A STUDY TO IDENTIFY REQUIREMENTS FOR NEW SERVICES ON A DIRECT BROADCAST SATELLITE (DBS) SYSTEM

CANADIAN ASTRONAUTICS LIMITED

A STUDY TO IDENTIFY REQUIREMENTS FOR NEW SERVICES ON A DIRECT BROADCAST SATELLITE (DBS) SYSTEM

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CANADIAN ASTRONAUTICS LIMITED
TAMEC INC.

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The report summarizes the work performed for the Department of Communications entitled, "A Study to Identify Requirements for New Services on a Direct Broadcast Satellite (DBS) System" under DSS Contract Number 17ST.36100-0-0577. The work described in the report represents the combined efforts of Canadian Astronautics Limited, the prime study contractor and technical consultant with the assistance of Tamec Inc. to lend support to economic aspects of the analyses performed.

The object of the study was to assess both the need and the requirements of potential additional services that can be offered on a DBS in addition to entertainment programming. The study purposely steered clear of entertainment oriented television broadcasting but did consider other services which could be offered in a video signal format. The concise list of objectives, specified in the statement of work, identified the following goals:

- to arrive at requirements for new services (i.e., non-existing services) that a DBS could provide in Canada in addition to television and radio service

- to translate these into requirements for satellite channel capacity, uplink and receive terminals

- to identify financial, and institutional issues and implications of these new services.

The approach taken in identifying feasible services involved filtering, in two stages, a long list of candidate services and eliminating those which are not compatible with the DBS architecture. Initial screening criteria filtered out services with the following characteristics:

- need for bidirectional symmetric interaction
- local or purely individual service market

- low demand at any point in time
- low frequency of information update
- large information storage requirement.

The second stage of the filtering process required a more detailed examination of service demand and supply attributes. Demand aspects include:

- preferred alternate user (AU) signal format
- market size and growth
- means of finance (sender/user)
- amount of sender/receiver interaction
- information response time
- user/sender distributions
- addressability requirements.

While bidirectional symmetric interaction was excluded earlier, we did acknowledge the concept of a limited return channel to allow some degree of flexibility to solely unidirectional transmission.

Essential service supply characteristics included the following factors:

- user terminal intelligence
- information storage (sender/user)
- level of signal security
- service bandwidth and SNR
- alternatives and competition.

An analysis based on the supply and demand characteristics of each service permitted correlating service and DBS characteristics and identified services which are both DBS compatible and unsatisfied by present methods.

The list of feasible services was consolidated under three broad categories; audio, digital data, and image information services. Within each category, generic services were grouped together to yield the final list, based upon which an abridged version includes:

- audio services
  - FM superstations
  - radio networking
  - specialized channels
- data services (business)
  - electronic mail
  - financial information service
  - newswires
  - specialized business publications
- data services (household)
  - directories
  - transportation/travel information
  - recreational/cultural services
  - electronic newspapers and magaznes
  - electronic mail
  - energy management
- image information services
  - education
  - video conferencing
  - facsimile and still picture transmission
  - high definition television

Having identified a number of candidate alternative user DBS services, more detailed technical and economic factors are evaluated. The technical analysis consists of a correlation of DBS system concepts and of user requirements to determine the optimum method of satisfying those demands. Given the number of time zones, the regional foci of culture, language and occupation encountered across Canada, suggests that the DBS will have to satisfy primarily regional demands. Several different signal formats have to be accomodated in each region, within a structure oriented mostly to wideband services. Another major factor to be considered is the ultimate cost and degree of flexibility of the domestic receiving terminal. Terminal flexibility and interface standardization is vital to allow unimpeded growth of DBS services once the user community feels more comfortable with the technology and its potential benefits. Generally, most of the technical aspects were not found to be drivers of service feasibility since the method of offering a service can be restructured to match DBS constraints. Nevertheless, technical decisions and commitments must remain adaptable to future requirements.

Subsequent sections of the report examine the market and the requirements for each of the generic service categories. The viability of providing a given service on the DBS was primarily a function of the number and capabilities of competitive terresrial alternatives, the method of service financing (advertising vs. subscription) in relation to critical mass, and in an indirect sense, the prevailing regulatory/institutional environment. The ultimate results of our investigations have shown that the most promising services are:

- FM superstations
- radio networks
- household data services
- financial information services

Several other services have the potential of becoming leading alternate user services given better definition of the user market, resolution of technological alternatives and minimization of ground terminal costs. Among these are:

- specialized audio channels
- supplementary business services
- video conferencing (tele-education)
- high definition television

Study conclusions fall into six major areas:

- feasible services and characteristics
- prospects for services
- impact established industries
- implications to DBS System architecture
- compatibility of new technology and future services
- obstacles

The first two have already been mentioned above. A brief examination of the impact of DBS alternate services on the established communications industries shows that the influence of a DBS is more global or national in nature while most of the present information delivery methods are more localized or regionalized. As far as the electronic media is concerned, DBS services do not threaten their existance since they have a large potential for future expansion on a local and a regional level with new services not compatible with DBS characteristics. In the paper based media and publishing industries, DBS, by itself, has only a circumstantial influence with the main threat being imposed by the rapid growth of Telidon services.

Since national advertising contributes only a small percentage of the overall media revenues, we see DBS alternate services being predominantly subscriber financed. This may change with time, although the shift would be gradual since advertising revenues are highly concentrated on a local level.

At the present time, there are a number of obstacles that will arise with the introduction of some or all services on a DBS. Satellite system and broadcasting station operations are meticulously regulated in Canada; unfortunately, the structure of each of the regulations leads to a different treatment of a direct broadcast satellite. Prior to the launch of a DBS, this and its associated inconsistencies will have to be resolved; perhaps in the context of an overall structured communications - information exchange organization. The fundamental issue that must be determined is whether a DBS operation will be treated as a broadcast undertaking or as a carrier facility supplying services to the broadcasters. On the basis of this question, supplementary problems may arise such as the ownership of the vertical blanking interval of a television signal and whether a given broadcast leases a DBS service or a facility.

1.0 INTRODUCTION

1.1 STUDY BACKGROUND

This report presents the results of a study performed by Canadian Astronautics Limited and Tamec Inc., for the Department of Communications, under DSS Contract Number 17ST.36100-0-0577, to identify and evaluate requirements for new services on a direct broadcast satellite (DBS) system for Canada.

The concept of a direct broadcast satellite is soon to become a reality as program requirements are identified and the requisite technology developed. Through international cooperation and discussion, a variety of technological approaches and solutions have been developed to satisfy user needs and the general thirst for information. Program requirements differ from the evolution of technology in that they are functions of a nation's or region's culture, language, ethnic background, interests and especially the desired degree of 'dialog' with other people sharing a given geographical area. The driving force behind the offered programming is less likely to be the systems technology but rather is related to the needs of the people.

Given that the motivation for new forms of communication and broadcasting is the need for the exchange of ideas, concepts and the desire for information, the evolution of a direct broadcast satellite promises to revolutionize the Canadian broadcasting and telecommunication industries by providing direct access to each and every inhabitant of this country via the spacecraft. Potential benefits to be accrued include more extensive broadcast coverage areas, the availability of more bandwidth to expand the ensemble of services that can be offered and evolution of new technologies to meet these and other future requirements.

The concept of a DBS is currently the subject of critical examination throughout the world, most notably in Western Europe, Japan, the United States and in Canada. While technical concepts involve a variety of tradeoffs, there are considerable variations as to the objectives of each countries' DBS. Broadcasting, in recent years, has tended to be associated with the distribution of entertainment programming particularly in video form as evidenced by developments in the United States. On the other hand, there are other interests and requirements that can be satisfied by broadcast methods using a DBS such as tele-education and information dissemination of the type to be provided by the burgeoning Telidon technology.

1.2 STUDY OBJECTIVES

The objective of this study has been to assess both the need for and the requirements of potential additional services that can be offered on a DBS in addition to entertainment software. The study has purposely steered clear of entertainment oriented television broadcasting but has considered other services which could be offered in the video signal format.

A concise list of objectives, specified in the statement of work, set out the following goals:

- to arrive at requirements for new services (i.e., non-existing services) that a DBS could provide in Canada in addition to the television and radio services
- to translate these into requirements for satellite channel capacity, uplink and receive terminals
- to identify financial, and institutional issues and implications of these new services.

1.3 REPORT FORMAT

Our approach to this study has been to interleave technical and economic considerations in a way that would characterize the feasibility of either individual or groups of services as applied in the context of a direct broadcast satellite. Initial chapters highlight the service types that we deal with in later sections and the facilities and technologies available in meeting those demands.

Chapter 2 enumerates the services we initially postulated that could be considered alternate services. Most are characterized by their non-entertainment nature and correlate closely with those identified during the extensive work performed for the Wired City concept. We devised a filtering system to operate on the initial list of services to eliminate those that were obviously not feasible for delivery by a DBS. For instance, fully symmetric channel requirements and purely local services were eliminated first because of their basic incompatibility with the characteristics of a DBS. Other filters were applied sequentially until a short candidate list was aggregated for individual service feasibility evaluation in subsequent chapters.

Basic demographic data pertinent to the study is presented in Chapter 3. The chapter examines the feasibility of 2 possible DBS system configurations and how they can be integrated into the present communications structure in Canada. The discussion is aimed at forecasting the number of potential DBS clients and the effects of a DBS on terrestrial distribution systems such as cable networks. The data serves to put into perspective the total market for DBS services, its distribution across Canada and therfore the feasibility of the concept as well as of alternate services.

In Chapter 4, we discuss the technical aspects of the DBS system and what facilities are available or required to meet the needs for delivering DBS services to clients. The distribution of software or program suppliers, the distribution of the audience and the formats of potential candidate signals is examined in terms of the constraints that may be placed on the architecture and design of the DBS system. While most technical discussions deal with technological tradeoffs, our objective was to highlight system operational characteristics and attractiveness to a client and, later, use this criterion as the driver of the tradeoffs. Alternative modes of DBS reception are examined as are the competitive methods of terrestrial signal distribution, if possible.

Following the identification of candidate services done in Chapter 2, Chapters 5, 6, and 7 examine each of the application areas in more detail. These discussions form the heart of the report where we examine technical, financial, economic aspects of each of the service types. Markets are identified in terms of their financial structure and technical requirements are presented as they apply. Chapter 5 deals with audio services, encompassing radio broadcasting, radio networking, subscription services and distribution of syndicated material. Chapter 6 deals with digital data services of which we have focused primarily on the applicability of the Telidon technology in its teletext implementation for both business and household users. Chapter 7 examines image services such as the application of various forms of video transmission, facsimile and high definition television.

Conclusions and a report summary are found in Chapter 8. We have also highlighted issues of a jurisdictional, legal or regulatory nature which we have not attempted to resolve. Some of these also take the form of assumptions in preceding chapters in the market sensitivity analyses. A bibliography is presented in Section 9.

2.0 DEFINITION OF SERVICES

2.1 GENERAL

The establishment of a viable list of alternate services which could be carried on a Direct Broadcast Satellite was found to be a problematic exercise. Much of the uncertainty stemmed from the close inter-relationship between the information content of the signal and the signal format as delivered to a user. Furthermore, a comprehensive list of services is somewhat futuristic and complex, acknowledging the fact that repetition or omission of potentially valid entries is undesirable.

Our approach was to start with an initially long list, primarily geared to the information content rather than the signal format. Generic service classifications were ignored, at this stage, in order to focus attention on the specific service involved. The basis of the initial list was formed by a combination of our own brain-storming sessions supported by earlier studies such as the Telecommission Report - Study 8(d) [52] and a book by James Martin [1], both of which deal with future developments in telecommunications.

Given the initial list of services, we performed an initial screening to eliminate services which are not suited to carriage on a DBS. The filtering operation shortened the list and allowed a more detailed investigation of those services whose characteristics match those of a DBS.

The third stage of our examination was a detailed study of each of the remaining services, on an individual basis to identify desired signal formats, market potential, technical feasibility and the amount of bandwidth and/or power needed to satisfy the demands of the market. Our study concentrated primarily on the near to intermediate term requirements because the nature of the data accumulated is conditioned by current needs and by the present technical state-of-the-art. Long-term projections tend to be highly speculative under these conditions. The data presented does nevertheless, show the trend in user demands.

The results of the detailed examination or filtering are subsequently used as input to the fourth and final stage of the service definition. Having identified feasible services, we discuss them in more detail in subsequent chapters of this report; this time more from the generic service point-of-view. The reasons for aggregating results are twofold. Since many of the proposed services have similar information content and therefore may ultimately share a common signal format, they can be grouped together to constitute a type of service (e.g., information retrieval). Secondly, service groupings minimize unnecessary duplication of feasibility results since service prospects are a strong function of the nature of the information rather than the specific information content.

2.2 INITIAL LIST OF SERVICES

The list of possible alternate uses services initially postulated can be subdivided into 10 broad categories. The total list consists of 120 services, many of them of a highly specialized nature. Recognizing that business and household services envelope most of the possibilities, the other 8 categories basically are functions of the service supplier or specialized information content applicable to either home or business or both. Table 2.1 shows the service categories and Table 2.2 documents the complete list.

