DE L'EMPRUNTEUR

Government of Canada
Department of Communications
CIRCULATION RECORD

Gouvernement du Canada
Ministère des Communications
FICHE DE CIRCULATION
06-96
279

PRELIMINARY STUDY OF ECONOMICS, MARKETS AND POTENTIAL DEMAND FOR ISDN SERVICES