Table 2.1 Service Classification

1. Business
2. Political
3. Government Services
4. Health
5. Education
6. Agriculture
7. Household
8. Transportation
9. Culture, Entertainment, Recreation
10. Information - General

Table 2.2 List of Services

1. BUSINESS
   - 1.1 Secretarial assistance
   - 1.2 Person-to-person communication
   - 1.3 Person-to-group communication
   - 1.4 Computer assisted meetings
   - 1.5 Electronic mail
   - 1.6 Access to company files
   - 1.7 Message recording
   - 1.8 Shopping transactions
   - 1.9 Point-to-multi-point audio
   - 1.10 Point-to-multi-point facsimile
   - 1.11 Sales and inventory control
   - 1.12 'Cashless' society transactions
   - 1.13 Point-to-multi-point data
   - 1.14 Dedicated newspapers
   - 1.15 Banking
   - 1.16 Answering services
   - 1.17 Real estate listings
   - 1.18 Better Business Bureau
   - 1.19 'Paperless' stock market
   - 1.20 Special sale information
   - 1.21 Budget preparation and monitoring
   - 1.22 Access to historical public data

2. POLITICAL

2.1 Council meetings and other local meetings

2.2 Voting and opinion polling (local)

2.3 Voting and opinion polling (national)

2.4 Free political channel for candidates

2.5 Access to elected officials

2.6 Lists of elected members

3. GOVERNMENT SERVICES

3.1 Index of services

3.2 Social security

3.3 Immigration

3.4 Taxes

3.5 Weather information

3.6 Justice

3.7 Postal information

3.8 Welfare

3.9 Vocational counseling

3.10 Employment service

3.11 Emergency services

4. HEALTH

4.1 Remote diagnosis
4.2 Emergency medical information
4.3 Drug information
4.4 Health insurance
4.5 Medicare claim processing
4.6 Prescription automation
4.7 Dietetic meal planning and scheduling
4.8 Ambulance optimization
4.9 Outpatient services
4.10 Medical and dental appointment reminders
4.11 Advice on simple problems
4.12 Doctor directory
4.13 Immunization information
4.14 Mental Health Centre
4.15 Suicide prevention
4.16 Alcoholics Anonymous

5. EDUCATION

5.1 Correspondence schools

5.2 Computer tutor

5.3 Computer aided instruction

5.4 School related information

5.5 Adult and evening courses

5.6 Seminars

5.7 Consultation with teachers

6. AGRICULTURE

6.1 Soil conditions

6.2 Fertilizers and insecticides

6.3 Commodity market information

6.4 Gardening

6.5 Farm accounting

6.6 Farm management information

6.7 Machinery information

6.8 Agriculture publications

7. HOUSEHOLD

7.1 Meter reading
7.2 Energy management
7.3 Appliance management
7.4 Recipe files
7.5 Telegrams
7.6 Mail and messages
7.7 Daily calendars
7.8 Address book
7.9 Equipment maintenance reminders
7.10 Christmas lists
7.11 Shopping list preparation
7.12 Cleaning information
7.13 Food storage information

8. TRANSPORTATION

8.1 Vehicle purchase information
8.2 Road conditions
8.3 Travel advice
8.4 Traffic conditions
8.5 Vehicle maintenance information
8.6 Taxi service
8.7 Schedules
8.8 Maps
8.9 Accomodation information
8.10 Reservations
8.11 Tour information
8.12 Insurance information
8.13 Passports information

9. CULTURE, ENTERTAINMENT AND RECREATION

- 9.1 Current cultural events
- 9.2 Local plays movies
- 9.3 Ticket reservation
- 9.4 Restaurant lists and menus
- 9.5 Restaurant reservations
- 9.6 Computer dating
- 9.7 Classical radio station
- 9.8 Jazz radio station
- 9.9 Dedicated radio channel
- 9.10 Other audio channels
- 9.11 Outdoor recreation information
- 9.12 Indoor hobbies
- 9.13 Interactive games

10. INFORMATION-GENERAL

- 10.1 Index of all services
- 10.2 Library
- 10.3 Dictionaries
- 10.4 Encyclopedias
- 10.5 Yellow pages
- 10.6 Stock market information
- 10.7 National news
- 10.8 Local news
- 10.9 Magazines
- 10.10 Recent books information
- 10.11 Telephone area codes and new numbers

2.3 INITIAL SCREENING

The initial filtering operation on the services listed in Table 2.2 was performed to discard those services from further consideration that obviously cannot be accommodated on a Direct Broadcast Satellite. Since it is possible that some services can be reconfigured or force-fit into a DBS framework, the initial study considered alternative ways of offering any particular service before eliminating it from the final list.

Three criteria were used in this initial screening operation. All three had to be satisfied before a given service was accepted for further consideration. Failure of any one test meant that the service under consideration breached one of the fundamental characteristics of a DBS.

The criteria selected are summarized in Table 2.3. Since a DBS is inherently a one-way repeater, we eliminated any service type which depended on two-way symmetric interaction. Symmetry of operation is defined as a near equal amount of information flow to and from the user's terminal. A typical case of this mode of operation is a telephone conversation falling to the category of person-to-person communication (1.2). Given that limited interaction is feasible via an occassionally used return channel, we estimated a maximum acceptable "interaction" threshold to be in the order of 20%. If information flow-rate can be quantified as the transmission bandwidth multiplied by the transmission time, then 0.2 is the ratio of information flow from the user to that to the user.

If the service market is purely local, then currently available terrestrial distribution networks create virtually insurmountable competition for a direct broadcast satellite. A service example of this type is the transmission of a community billboard listing local activities exclusively of interest to a limited population sharing one small geographical region. In urban environments, cable television facilities can adequately satisfy this demand while the rural equivalent is the local newspaper, church billboard, pub or the gossip chain.

Table 2.3 Initial Screening Criteria

(i) need for bidirectional symmetric interaction

(ii) service market is purely local or individual (personal)

(iii) low demand at any point in time or,
low frequency of information update or,
large information storage requirements

For a service to be economically viable on a DBS, we estimated, initially, that the information or service be of interest to at least 10% of the people living in a given coverage area. This criteria eliminates purely local services but allows regional market (e.g., Eastern Townships in Quebec) to be served by the DBS.

Of the last three standards in Table 2.3, we eliminated from further evaluation any service which exhibited more than one of the three characteristics. Low demand for any service is somewhat subjective but coupled with any other of the two remaining criteria implies wasted bandwidth on the DBS and unrecoverable information storage costs. Low frequency of update and large storage requirements have traditionally been satisfied by printed matter as in dictionaries or encyclopedias.

Sequentially applying the criteria of Table 2.3 to the list of services shown in Table 2.2, enabled us to eliminate 63 services, leaving 57 likely ones requiring deeper analysis. The list of services eliminated and the criterion used to discard each is shown in Table 2.4.

Table 2.4

Services Eliminated by Initial Screening

Sevices	Two-way Symmetric Interaction	Purely Local Market	Low Demand Low Update Frequency Large Storage Requirement
1. Business (11 eliminated)			
1.1 Secretarial Assistance	X		
1.2 Person-to-person communication	X		
1.6 Access to company files	X		
1.8 Shopping transactions	X		
1.11 Sales & inventory control	X		
1.12 "cashless" society transaction	X		
1.15 Banking	X		
1.16 Answering Service	X		
1.19 "Paperless stock market	X		
1.21 Budget preparation & monitoring	X		
1.22 Access to historical public data			X
2. Political (3 eliminated)			
2.1 Council and other local meetings		X	X
2.2 Voting & opinion polling			X
2.5 Access to elected officials	X	X	
3. Government Services (2 eliminated)			
3.3 Immigration information			X
3.6 Justice Information			X

Table 2.4 (Continued)

Services	Two-way Symmetric Interaction	Purely Local Market	Low Demand Low Update Frequency Large Storage Requirement
4. Health (15 eliminated)			
4.1 Remote diagnosis	X		
4.2 Emergency Medical Information		X	
4.3 Drug Information			X
4.4 Health insurance information			X
4.5 Medicare claim processing	X		
4.6 Prescription automation	X		
4.7 Dietetic meal planning and scheduling			X
4.8 Ambulance coordination	X		
4.10 Appointment reminders		X	
4.11 Advice on simple problems	X		
4.12 Doctor directory		X	
4.13 Immunization information			X
4.14 Mental Health Centre		X	
4.15 Suicide prevention	X		
4.16 Alcholics Anonymous		X	
5. Education (2 eliminated)			
5.2 Computer tutor	X		
5.7 Consultation with teachers	X		
6. Agriculture (2 eliminated)			
6.4 Gardening			X
6.5 Farm accounting	X		

Table 2.4

Services Eliminated by Initial Screening

Sevices	Two-way Symmetric Interaction	Purely Local Market	Low Demand Low Update Frequency Large Storage Requirement
7. Household (9 eliminated)			
* 7.1 Meter Reading	X		
7.4 Recipe files			X
7.7 Daily Calendars		X	
7.8 Address Book		X	
7.9 Equipment Maintenance reminders		X	
7.10 Christmas lists		X	
7.11 Shopping list preparation	X	X	
7.12 Cleaning Information			X
7.13 Food Storage information			X
8. Transportation (7 eliminated)			
8.4 Traffic conditions		X	
8.5 Vehicle maintenance information			X
8.6 Taxi service	X	X	
8.8 Maps			X
8.10 Reservations	X		
8.12 Insurance information			X
8.13 Passport information			X
9. Culture, Entertainment & Recreation (6 eliminated)			
9.1 Current cultural affairs		X	
9.2 Local plays and movies		X	X
9.3 Ticket reservations	X		X
9.4 Restaurant lists and menus		X	
9.5 Restaurant reservations	X	X	
9.6 Computer dating	X		

* Note: This service represents a multipoint-to-point network application as opposed to a DBS point-to-multipoint configuration.

Table 2.4 (Continued)

Services	Two-way Symmetric Interaction	Purely Local Market	Low Demand Low Update Frequency Large Storage Requirement
10. Information - General (6 eliminated)			
10.2 Library			X
10.3 Dictionaries			X
10.4 Encylopedias			X
10.5 Yellow Pages		X	
10.8 Local News		X	
10.11 Telephone area codes and new numbers			X

2.4 DETAILED SERVICE ANALYSIS

2.4.1 CRITERIA

Having identified 57 "DBS-compatible" services, we examined these in more detail. The tabular approach used in previous sections was not found to be either a convenient or an efficient analysis tool so that we devised a "per-service" data sheet to assist in accumulating and organizing the information.

Major service characteristics fall into either a supply or a demand classification. Demand characteristics include:

- preferred alternate user (AU) signal format
- market size and growth
- means of finance (sender/user)
- amount of sender/receiver interaction
- response time
- user/supplier distributions
- addressability

On the supply side, essential service characteristics must include the following factors:

- user terminal intelligence
- information storage (sender/user)
- level of signal security
- receiver cost
- service bandwidth and signal-to-noise ratio
- alternatives and competition

Given an estimate of market size and growth and the required bandwidth for a particular service, we attempted to quantify the amount of traffic per unit time and be in a position to forecast the number of such channels needed per beam of the DBS.

A representative data sheet is shown in Figure 2.1. For each of the characteristics, we have indicated the type of entry that was desired. Due to the speculative nature of this study and the uncertain data, much of the information presented was qualitative. We expect that as user requirements and the state-of-the-art develop then the required information may become more specific.

In addition to the high, medium or low market evaluation, we have enlarged on these indicators further in the report. In most cases it was found that market evaluations on a per service basis were not meaningful as in, for instance, news or weather information. We resorted to qualitative estimates initially; later, after combining or aggregating similar services, we investigated the market for news and weather services together. In other words, the service market was not addressed explicitly but rather was substituted by the format market for a given set of services. An illustration of this discrimination can be discerned in the newspaper business where the publisher sometimes has little idea of the usefulness of any particular section but can only assess the popularity of the overall product.

The question of selectivity is twofold. Since local markets have been excluded by earlier analysis, market selectivity can be classified as regional, provincial or national. Two "selectivities" or distributions are under investigation. One is the selectivity of the user market implying, for instance, that the prairie agricultural community is not particularly interested in sea or fishing information. Secondly, provider selectivity is also a factor in that east or west coast sea/weather information will never originate from the prairies. In other words, our definition of selectivity considers the point-to-multipoint aspect of the service from both the sender's and receiver's perspectives, recognizing that this characteristic is a fundamental feature of a direct broadcast satellite.

Figure 2.1 Service Data Sheet

Service Type/Category:	Preferred AU Format: audio, alphnumerics, video, slow scan video, fax, reduced rate video, μp data
Service Description: - illustration of service concept - service compatibility with: • individual DBT • cable distribution • MATV • telephone etc.	
Service Supplier: • who provides info/service?	Service Consumer: • service users/clients?
Market Size/Growth: • size: high, medium, low • growth: high, medium, low • critical mass attainment?	Distribution: • regional, provincial, national • supply of info, info users
Means of Finance: • sender vs. user	Addressability: • resolution of individual users • 1 of ? based on market
Response Time: • instantaneous • rapid - less than 1 μsec delay • delayed - 24 hrs	Level of Interaction: • use of return channel • % of time x BW with respect to forward channel
Security: • absolutely secure • modest • little or none	Receiver Intelligence: • manipulation of data - μp software • display formatting • hardware processing only (audio)

(continued)

Figure 2.1 Service Data Sheet
(continued)

Traffic per unit time: • continuous or bursty? • traffic volume (kbits/sec)	Bandwidth; SNR: • typical channel BW • channel quality
Storage: local, regional, national • supplier vs. consumer • amount, and cost of storage	Receiver Cost: • hardware, software in addition to DBT
Alternatives: cable, telephone, other local distribution, newspapers, or not predictable	Overall Assessment: • high, medium, low

Closely related to the issue of selectivity is that of addressability. Since a DBS will operate primarily in a broadcast mode, individual user access to a given channel, whether dedicated or not, is not a particularly desirable feature. Addressable services can be accommodated but the cost of the service is proportionally more expensive and may result in a smaller market size. Other identified features also have a similar impact. Among these are the need for security and information storage.

We have identified three levels of receiver intelligence. The most complex involves the user terminal to have its own microprocessor to execute downloaded software. Implicit in the use of a microprocessor is the provision of all necessary peripherals. The second level of intelligence/complexity is the formatting of incoming data for display on a television screen. The user terminal is generally not very complex and within this classification we include teletext receivers such as Ceefax and Telidon. Although Telidon is somewhat different from Ceefax and could possibly be included in the first category, it is user transparent and has limited controllability by the user in its teletext format. Two-way interactive Telidon has already been excluded as a viable offering on a DBS. The third and last level of receiver intelligence is simple hardware processing of the incoming signal, such as in the detection and display of television and/or audio signals. It should be noted, at this point, that the NABU concept will reduce the impact of receiver intelligence on service feasibility. While the NABU awaits the development of a standard and suitable hardware, the conceptual marriage of information distribution and processing can only enhance the viability of many services by removing constraints imposed by the utilization of present day technology.

The level of interaction between service supplier and service consumer is a direct acknowledgement of the fact that many services may benefit from the use of a limited return channel. We arbitrarily assigned a threshold of 20% as the maximum ratio of information flow from the service consumer to that going in the forward direction, where the amount of information is traditionally defined as a time-bandwidth product.

Two of the more important data shown in Figure 2.1 are the alternative methods of providing a given service and the compatibility of a given service with terrestrial distribution. Alternative methods of service delivery limit the market size for the DBS delivered signal and impact greatly on the economic feasibility of DBS carriage. In some cases, we found that even a qualitative assessment of alternatives can disqualify a service from further consideration. An example is the storage of dictionaries/encyclopedias for recall in a Telidon-teletext format. The competition to this service offering is the wide proliferation of printed material, especially in paperback form, and the availability of the information in local libraries. Information distribution by electronic methods is uniquely suited to finite size libraries which require relatively frequent updates. In the case of large libraries, containing non-volatile (i.e. non-time critical) information, printed matter seems to be preferrable.

Compatibility of a service offering with terrestrial distribution methods specifically addresses the issue that not all households/businesses will opt for the purchase of a direct broadcast receiving terminal (DBT) but will retain their current connections to cable systems, local broadband networks (LBN's) or community antenna systems on top of apartment buildings. Since a DBS is not likely to replace existing distribution systems, it is foreseeable to have one DBT feeding a cable or other terrestrial system. The issue amounts to whether the terrestrial distribution system can interface, in principle, the DBS service and the subscriber's equipment. In most of the services that we considered, technical aspects of interconnection were not a problem, however the availability of facilities offered by the cable operator, particularly narrowband channels, may limit widespread introduction of such schemes.

2.4.2 ANALYSIS RESULTS

Applying the methodology and the accompanying criteria of previous sections to the initial list of feasible services narrows the choice of services that can be carried on a direct broadcast satellite.

During the analysis, it was found that technical feasibility was generally not a problem with few exceptions. Since technical criteria are a supply characteristic, most services can be configured for carriage by a DBS. Similarly, other supply characteristics such as addressability, security, receiver intelligence and information storage requirements can be arranged. Compatibility of a DBS carried service with terrestrial distribution methods was also not found to be a problem.

Major impediments to a DBS carried service lay generally on the demand side. Despite the difficulty in deriving accurate data, we found that the simplicity of a service offering would affect the potential market, particularly when competitive methods of service delivery held more appeal. The method of finance for a given service is obviously closely related to market size, especially when the user or receiver of the information bears the cost of service.

A summary of our results is shown in Table 2.5. We have listed the service type and its delivered format and have indicated the major alternative/competitive methods of providing those services. A final column shows our estimate of the prospects for the service if carried on a direct broadcast satellite. The economic feasibility, as well as overall viability, of a given service is inversely proportional to the strength of the competition.

The results shown in Table 2.5 indicate that, in the realm of alternate services, the direct broadcast satellite could have major impact in the educational, publishing and radio broadcasting fields as well as in providing general information services. It is interesting to note that all of the above information types are of the point-to-multipoint variety matching the characteristic of a DBS very closely. In later chapters of this report, we return to the abovementioned application areas to discuss, in more detail, the factors that make them feasible for carriage on a DBS as alternate services.

Table 2.5 Detailed Analysis Summary

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
1.3	Person-to-group communications	audio/video/ reduced rate TV/ slow scan TV	telecom carriers cable systems	fair - good
1.4	Computer assisted meetings	data/video/ alphanumerics	microprocessors terrestrial networks	poor
1.5	Electronic mail	alphanumerics	postal service couriers	fair
1.7	Message recording	audio/data	telegrams, answering machines	fair
1.9	Point-to-multipoint audio (radio services)	audio	terrestrial networks, cable systems	good - excellent
1.10	Point-to-multipoint facsimile	audio facilities, imaging systems	telephone network	poor
1.13	Point-to-multipoint data	data	Datapac, Infonet	fair - good
1.14	Dedicated newspaper	alphanumerics	printed matter	good - excellent

Table 2.5 Detailed Analysis Summary
(continued)

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
1.17	Real estate listings	data/video/ alphanumerics	printed matter cable systems	fair - good
1.18	Better Business Bureau - also Dun and Bradstreet credit card companies	alphanumerics/ data	printed matter	good - excellent
1.20	Advertising Distribution	alphanumerics	printed matter	good - excellent
2.3	Voting and Opinion Polling	alphanumerics	printed matter, telephone inquiry	poor
2.4	Political channel for candidates	audio/RRTV reduced rate TV	printed matter, local distribution	poor
2.6	List of elected officials	alphanumerics	printed matter	excellent
3.1	Index of government services	alphanumerics	printed matter	excellent
3.2	Social services index	alphanumerics	printed matter	excellent

Table 2.5 Detailed Analysis Summary
(continued)

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
3.4	Tax information	alphanumerics	printed matter	excellent
3.5	Weather information/ forecasts	alphanumerics data/audio	fax, audio, printed matter	excellent
3.7	Postal information	alphanumerics	printed matter	excellent
3.8	Welfare services	alphanumerics	printed matter	excellent
3.10	Employment services	alphanumerics	printed matter	excellent
3.11	Emergency services index	alphanumerics	printed matter	excellent
4.9	Outpatient services	audio/video alphanumerics	local info service	fair
5.1	Correspondence schools	alphanumerics	printed matter postal service	good
5.3	Computer-aided instruction (programmed learning)	alphanumerics	cable systems, telephone network	fair - good
5.4	School information	alphanumerics	printed matter	excellent

Table 2.5 Detailed Analysis Summary
(continued)

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
5.5	Evening courses/ seminars	video/audio/ reduced rate TV	local schools cable systems	good
5.6	Seminars (eg, "Cross Canada Checkup")	audio/video	terrestrial networks	good
6.1 6.2	Special interest channels	alphanumerics video/audio	---	good
6.3	Commodity market quotations	alphanumerics data	telephone/data networks	good
6.6 6.7	Farm management information	alphanumerics	printed matter	good
6.8	Special Publications	alphanumerics	printed matter	good - excellent
7.2	Energy and appliance management	data	local distri- bution systems	poor - fair
7.5	Telegrams	alphanumerics	existing terrestrial networks	poor
7.6	Mail and messages	audio/ alphanumerics	postal service, couriers, tele- phone networks	fair

Table 2.5 Detailed Analysis Summary
(continued)

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
8.1	Vehicle purchase information	alphanumerics slow scan	local available printed matter	poor
8.2	Road Conditions	alphanumerics	printed matter, telephone inquiry	good - excellent
8.3	Travel information	alphanumerics slow scan video	printed matter	good - excellent
8.7	Schedules	alphanumerics	printed matter	excellent
8.9	Accommodation and tour information	alphanumerics slow scan video	printed matter	good
9.7 9.8	Uni-thematic radio stations (classical, jazz, etc.)	audio	terrestrial networks	good - excellent
9.9	Dedicated radio channel	audio	subscription services	good
9.10	Other radio channels	audio	-	-
9.11	Outdoor recreation information	alphanumerics	printed matter	fair

Table 2.5 Detailed Analysis Summary
(continued)

	Service	Preferred AU Format	Competing Alternatives	DBS Carriage Prospects
9.12	Indoor Hobbies	alphanumerics	printed matter	fair
9.13	Games	data	microprocessor	poor - fair
10.1	Index of services	alphanumerics	printed matter	good
10.6	Stock market quotations	alphanumerics data	dedicated land line, printed matter	excellent
10.7	National news	alphanumerics audio	radio printed matter	excellent
10.9	Magazines	alphanumerics	printed matter	excellent
10.10	Recent releases (book, record indices)	alphanumerics slow scan TV	printed matter	excellent

2.5 CONSOLIDATION OF RESULTS

In previous sections, our analysis of service feasibility was based on the information delivered to a subscriber and did not specifically consider the method of signal delivery. Having identified feasible types of information and the preferred signal format, we consolidated these results using the preferred signal format as a parameter.

The regrouping of feasible services by signal format is a realistic approach in that it serves to translate DBS feasible user demands into quantities of channels required to meet these demands. Since the information supplied by a given service may be similar to another service (e.g., government services directories and transportation/travel information), signal formats may be identical and neither service may warrant a dedicated channel in terms of quantity. Thus the grouping of services under a more general classification facilitates a study of market size and growth.

The previous list of services was consolidated under three broad categories:

- audio services
- digital data services
- image information services

Within each category, we further subdivided the list of possibilities by considering the prime customer of the service; basically, business or household. The regrouped list of possible services is shown in Table 2.6. Subsequent chapters of this report examine the technical and market prospects of each type of service classification.

Table 2.6

CONSOLIDATED SERVICE LIST

Audio Services

- FM supersatations
  - classical radio stations
  - jazz radio stations
  - etc

- Radio networking
  - point-to-multipoint audio
  - distribution of syndicated programming
  - advertising distribution
  - message recording

- Specialized channels
  - dedicated audio

Data Services (Business)

- Electronic Mail
- Financial information service
  - stock exchange
  - data banks
- Newswires
- Specialized business publications

Data Services (Household)

- Directories
  - Government services index
- Transportation and travel information
- Recreational and cultural services
- Electronic newspapers and magazines

Table 2.6 (continued)

Data Services (Household) cont'd.

- Electronic mail
  - catalogues
  - advertising
- Energy management
- Education
  - correspondence schools
  - programmed learning

Image Information Services

- Education
  - lectures, seminars
- Video conferencing
- Facsimile and still picture transmission
  - Weather maps
  - Complements to data services (e.g. travel)
- High definition television

3.0 BASIC DEMOGRAPHIC DATA

3.1 INTRODUCTION

The purpose of this chapter is to develop the market scenario for alternate users of a direct broadcast satellite. The quantification of a DBS 'clients' forecast for the 1980-2000 time period involves the prediction of a number of other interconnected variables. Because DBS 'clients' will be part of the overall broadcast receiving audience, quantity and geographic distribution forecasts are needed for the following variables:

- population and households
- households passed and not passed by cable
- basic TVRO households
- cable subscribers
- DBS 'clients'

The information presented in this chapter is also part of another report, "A Feasibility Study for a Canadian DBS Satellite Program Package" (July 1981), prepared by Tamec Inc. for the Department of Communications.

3.2 POPULATION AND HOUSEHOLD FORECAST

The population and household forecast was generated using the logic illustrated in Figure 3.1. Data for the forecasts was obtained from Statistics Canada publications.

Statistics Canada produced four different forecasts from which we developed a single average scenario to effectively represent reality. The assumptions that we used are illustrated in Figures 3.2, 3.3 and Table 3.1. Figure 3.2 shows that the average annual growth of population is decreasing from 1.2% in 1981 to 0.7% by the year 2000, indicative of the fact that the population base is not growing at the same high rate as in the past decade. Closely related to population is the average number of persons per household shown in Figure 3.3. Single point projections for the year 2000 show that approximately 2.7 people will occupy one household, a decrease of 15% from 1981.

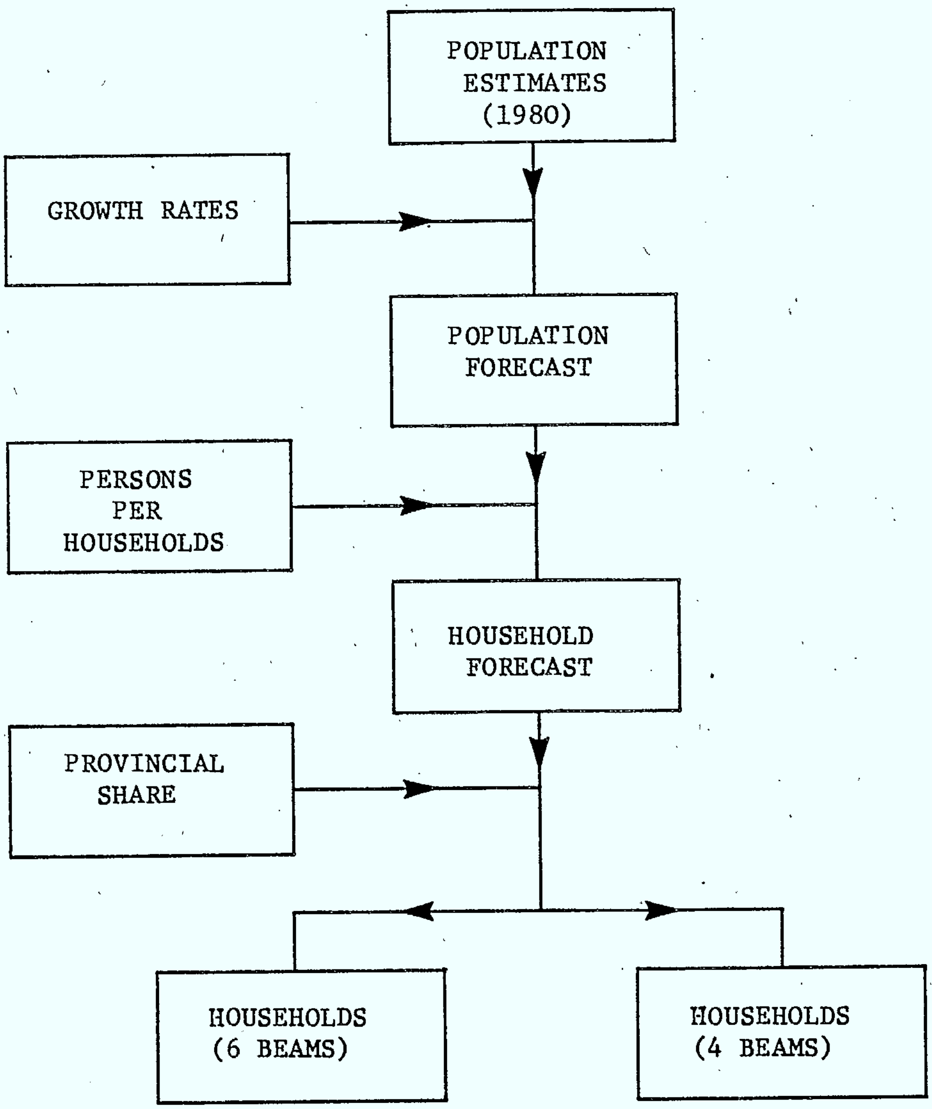


Figure 3-1 Demography Methodology

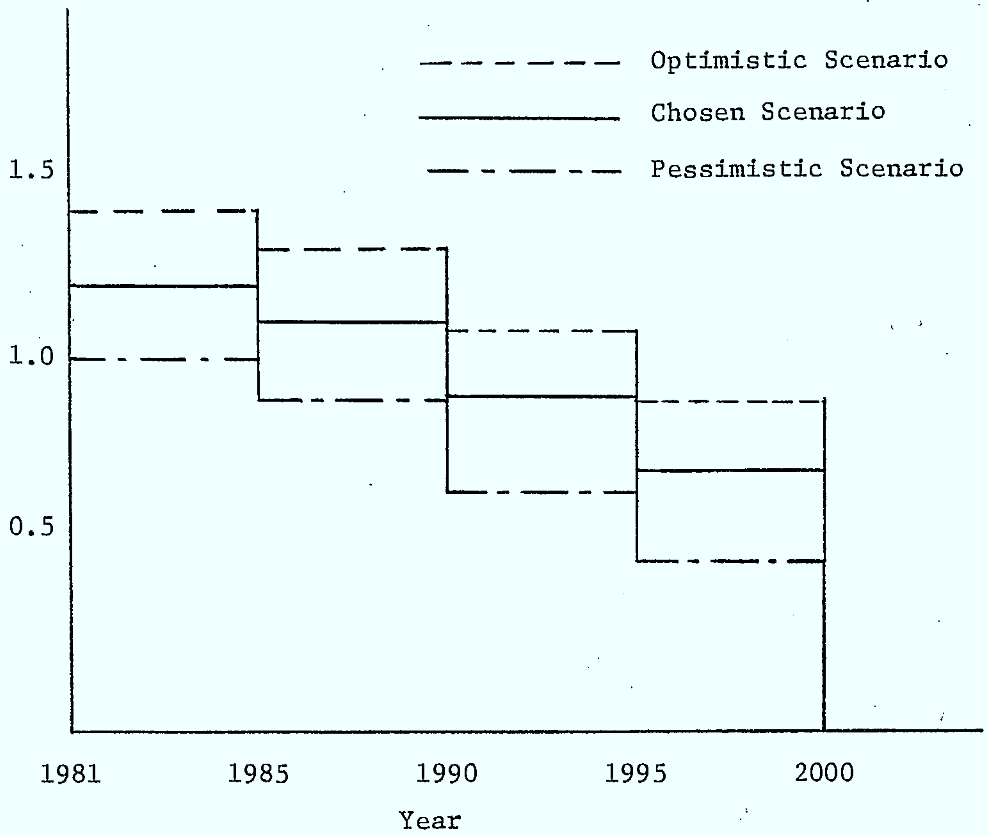


Figure 3.2 Average Annual Growth - Population

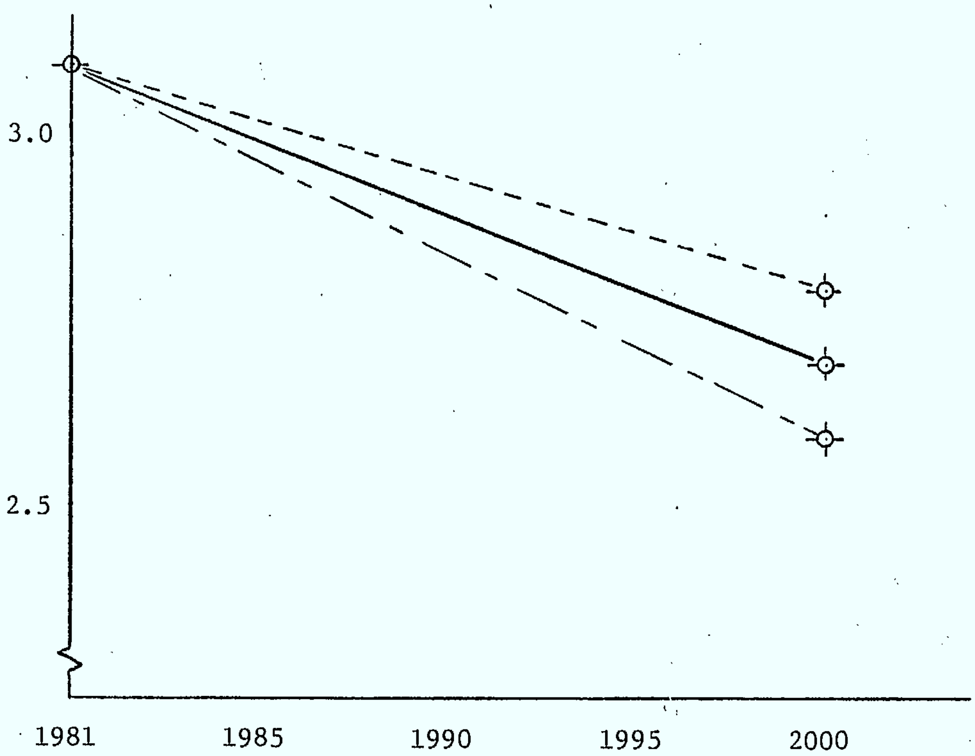


Figure 3-3 Average Number of Persons Per Household

Our forecasts are summarized in Table 3.1. The results show that by the year 2000, the number of households in Canada should grow from the present 7.8 million to approximately 11 million.

Table 3.1 Population and Household Forecast, Canada, 1985-2000

Year	Population (000)	Average Number of Persons Per Households	Households (000)
1985	25,384	3.0	8,561
1990	26,811	2.9	9,342
1995	28,039	2.8	10,104
2000	29,034	2.7	10,834

3.3 HOUSEHOLDS BY REGION

Since the basic coverage area of a single DBS beam will be a province or a region, we distributed the households forecast across Canada. The data used was originally produced by Statistics Canada.

Two basic assumptions have been made in this analysis. Households in the North West Territories and the Yukon have been grouped together with British Columbia. This assumption is reasonable when one considers that the combined population of the two northerly regions is relatively small and concentrated along and west of the MacKenzie Valley.

Secondly, we presented typical household distributions in two possible DBS configurations; a six beam and a four beam implementation. Some care is required in the interpretation of Tables 3.2 and 3.3 because there will likely be beam overlaps. For the purposes of this analysis, the results, nevertheless, present an acceptable description of the population and households that would be served by a direct broadcast satellite.

Table 3.2 Households by Region (6 Beam Model)

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic	676	713	744	768
2	Quebec	2,176	2,299	2,407	2,494
3	Ontario	3,267	3,649	4,039	4,429
4	Manitoba and Saskatchewan	660	655	639	610
5	Alberta	730	801	870	938
6	British Columbia, Yukon and NWT	1,052	1,222	1,403	1,591
	Canada	8,561	9,342	10,104	10,834

Table 3.3 Households by Region (4 Beam Model)

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic/Quebec	2,852	3,012	3,151	3,262
2	Ontario	3,267	3,649	4,039	4,429
3	Manitoba/Sask.	660	655	639	610
4	Alberta/B.C./ Yukon and NWT	1,782	2,023	2,273	2,529
	Canada	8,561	9,342	10,104	10,834

3.4 DBS CLIENTS FORECAST

3.4.1 APPROACH

The DBS clients analysis is illustrated in Figure 3.4. DBS clients will consist of both TVRO households as well as cable subscribers having indirect access to a direct broadcast satellite. In terms of the previous forecasts, DBS clients will include the following:

- households not passed by cable equipped with an earth station
- households passed by cable that elect to purchase an earth station rather than subscribe to cable, for one reason or another
- cable subscribers suitably equipped with a converter.

The implicit assumption in the present analysis is that television programming, distributed via a DBS, will consist of new services not presently available off-air. Distribution of these new services, furthermore, will involve direct reception by individuals equipped with a TVRO (or a DBT: direct broadcast terminal) or interconnect to traditional cable facilities which offer DBS services.

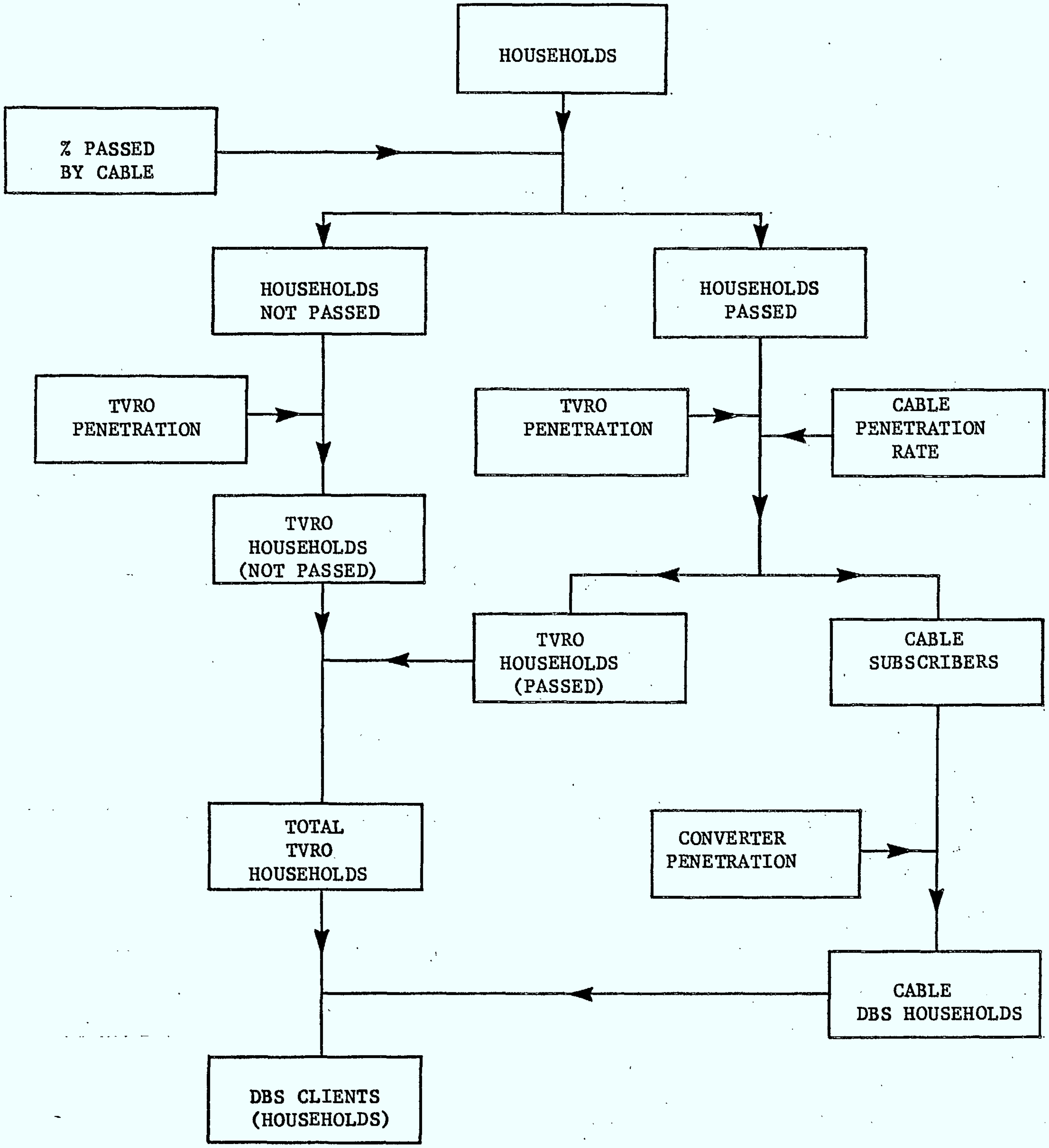


Figure 3-4 DBS Forecast

If the Canadian DBS will carry only new services, this represents a departure from current practices in which satellites distribute conventional off-air signals to rural and remote regions of the country. Only La Sette and to some extent TV Ontario are notable exceptions to the above mode of operation.

If new services are envisaged on the DBS, these will, of necessity, have to bear the full cost of not only distribution but also content. It then becomes essential that the subscriber base be as large as possible to minimize the per subscriber amortized cost. From the point of view of this study we have adopted the realistic attitude that the marketplace should decide whether to depend on cable or purchase direct broadcast receiving terminals to gain access to DBS services.

3.4.2 HOUSEHOLDS PASSED BY CABLE

Our assumptions for the households passed by cable facilities are shown in Figure 3.5. Historical data shows that high growth rates occurred between 1970 and 1977 until the market began to saturate. The prediction of a 92% cable pass rate is consistent with a rural/urban household distribution and that which can be economically served by cable. From a different perspective, cable presence is following a well defined S-curve which fits the historical data and provides the prediction. Note that so far we have only addressed homes passed by cable; actual cable penetration into the homes is discussed later.

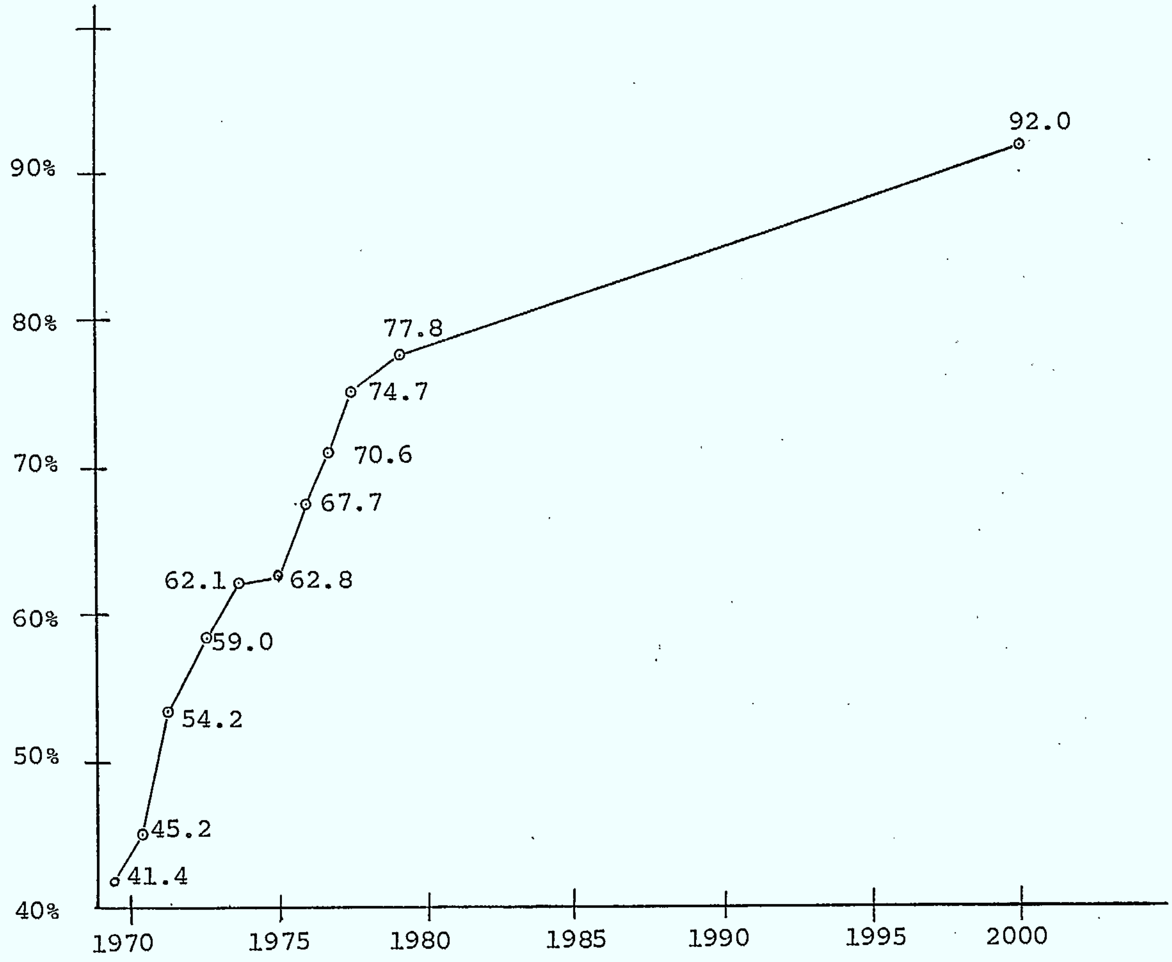


Figure 3-5 Percentage of Canadian Households Passed by Cable, 1970-2000

Although cable has reached a saturation level in terms of homes passed, some growth remains because of the following factors:

- Households growth is expected to be stronger in urban areas where cable is more cost effective.

- Some communities presently have a sufficiently high population density to justify cable per se, but are prevented from getting it because of the prohibitive cost of carrying TV signals via microwave; satellite distribution can be expected to largely solve this trunking problem.

- On the other hand, distribution of discretionary, subscriber paid services can be expected to improve revenues per subscriber which would tend to make cable more attractive in some lower population density areas where cable is not presently economically feasible.

Breaking down the available data on a regional basis (Table 3.4) shows that only Manitoba, Saskatchewan and the Atlantic provinces will have more than 10% of homes not passed by cable. The figures in Table 3.4 are based on 1979 Statistics Canada data and estimated for the year 2000.

Table 3.4 Percentage of Households Passed by Cable 1979 and 2000

REGION	1979	2000
Atlantic	48.7	85
Quebec	77.4	92
Ontario	82.7	92
Man./Sask.	58.8	85
Alberta	81.4	92
B.C./Yukon/N.W.T.	95.3	95
Canada	77.8	92

Source: 1979 Statistics Canada estimated for the year 2000.

3.4.3 TVRO HOUSEHOLDS FORECAST

As previously mentioned TVRO households consist of two categories of households which are:

- households not passed by cable
- households passed by cable.

For the households not passed by cable category we made the assumption that penetration of colour television in Canadian households would provide a good analogy with potential TVRO penetration in a DBS system. The price of colour television sets has actually declined from $1500 - $2000 (constant 1981 dollars) when they were introduced in 1967 - 1968 to approximately $400 - $500 in 1981. Historical penetration of colour TV sets follows the well defined S-curve shown in Figure 3.6. Assuming that 12 GHz TVRO's (DBT's) will be introduced in 1983 when the Anik C interim DBS service is initiated, we have predicted the penetration rate of these terminals as shown in Table 3.5.

As far as households passed by cable are concerned, we considered that a DBS system would have relatively insignificant impact on the market. Our reasoning for making this assumption is discussed below. Firstly, the vast majority of cable systems are presently distributing one or more of the four U.S. networks (ABC, NBC, CBS, PBS). Since these signals, primarily entertainment oriented, will not be available on a DBS, this leaves the cable industry in a strong competitive position. The same argument can also be applied when addressing the distribution of Canadian signals on a regional basis.

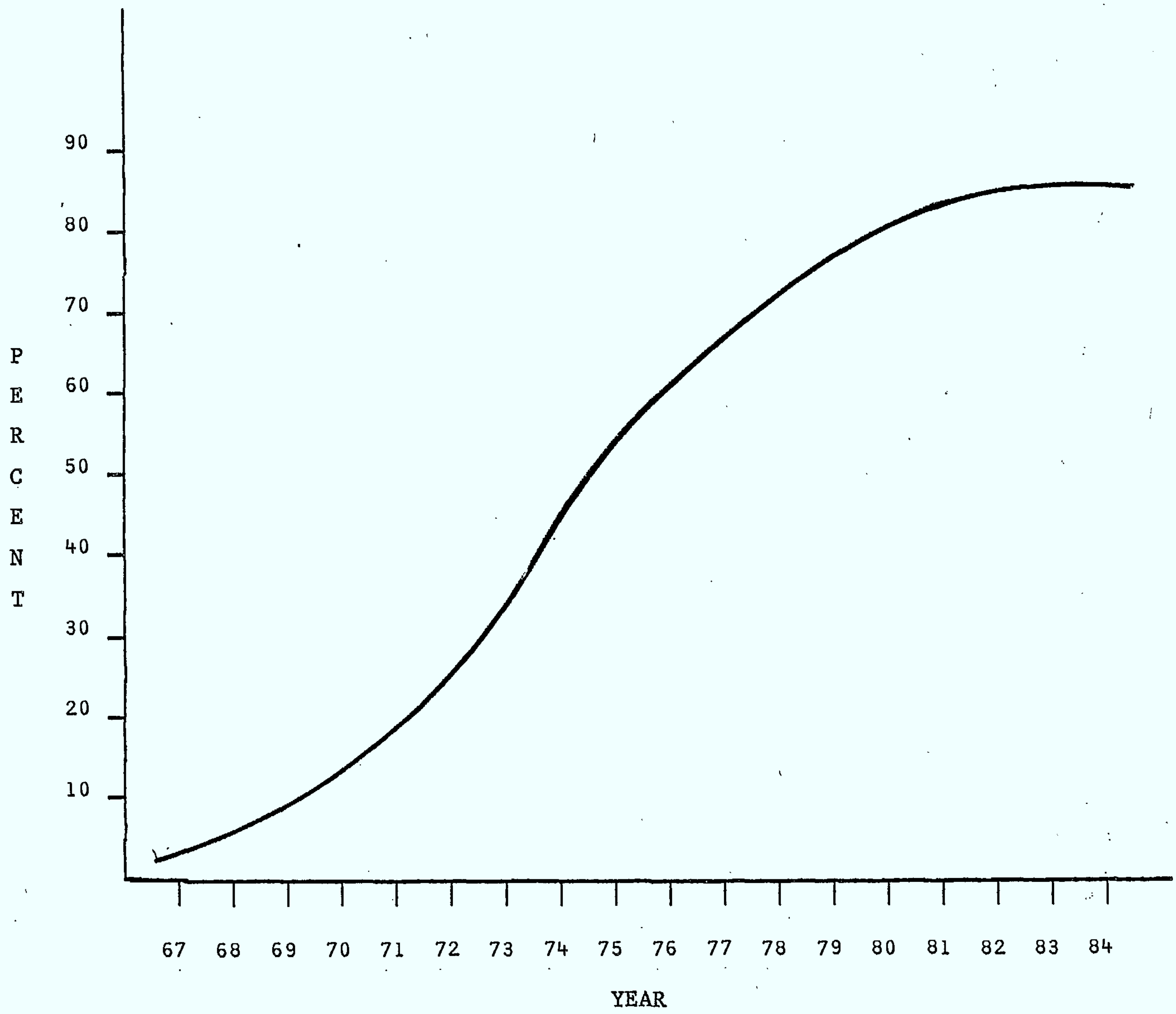


Figure 3.6 Pentration Rate Of Colour TV Sets In Canada, 1967-1984

Table 3.5 Penetration Rate of TVROs in Households not Passed by Cable (1983 - 2000)

YEAR	PENETRATION RATE
1983	2.0
1984	4.2
1985	8.0
1986	12.1
1987	18.4
1988	24.2
1989	33.1
1990	44.5
1991	53.3
1992	60.7
1993	67.8
1994	72.3
1995	76.7
1996	81.2
1997	84.2
1998	86.2
1999	87.2
2000	87.7

The second favourable point is that the cable industry has and will continue to have the option of developing services at the local level. These will consist of not only traditional audio and video services but also may include Telidon and diverse, nonprogrammable services such as fire/burglar alarm facilities, energy management and other interactive information exchange.

All of the above factors lead to the conclusion that the cable industry will most probably be able to not only compete with a DBS but also explore new service markets available to a DBS. Assuming that the cable industry remains cost competitive and provides reasonable reliability, we predict that the DBS will not affect more than 3% of the households passed by cable.

Table 3.6 Penetration of TVRO's in Households Passed by Cable

1983	0.5%
1987 and after	3.0%

The results associated with the above logic, are illustrated in Tables 3.7 and 3.8 for both six and four beam models. On the basis of all households in Canada, the tables show that there will be a maximum of 1.0 to 1.2 million TVRO households by 1995.

Table 3.7 TVRO Households Forecast (000)
(Passed and Not Passed by Cable)
6 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic	28	116	152	121
2	Quebec	59	212	276	244
3	Ontario	80	299	427	434
4	Manitoba and Saskatchewan	25	94	119	96
5	Alberta	18	68	93	92
6	British Columbia, Yukon and NWT	19	61	91	112
	Canada	229	849	1,157	1,097

Table 3.8 TVRO Households Forecast (000)
(Passed and Not Passed by Cable)
4 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic/Quebec	57	328	428	365
2	Ontario	80	299	427	434
3	Manitoba/Sask.	25	94	119	96
4	Alberta/B.C./ Yukon and NWT	37	129	184	204
	Canada	229	849	1,157	1,097

3.4.4 CABLE SUBSCRIBERS FORECAST

The cable subscribers forecast was obtained by applying a penetration rate to the number of households passed by cable. The assumption is that this penetration rate would reach 90% in all regions of Canada except Quebec where the penetration rate would reach 75% in the year 2000. In addition, converter penetration, which we estimate at 30% using CBC Research Department data, should grow linearly to 100% by 1990 due to increased efforts by cable companies and the influx of new colour TV sets which have built-in converters. Table 3.9 shows the penetration rate of cable TV by region. Data for the year 2000 is our prediction based on earlier assumptions.

Translating penetration rates to numbers of subscribers indicates that by the year 2000, cable systems will have approximately 8.6 million subscribers, an increase from 4 million (with or without converters) in 1980. Tables 3.10 and 3.11 show the regional distribution of cable subscribers for the 6 and 4 beam DBS models.

Table 3.9 Cable TV Penetration Rates in % by Region, 1973-1978

REGION	1972	1973	1974	1975	1976	1977	1978	1979	2000*
Atlantic	39.2%	43.5%	58.1%	59.5%	61.8%	62.6%	68.2%	72.4%	90.0%
Quebec	32.5%	40.9%	44.9%	47.6%	47.1%	49.5%	49.5%	48.3%	75.0%
Ontario	55.8%	62.0%	69.3%	71.6%	73.3%	73.2%	73.9%	75.5%	90.0%
Manitoba and Saskatchewan	49.2%	53.3%	59.4%	68.3%	73.7%	77.1%	75.0%	70.1%	90.0%
Alberta	26.1%	41.0%	50.4%	56.3%	58.4%	61.8%	61.2%	64.4%	90.0%
British Columbia	78.2%	82.4%	85.6%	86.8%	85.9%	86.4%	87.2%	88.8%	90.0%
TOTAL	50.1%	56.9%	63.2%	66.3%	66.8%	67.7%	68.1%	68.7%	86.2%

Source: Statistics Canada

* Estimated

Note: Systems with more than 1,000 subscribers

Table 3.10 Cable Subscriber Forecast (000) (With Converter)
6 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic	201	394	487	588
2	Quebec	637	1,205	1,448	1,705
3	Ontario	1,439	2,648	3,130	3,659
4	Manitoba and Saskatchewan	215	381	428	465
5	Alberta	285	538	650	773
6	British Columbia, Yukon and NWT	585	1,048	1,204	1,365
	Canada	3,362	6,215	7,347	8,555

Table 3.11 Cable Subscriber Forecast (000) (With Converter)
4 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic/Quebec	838	1,599	1,935	2,293
2	Ontario	1,439	2,648	3,130	3,659
3	Manitoba/Sask.	215	381	428	465
4	Alberta/B.C./ Yukon and NWT	870	1,586	1,854	2,138
	Canada	3,362	6,215	7,347	8,555

3.4.5 DBS CLIENTS

DBS clients will consist of both TVRO households and cable subscribers since it was assumed that distribution of DBS service by terrestrial networks would be permitted. The data that is presented assumes that the interim DBS, ANIK-C, will be operational in early 1983 and that a DBS will be launched in late 1988.

The results of our analysis are summarized in Tables 3.12 and 3.13 for the 4 and 6 beam DBS models. The figures show that a DBS system will serve close to 10 million households by the year 2000. While this number of households, at first glance, would appear to be sufficient to justify the economic viability of a DBS system it is not clear whether such a conclusion would apply both to the 6 and 4 beam models.

The present results were based on an assumption that the percentage of households passed by cable would still grow, albeit slowly, from the present 78% of total Canadian households to 92% by the year 2000. The forecast shows (Table 3.14) that TVRO households would constitute only 12 to 14 percent of total DBS clients.

Table 3.12 DBS 'Clients' Forecast (000) 6 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic	229	511	639	708
2	Quebec	696	1,416	1,724	1,949
3	Ontario	1,519	2,946	3,557	4,093
4	Manitoba and Saskatchewan	239	476	547	561
5	Alberta	304	606	744	865
6	British Columbia, Yukon and NWT	604	1,109	1,294	1,476
	Canada	3,591	7,064	8,504	9,652

Table 3.13 DBS 'Clients' Forecast (000) 4 Beam Model

Beam Number	Region	YEAR 1985	1990	1995	2000
1	Atlantic/Quebec	925	1,927	2,363	2,657
2	Ontario	1,519	2,946	3,557	4,093
3	Manitoba/Sask.	239	476	547	561
4	Alberta/B.C./ Yukon and NWT	908	1,715	2,038	2,341
	Canada	3,591	7,064	8,504	9,652

Table 3.14 DBS Clients Forecast

DBS CLIENTS	1990 Number (000)	1990 %	1995 Number (000)	1995 %	2000 Number (000)	2000 %
TVRO households	849	12.0	1157	13.6	1097	11.4
Cable subscribers	6215	88.0	7347	86.4	8555	88.6
TOTAL	7064	100.0	8504	100.0	9652	100.0

An entirely different scenario could be developed by assuming that the ratio of households passed by cable will remain unchanged from the present 78% level. Table 3.15 illustrates the impact of this assumption on the DBS clients forecast (other things being equal).

Table 3.15 DBS Clients Forecast (no cable growth)

DBS CLIENTS	1990 Number (000)	1990 %	1995 Number (000)	1995 %	2000 Number (000)	2000 %
TVRO households	1133	16.6	1941	23.1	2343	24.3
Cable subscribers	5684	83.4	6478	76.9	7285	75.7
TOTAL	6817	100.0	8420	100.0	9628	100.0

Despite minor differences in the two tables, the total number of DBS clients will not be much different because no cable growth implies an increase in the number of TVRO households and a decrease in the number of cable subscribers. In fact, with no cable growth, the forecast shows that the number of DBS clients may actually decrease slightly.

For household services, the crucial figure is the total DBS client population. Costs for every service category envisaged have to be amortized over as large a subscriber base as possible for DBS delivery to become an economically viable proposition. Our conclusion, therefore, is that further DBS development, including alternate user services in addition to radio and television, will have to consider a market comprised of both community reception systems and individual receiving terminals.

4.0 DBS SYSTEM OVERVIEW

4.1 INTRODUCTION

The purpose of this chapter is to examine the supply characteristics of services that may forseeably be offered on a direct broadcast satellite. The eventual launch of a DBS hinges on the demand for extra services which, at present, cannot be met or are constrained by existing transmission techniques. While demand characteristics ultimately decide whether a service is economically viable, supply considerations have major impacts on this issue. In effect, an examination of supply characteristics during the planning of new services is simply a matching of system concepts and user requirements to determine the optimum method of satisfying those demands. The ultimate system has to not only meet the requirements of the market in terms of quantity/quality of signals and services but also meet the operational and functional needs of the participating public, whether private or commercial. Although the planning can accommodate future growth or changes, the system must be designed with enough flexibility to satisfy a certain proportion of unforseen future requirements during the active life of the spacecraft.

The DBS concept has been under investigation in Canada for sometime now. Experiments with Hermes and Anik B have demonstrated the technical feasibility of the DBS concept primarily in delivering TV services to individual, modestly priced terrestrial receivers. Starting in 1983 after the launch of Anik C in late 1982, Canada will have the opportunity of exploring the economic viability of the DBS concept since Anik C interim DBS service will carry a number of subscription services (e.g. PAY-TV) and generally move the concept in the direction of a commercial operation. Experience with the interim DBS will, no doubt, suggest feasible true DBS configurations both in a technical sense and from the aspect of commercial success.

4.2 USER AND SUPPLIER DISTRIBUTIONS

The purpose of examining signal user and signal supplier distributions is to assess the correlation between market characteristics and the DBS point-to-multipoint feature. It specifically addresses the demographic and geographic distribution of users of a given service. In terrestrial broadcast systems, distribution is more of a demand rather than a supply attribute since radio and TV stations would not be located in regions having no potential audience. The case of a DBS is somewhat different since it is capable of serving the entire Canadian audience as well as covering sparsely populated regions.

Some broadcast distribution sensitivity to geography and demographics is provided by the concept of regionalized beams in which the aggregate coverage can be viewed as an "all-Canada" beam. While the downlink beam structure of a DBS can compensate for cultural, linguistic and temporal differences across Canada, the information providers or broadcasters are not expected to be as well distributed as their audience. The assumption of uplink and downlink symmetry (equal uplink and downlink capacities between the satellite and a particular terrestrial ground station) may not be an efficient solution to the overall system architecture.

Subsequent sections discuss the distribution tradeoffs that can be made in terms of signal origination or uplink structure, signal reception by the DBS audience and the requirement of some services for addressable signal delivery. There is a possibility that a DBS will be a national/provincial/regional signal distributor and that local markets will interface with a DBS via terrestrial facilities such as local broadband networks or cable systems. If this is the case, then intersystem compatibility also becomes a critical issue.

4.2.1 SIGNAL ORIGINATION

The Canadian DBS is expected to serve the needs of the population on a national basis as well as on a regional one. Due to cultural, linguistic, temporal or occupational differences across Canada, a high degree of regional service is desirable to tailor the service coverage area to the potential audience. True national coverage with only one beam and only one set of information signals (video, audio, data, etc.) is clearly not feasible economically as well as technically.

There are three possible uplink architectures for the DBS:

- fully distributed
- regionally distributed
- centralized

The fully distributed concept assumes that each of the information providers or broadcasters will be equipped with an uplink terminal. Uplink channel assignment is either fixed or can be assigned by network control prior to transmission. Major advantages to this scheme are:

- no backhaul transmission
- total network flexibility.

The distributed multiple access approach is restricted to using SCPC channel assignments unless uplink facilities are shared with other similar users. The disadvantages of operating a fully distributed network are:

- network control is complex and expensive
- no FDM possible for narrowband signals
- reduced narrowband capacity (SCPC).

Several influential factors have to be highlighted. If each broadcaster or information supplier had to provide his own uplink, the smaller, more specialized service providers are placed at a disadvantage in relation to major network operators. The cost of a wideband uplink terminal is not significantly greater than that of a narrowband unit while audience sizes may be considerably different. Major networks are likely to transmit continuously for the better part of the day while specialized service suppliers may need only a fraction of that time after which the uplink terminal sits idle. Based on audience size and transmission or service delivery time, the fully distributed uplink structure appears to favour major network operators, particularly those in the entertainment broadcasting field.

The other extreme is the centralized structure where there is only one uplink terminal to the DBS for all of Canada. Principle advantages are that network control is simple and cost effective since all people and resources are located at only one site. There is total flexibility in the selection of SCPC or FDM modes of transmission since all signals are focussed at one location prior to being uplinked. The overwhelming disadvantage is the need for extensive and multiple backhaul routes to reach the uplink site. As in the case of the fully distributed concept, this scheme tends to favour the major network operators from the point of view that their audience is likely to consist of most of Canada; whereas, the smaller supplier may have a market only in his province or region. Thus the centralized concept is favourable only from the point of view of network control and system flexibility. System flexibility, moreover, is of prime importance only during the initial service planning stages and is less of a determining factor in future growth of the network.

Between the two extremes is a regionally distributed or hybrid structure which combines the best features of both the fully distributed and the centralized concepts. This approach may have several possible implementations to maintain uplink flexibility. Assuming that major television and FM superstations can justify the cost of individual uplink terminals, the scheme provides at least one gateway station in each region of the country. Multiple secondary gateways can be envisaged to serve more distant supplier concentrations. Smaller information providers use the gateways on a time division basis with only a modest increase of cost and effort for network control. Backhaul requirements are minimized and both SCPC and FDM transmission are possible, especially for narrowband services.

Adoption of the regionally distributed or fully distributed concepts means that true national coverage of Canada is achievable by uplinking the same signal in each beam unless provision is made for on-board switching in the spacecraft. In a centralized scheme, national coverage is possible by parallel feeds to several uplink channels or by DBS on-board distribution to downlink beams via switching matrices. Given that the aggregation of regions or beams creates national coverage, the distributed architectures require backhaul/distribution networks in order to service each beam. While this may seem cumbersome initially, the small number of regional gateways (4 to 10) could be interconnected by broadband trunks to facilitate both distribution and backhaul functions.

Clearly, the optimum choice of uplink structure is the regionally distributed or hybrid scheme since it combines desirable features of the other two concepts. It fulfills the need for system agility in meeting "true national" and "true regional" broadcasts on an "as-needed" basis. Large users (large bandwidth, long channel occupancy) are easily accommodated as are small, regional or part-time users who choose to broadcast through the DBS.

The degree of decentralization in a hybrid network is still an open question. This will depend, to a large extent,on identifying specific users of a DBS, their geographical location, the desired coverage area and how this service fits into the overall menu to be offered via the DBS. These are issues to be examined during the second or third phases of the Delphi study.

4.2.2 SIGNAL RECEPTION

DBS audience selectivity is an issue encompassing both the demand and the supply characteristics of the DBS market. Selectivity-demand characteristics typically focus on the size of the audience or market, for a given service and its distribution throughout the entire coverage area. From the point of view of available technology and in light of the wide proliferation of terrestrial distribution systems in urban areas, this means that a large proportion of the potential DBS audience may be faced with the choice of acquiring an individual ground terminal or requesting these services from their local cable network. If DBS services were to compete with those currently offered on cable, it is unlikely that the DBS will attract the urban audience. If, on the other hand, the DBS were to offer complementary services to those on cable, there is a strong likelihood that the urban market may form part of the DBS audience conditional on the quality and type of programming delivered via the DBS. The impact of local terrestrial distribution networks is not limited only to cable systems but may include data services such as Datapac, Dataroute and Infonet offered by the common carriers, and AM/FM/TV rebroadcast stations, owned mostly by the CBC.

The issue of DBS compatibility with existing telecommunication and distribution networks can be qualified by examining the following attributes:

- capability to handle different signal types
- subscriber equipment required for network access
- return channel capability
- serial or parallel subscriber access

We investigated the interoperability of several terrestrial distribution systems with the DBS and found no major problems that were not expected. Table 4.1 summarizes our conclusions.

Essential differences between the individual networks and a DBS-RO (direct broadcast satellite - receive only) terminal can be ascribed to the fact that since direct broadcast satellite service is at its inception, the system can be configured to handle virtually any type of service. All signal types can be received and processed by a receive only terminal; whereas, present terrestrial networks are generally constrained by their designed objectives. This is illustrated by comparing the telephone and CATV network structures. CATV systems have been designed to handle broadcast signals which are generally wideband and do not require interaction between supplier and consumer. Moreover, the systems are closely tied to the traditional VHF/UHF spectral assignments although this seems to be changing with the recognition that cable systems are selfcontained and that services are restricted by the cost of subscriber equipment.

Table 4.1 DBS Compatibility

	Cable Network	Telephone Network	Data Network	Individual Receive-only Terminal	Rebroadcast Facility
Signal types	image (all forms) high quality audio teletext data (56 kbps)	image (slow scan) low quality audio videotext, teletext data (9.6 kbps)	data (56 kbps) teletype (75 baud)	image (real time) high quality audio teletext data (56 kbps)	image (off-air, real time) high quality audio teletext data (land line 9.6 kbps)
Subscriber equipment (in addition to TV and radio receivers)	data terminal teletext processor	slow scan converter teletext processor videotex keypad data modem/ terminal	data modem/ terminal	teletext processor data terminal	teletext processor data modem/ terminal
Return channel	Mail system telephone network	same as in-coming channel	same as in-coming channel	mail system telephone network	mail system telephone network
Multiple Subscriber access	parallel	serial	serial	parallel	parallel

Telephone networks and data systems, on the other hand, have been designed to supply consumers with narrowband, interactive services and provide wider band, backhaul facilities on special order. Most common carrier networks have bidirectional capability obviating the need for a distinct and separate return channel. The disadvantage to a telephone system or a data network such as Datapac is that they are intended to be point-to-point systems as opposed to point-to-multipoint. Various methods are available to create the illusion of a multipoint receiver such as daisy chaining the signal from subscriber to subscriber via the terrestrial network. Despite the feasibility of this mode of operation, network transparency, in terms of timing and delay of data signals and SNR degradation of analog signals, becomes objectionable if the distribution requirement is large.

Comparable to cable systems and individual receive only terminals is the local rebroadcaster. At present, low power relay transmitters (LPRT) are commonly associated with radio and television coverage in remote communities or in mountainous areas where broadcast coverage is unreliable. LPRT's normally receive program feeds via terrestrial microwave, or even by telephone line in the case of AM radio services, and broadcast the signal in the VHF/UHF bands so that users can "tune in" on their available TV or radio receiving equipment. Although audio and image signals are easily handled by LPRT's, data services may encounter difficulties because of the additional RF channels needed to distribute data in other than a teletext format and the availability of suitable receivers. Although conventional LPRT's cannot handle data signals easily, local area rebroadcast via land lines is a suitable alternative.

4.2.3 ADDRESSABILITY

Although individual user addressability is not needed for entertainment broadcast reception, it is likely to be a requirement for subscription services such as PAY-TV, specialized audio and data services. Addressability of individual users can also be considered as a method of security to prevent unauthorized reception of certain signals.

There are two approaches that can be employed in limiting or controlling user access to a given signal or service. Without actually considering any particular signal format, for the time being, the supplier is limited to transmitting some type of address which is embedded in the signal or is carried on a narrowband control channel adjacent to the actual signal band. The address is typically a unique access code which allows any valid user to extract the information from the signal. After the downlink signal is demodulated to baseband, the user must match the embedded address or code with his decoding equipment to enable the receiver to extract the information. Clearly, this technique lends itself to image (video) and data signals where there is space in which to embed the address as in blank video lines and where the address signal format is compatible with the information signal.

An alternative method of limiting user access is to control the distribution of receivers which are needed by users to access the particular service. A typical example is the distribution of subscription background audio signals via the FM-SCA channel. The subscription signal is broadcast in parallel with the main FM program via the normal FM transmitter and antenna. All of the FM receivers have the ability to access, decode and emit the left and right channels of the FM stereo signal but cannot do the same for the SCA channel located above 53 kHz in the composite baseband. The operator of the subscription service supplies "add-on" signal processors for the SCA channel to paid-up customers. These processors enable the user to receive the service via a regular FM radio receiver. This approach has advantages. Firstly, the information signal suffers no loss of quality or bandwidth reduction due to the presence of an address signal and secondly, the transmission of the subscription service is transparent to the radio audience except for those equipped with an SCA channel processor. Finally, users of the service are not required to purchase exotic receivers since the service is compatible with the broadcast regulations and signal processors are supplied by the service provider. This type of system, however, is open to privacy due to its simplistic nature.

4.3 SIGNAL FORMATS AND PROCESSING

4.3.1 SIGNAL FORMATS AND SATELLITE ACCESS

In Chapter 2 we identified three basic signal formats which may be used to carry alternate user services on a DBS. The most likely consist of:

- audio signals
- digital data signals
  - displayable (alphanumerics)
  - nondisplayable (pure data)
- image signals
  - full rate video
  - slow scan video
  - motion adaptive video (reduced rate)
  - facsimile
  - high definition TV (HDTV).

In terms of satellite access, there are several possibilities, among them:

- single channel per carrier (SCPC)
- video subcarrier
- frequency division multiplex (FDM)
- time division multiplex (TDM).

Subsequent sections briefly examine feasible combinations of access method and signal format and the implications to the configuration of the receiving terminal.

4.3.1.1 Audio

Voiceband services direct to the home are still supplied in analog format despite the availability and maturity of digital transmission techniques. Although one can prognosticate that digital audio is on the way, we feel that any widespread availability of suitable broadcast receivers will not occur in the next two decades. Home playback of digitally recorded programs may be realized much sooner but broadcast conversion from analog to digital will happen only when a large percentage of the total audience is equipped to receive it. Consequently, we restricted our discussion of individual terminal audio services to those offered in essentially an analog format using FM to take advantage of its superior noise performance.

Spacecraft access for audio signals is relatively flexible in terms of available choices (Table 4.2). The relative merits of each access scheme, when considering features such as bandwidth/power efficiency, SNR performance, uplink flexibility and the ease of individual reception tend to favour the use of video subcarrier techniques [9]. This conclusion, however, does not consider the possible requirement for one DBS receiver to feed multiple customer receivers. The alternatives to achieve an acceptable level of flexibility are to provide multiple independent IF to baseband downconverters and demodulators or to use SCPC as the preferred access method. Multiple downconverters and demodulators are likely to be expensive while the SCPC approach has lower bandwidth efficiency.

Another possibility arises on the basis of the independence and separability of television and radio signals. One transponder per beam could be reserved for audio and alternate user services. The audio signals which would serve the particular beam could be frequency division multiplexed at the regional gateway and then used to modulate an "audio" carrier. The DBS receiver would then downconvert and demodulate one fixed channel allowing the user to tune through the output FDM baseband using an auxilary tuner.

Table 4.2 Audio Services

	Signal Format	
Access Method	Analog (FM)	Digital (PSK)
SCPC	• operationally best for individual DBS rcvr • BW inefficient • maximum growth flexibility	• cable headend user • BW inefficient • maximum growth • flexibility
Video Subcarrier	• technically best for individual DBS rcvr • operationally may be awkward for individual DBS rcvr	• point-to-point application • cable headend user • DCC "DATE" system
FDM	• operationally and technically feasible • requires dedicated transponder	• inefficient compared to TDM techniques
TDM	• not feasible	• technically optimum for point-to-point applications • cable headend user

If the end user of the audio signals is a cable subscriber, access method and signal format are not critical factors assuming that the services will be offered on cable. In fact, for cable subscribers, audio services to the cable headend could even be offered in digital format and be time division multiplexed. Both Pye and Digital Communications Corporation (DCC) have pioneered digital audio techniques for point-to-point applications. DCC's system, called DATE, digitizes four 15 kHz audio channels and time division multiplexes them onto a 5.5 MHz video subcarrier. Each audio sample consists of 14 PCM bits and the multiplexer serializes the data into two continuous data streams, each at one half of the total bit rate of 1.79 Megabits per second.

The Pye system is unique in the sense that it eliminates the traditional audio subcarrier by sending the digitized audio signal, in burst mode, during the horizontal synchronization pulse. Twenty-one bits of information are stuffed into a 3.8 microsecond interval for an instantaneous data rate of 5.5 Mbps. The system samples in a 14 kHz bandwidth and uses 10 bit PCM encoding which yields a 33 kbps sampling rate.

4.3.1.2 Digital Data Services

We distinquish between two types of digital data services based on our consolidated service list shown in Table 2.6. The classification depends mainly on the destination of the signal, be it a domestic or a business application. Another hierarchical level of subdivisions was initially created by considering whether the data signal is displayable or consists of pure software. Displayable data usually refers to the transmission of alphanumerics and graphics whose destination is the television screen. Telidon can be considered a special case of this family since it sends Picture Description Instructions (PDI's) for display recreation by a local microprocessor.

Non-displayable data is an information form which typically consists of data base updates, software downloads and teletype operations. We differentiated between these two data forms initially thinking that this approach may give rise to seperate methods of handling the signal types. Ultimately we reached a conclusion that signal types did not pertain to either our conclusions or the arguments supporting the results. The irrelevance of this proposed segmentation became quite obvious when trying to classify Telidon signals. On one hand they are definitely displayable; in addition to being considered downloaded software by virtue of the PDI's. The subsequent discussion, therefore, centres around Telidon signals but implicitly encompasses all forms of digital data traffic.

Because Telidon teletext signals are displayed on a television screen, the most obvious carrier for them is the NTSC video signal. NTSC sync is used in not only transmission synchronization but also in the storage and subsequent display of the information. Furthermore, since normal broadcast video signals do not use every single line of a 525 line frame, the blank lines can be used for teletext data. Because the video channel is highly linear, data can be 5 level encoded to quintuple the effective data rate. In terms of our initial definitions of access schemes, use of the blank lines in the vertical retrace interval is a time division multiplexing operation.

Teletext systems are part of the videotex family which makes available, to customers, "pages" of alphanumeric data. In the teletext mode, the user cannot generate queries or transmit information, but has the ability to select "pages" of interest. The size of the teletext database that can be handled by the VBI is a function of the maximum delay that the user will accept from the moment a request is entered to the time the appropriate information is displayed. Signal bandwidth for many NTSC-M receivers is conservatively estimated as 4.2 MHz. The minimum data symbol period is the reciprocal, or 0.24 microseconds. The duration of a line is 63.5 microseconds; 51.5 if the horizontal sync pulse and colour burst are excluded. Therefore, 216 bits can be inserted onto each line. Allowing for vertical retrace, equalization pulses and the vertical interval reference signal (VIR), 20 lines are available for data; 10 per field. This yields 4.33 kilobits per frame or a 129.8 kilobit per second transmission rate. We have assumed that no source encoding or multilevel transmission schemes are employed to increase the data rate.

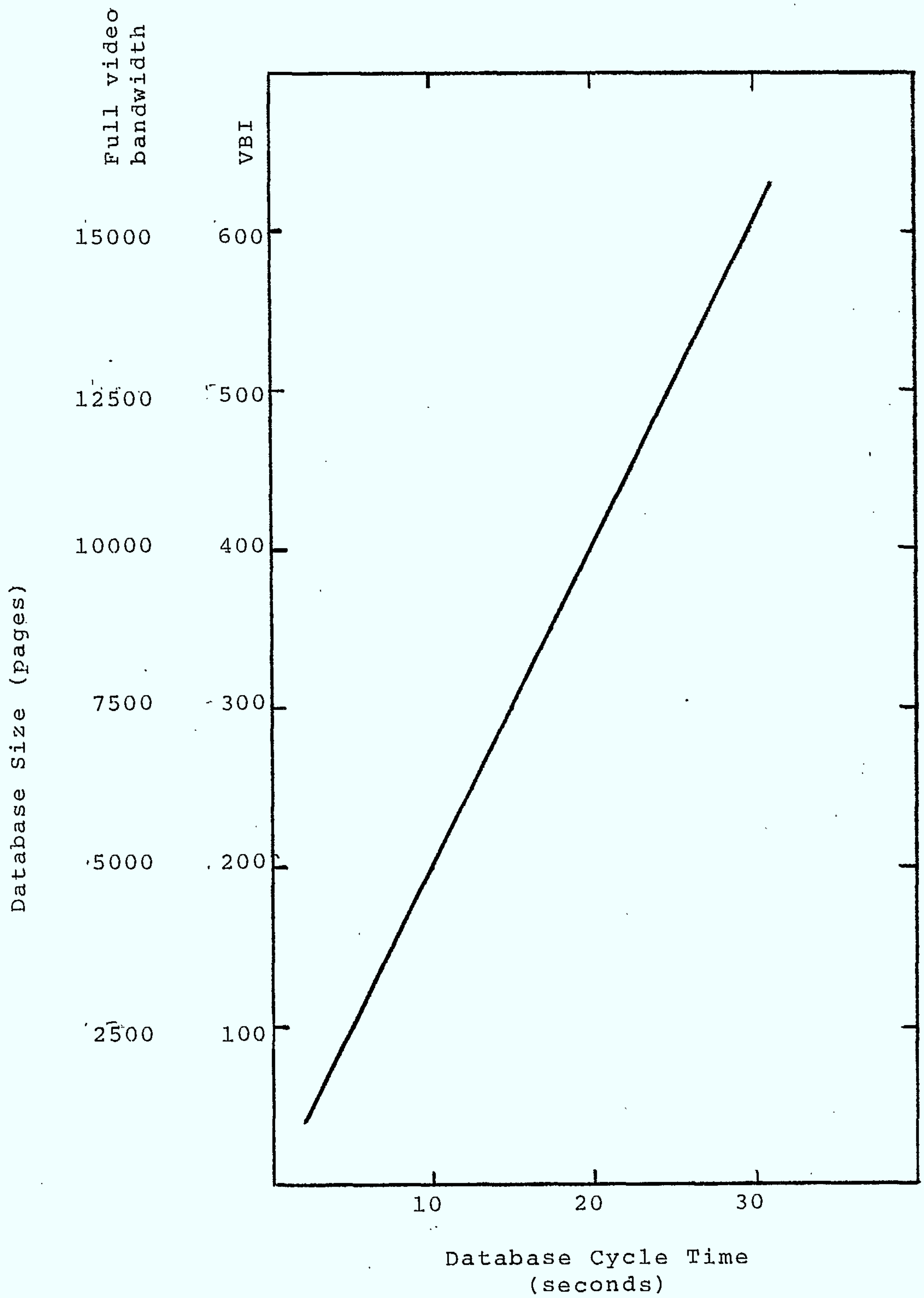


Figure 4.1 Teletext Database Size - Access Time Bounds

If one assumes that a 400 page magazine is to be transmitted with each page containing 800 characters of 8 bits each, this yields a total VBI transmission time of 19.72 seconds. If a maximum delay of 10 seconds were deemed acceptable the VBI could handle 202 pages of information. Thus, the limitation of the VBI teletext service is the recall time x quantity (bandwidth) constraint. Using the present numbers, Figure 4.1 illustrates the tradeoff that has to be made.

The conventional telextext format sent via the VBI may be sufficient to accomodate some services from both the point-of-view of database size and the average waiting time before the desired information is accessed. However, when the service database is large and there is a requirement for quick information turnaround/update, the entire video signal can be replaced by alphanumeric data. This system has the disadvantage that service users have to bear the total cost of a satellite transponder because revenue per frame is dependent on individual users rather than a mass audience.

The capacity of an entire video frame, using the assumptions from the previous discussion, is 108 kilobits yielding a 3.24 Mbps transmission rate. This transmission rate conservatively assumes that 25 lines of each frame will not be used to allow vertical retrace and equalization pulses to be clearly identifiable to the television receiver. The capacity-time tradeoff, identified in Figure 4.1, is applicable with a factor of 25 increase in the ordinate. The maximum recall time of one page in a 500 page database (or "magazine") is just under 1 second as opposed to 25 seconds when using only the VBI.

Segmentation of the database to make user access more efficient would involve a scheme by which the user would address not only a page of information, but implicitly select both a frame and a line on which his desired information was being sent. Although this type of system may involve added costs to the user, above and beyond that incurred in acquiring VBI teletext service, we feel that commercial users could justify the additional costs assuming they were commensurate with performance.

Given that a full bandwidth video transponder can be logically segmented to carry a large number of distinct data "pages" of a teletext format, there is no reason why this type of system could not be employed to transmit nondisplayable data. Because of the digital nature of the signal, the choice of addressing and encryption methods is not only very broad but also not complex or expensive. Making use of the full NTSC signal for time-division-multiplexed data, whether displayable or otherwise, avoids the problem of allocating narrowband transmission channels to individual users in a transmission plan primarily geared to wideband services such as television. It is important to recognize that the technique suggested here is aimed at the point-to-multipoint services which require low cost user interfaces to be economically viable in a larger market segment.

4.3.1.3 Image Signals

We have distinguished five methods of image transmission to a DBS service consumer. Three of the signal formats are compatible with the NTSC-M system which is currently employed by broadcasters in North America and Japan. Undoubtedly, PAL and SECAM compatible systems either exist or can easily be visualized. These three methods are referred to as real-time video, reduced rate video (possibly motion adaptive) and slow scan video. For the purposes of this study, we have considered facsimile transmission to be an image oriented technique since it can handle graphic forms of information when digital data techniques cannot for the same level of receiver complexity. Finally, we also briefly address one of the new developments in television: high definition television (HDTV).

The type of programming that can be carried by a real time video signal is virtually endless. The most obvious are entertainment oriented, but over the years, video conferencing and tele-education emerged as viable video services.

The television signal is generally not bandwidth efficient particularly when one considers the amount of redundant information that is transmitted and the speed of motion of the image in relation to the field/frame rate. Every consecutive frame that is sent, on the average, contains approximately 90% of the information transmitted by the previous frame because image motion must be constrained to that which can be perceived by the viewer.

Reduced rate video takes advantage of inter-frame and interfield correlations to reduce the effective bandwidth needed for transmission. Instead of transmitting 30 frames or 60 fields per second, a multiplexer sends only alternate frames or fields of the signal reducing the frame rate to 15 per second per signal. The availability of 15 alternating empty frames can be assigned to another, totally independent video signal. At the receiver, a frame memory stores the most recent frames and displays each for two consecutive frame periods to maintain signal continuity to the television screens. The demultiplexing feature is realized by tagging each frame with a unique identifier inserted in the vertical blanking interval. The amount of compression (2 in the above example) that can be achieved and avoid viewer discomfort and image flicker is dependent on the source material. High activity signals such as sports events typically cannot be compressed without image distortion. Talk shows, lectures, and other similar programming can be compressed by a factor of 3 without introducing noticeable motion jerkiness. An interesting variant of the reduced rate scheme is motion adapation in which the frame rate can be varied in proportion to the speed of image motion.

Slow scan video is a method of transmitting image information using narrowband channels. The basic technique used in generating and transmitting slow scan video is to sample ("frame freeze") one frame of a live video signal. The sampler/compressor then sends the signal over a narrowband channel at a rate commensurate with the bandwidth. For instance, the stored frame is read from the compressor at 8 kHz after being recorded at 4.2 MHz. At the receiver, the signal is recorded in an expander/frame store and can be read out at 4.2 MHz (30 frames per second) once the entire frame has been accumulated. Equipment also exists to blend a new frame of information with an old one to create a "wipe" display. Use of an 8 kHz channel requires a frame transmission period of 525 seconds or 8.75 minutes.

The latter two techniques, namely reduced rate and slow-scan television, lend themselves more readily to applications where the end users receive DBS services via their local CATV facilities. The image memory and expander hardware required are expensive and it is doubtful whether there would be mass market appeal for services using these methods to justify mass production of the hardware and subsequent price reduction of the receiving systems.

The subject of high definition television (HDTV) is receiving, at present, a considerable amount of attention, both from the technical development and the potential user communities. Since many of the current results and achievements are subject to change for the purpose of international standardization, our entire discussion of the potential viability of HDTV is deferred to chapter 7 where it is covered in-toto.

4.3.2 RECEIVING TERMINAL CONFIGURATION

Commercial feasibility of a DBS system will depend, to a great extent, on the cost of a user ground terminal and its flexibility in delivering all of the desired services to the household. While "bells and whistles" contribute to the attractiveness of a given piece of equipment, the quantity, quality and accessibility to the promised services is seen to be the real driving force.

Operational flexibility is a major requirement of the entire DBS system, both the ground and space segments, particularly since it is not known the exact type and quantity of signals that will have to be processed apart from television and audio programming. The architecture of the ground terminal must allow for the addition of future services at reasonable, if not negligible, retrofit or modification cost and effort.

There are two major obstacles to the rapid proliferation of domestic earth terminals apart from the issue of programming. One is the state of the broadcast receiver market which is still intimately tied to the current regulatory infrastructure. Both television and FM radio receivers are built for signal reception in the traditional VHF/UHF frequency bands. The second issue is one of compatibility. The user earth terminal has to be compatible with both the existing equipment that users already possess and the terrestrial distribution systems in existance such as cable facilities and/or telephone systems.

The structure of the receiving terminal for the reception of broadcasts from a satellite has been the subject of technological investigation for some time now, both in Canada and in other parts of the world. The studies have focussed primarily on available technology, its cost and feasibility in the design of a low cost, simple domestic receiver for television signals. To our knowledge, no studies have been done in considering the needs of system users who want more than just television services.

Current plans and studies assume an earth terminal consists of three basic elements: the antenna, an outdoor unit (ODU) mounted in back of the antenna and an indoor unit (IDU) located near the television receiver. A typical block diagram is shown in Figure 4.2. An all-weather cable connects the ODU and IDU and operates at an intermediate frequency sufficiently high enough to accomodate the full bandwidth that the satellite signals occupy. Typically IF's under consideration are in the range of 550 MHz to 1.5 GHz. The ODU downconverts the nominal 12 GHz signal to the IF using a fixed local oscillator and drives the interfacility cable. Tuning is performed in the IDU where the user adjusts the frequency of the second local oscillator depending on which channel is desired. After limiting and demodulation, the audio subcarrier is extracted and the audio signal demodulated. The two signals are then multiplexed according to the standard NTSC broadcast format and VSB-amplitude modulate a VHF/UHF carrier so that the home television receiver can process the combined audio/video signal.

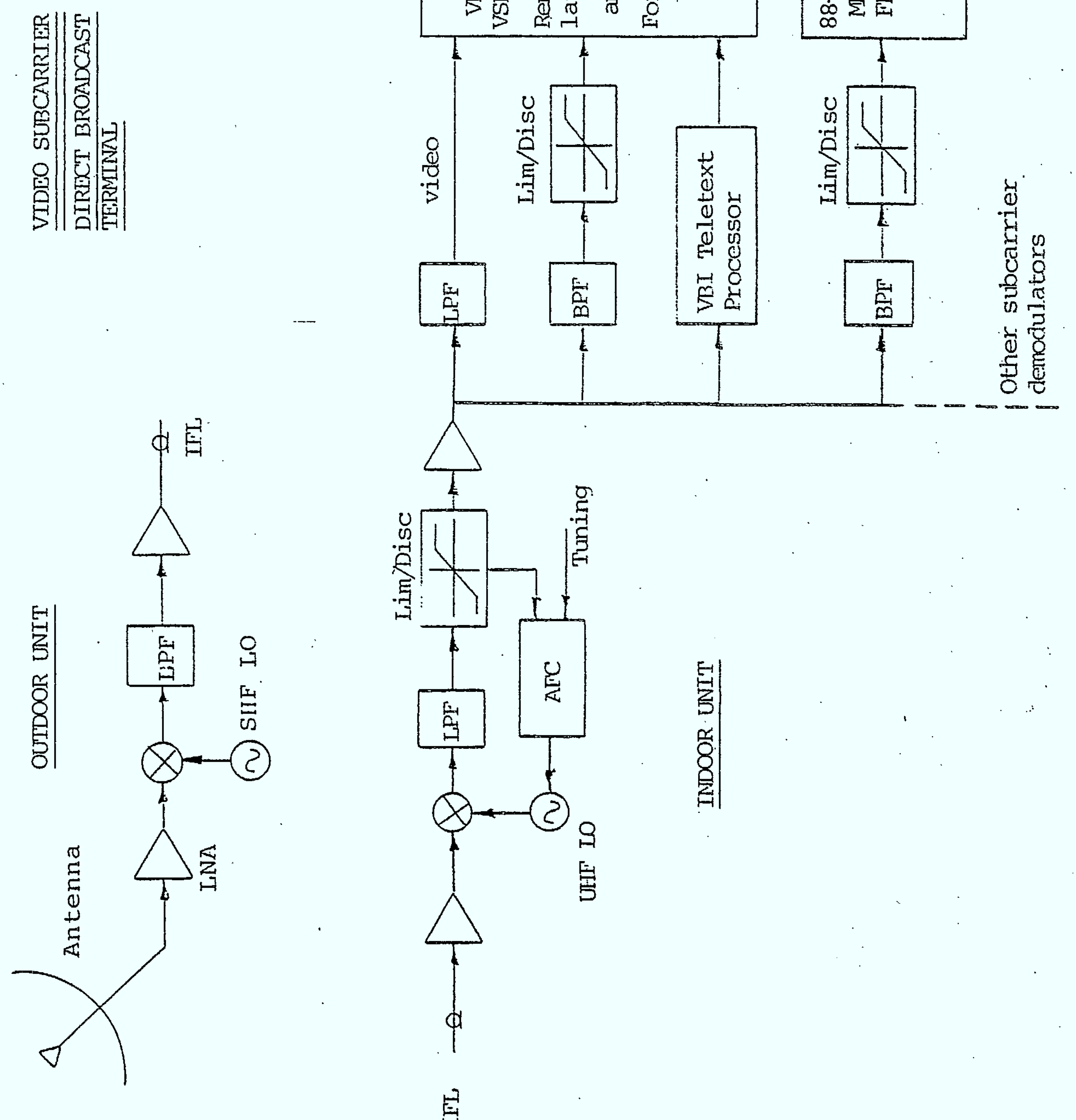


FIGURE 4.2 Video Subcarrier Direct Broadcast Terminal

From the user's standpoint, this configuration has two faults. The first is that a remodulator is not really necessary if the television set could be equipped with a baseband input to accept 1 volt peak-to-peak video signals and display them. The second is that the subcarrier is useful only for signals related to the video program material. If the desired narrowband signal is carried on a video subcarrier, then the whole channel has to be downconverted and demodulated to access the subcarrier.

The alternative to using video subcarrier channels for narrowband information signals is the single channel per carrier (SCPC) mode of operation. The configuration assumes that video signals and their associated audio and/or data are transmitted in one transponder. Other signals, such as FM stereo programming and alternate user channels are grouped into another transponder. The functional separation allows independent and simultaneous tuning of both video and audio signals. Further segmentation of the narrowband signal transponder into audio programming and data services leads to a receiver configuration which is both efficient and easily expandable. Figure 4.3 illustrates a typical block diagram.

The layout of the terminal is simple and easily expanded to allow users a choice of basic and extended services. While the video subsystem remains the same as in Figure 4.2, narrowband services such as FM stereo programming and other video unrelated signals are carried in a separate transponder. Segmentation into bands by service type simplifies receiver design, particularly the front end tuner, by channelling like signals to the appropriate baseband processing equipment.

Compatibility of individual reception and cable feed systems is an inherent property of the terminal configurations shown in Figures 4.2 and 4.3. The cable system headend site would receive the IF signal from an outdoor unit and could either distribute the UHF signals as received or could demodulate them into their baseband formats and remodulate them to standard broadcast format to occupy the conventional VHF/UHF and midband assignments.

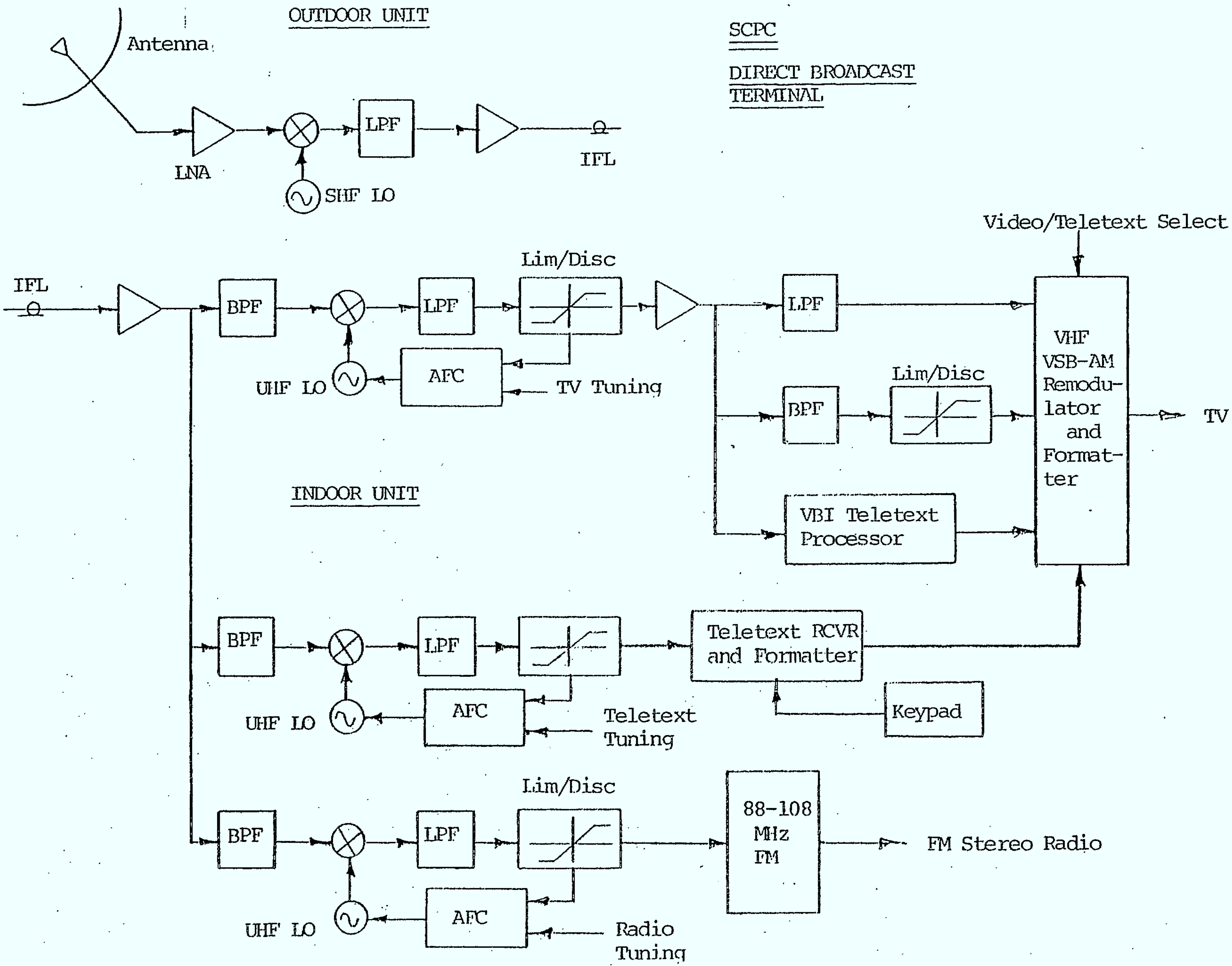


Figure 4.3 . SCPC Direct Broadcast Terminal

Although the marketing strategy has to be determined by each cable operator, we feel that the optimum solution would be to demodulate all the satellite signals in parallel and offer them to customers via existing facilities. Adopting this approach, however, does bring to light some inequalities in that the costs of satellite service per cable client would be very small in relation to the isolated customer who requires a complete terminal.

To round out the discussion of the earth segment receiving terminal we examined the costs of the direct broadcast terminals shown in Figures 4.2 and 4.3. Although it is somewhat early to price specific services without actually knowing all the details, our analysis does exhibit the cost trends. A large part of the work is based on earlier reports which estimated the cost of the 12 GHz technology.

The most comprehensive cost estimates for the direct broadcast terminal were documented by Douville (13). His analysis considered the terminal to the point where the outputs were baseband NTSC video and a baseband audio signal to feed both a monitor and a speaker. The structure of the terminal was very similar to that shown in Figure 4.2 except that only one subcarrier was used. Douville concluded that the price breakdown of the entire terminal follows that shown in Table 4.3, under the assumption of mass production of all components. His figure for mass production, we feel, is somewhat low at 10,000, and we suspect that the figures quoted would be more reasonable if based on units of 100,000.

Table 4.3

ODU	$150 - 300
IDU (with tuner)	$100
Antenna (1.2 m)	$ 60 - 90
Interfacility Link (cable)	$ 40
Total	$350 - 530

The prices shown in Table 4.3 have to be augmented to correspond to Figures 4.2 and 4.3. We estimated the cost of a VSB amplitude modulator and FM modulator for stereo audio signals to be approximately $20. Texas Instruments expects to price their Ceefax/Viewdata decoders at roughly $50, down from $225 in 1976. Additional subcarrier demodulators, with multichannel tuning capability should be priced at about $50 each. We conclude that the terminal configuration shown in Figure 4.2 should cost the user between $490 and $670 once the equipment is made compatible with current domestic receivers.

The alternative system, operating in a band partitioned mode, is expected to be somewhat more costly. The antenna and ODU price remain the same as before, but now there is an additional price element due to the individual carrier tuner and demodulator. A conservative estimate places this at about $100. The total price of the terminal shown in Figure 4.3 without the teletext receiver/formatter, is between $540 and $720.

Adding a high rate teletext service to the DBS system involves using a complete video channel. This solution is somewhat speculative at the present time, but seems reasonable in order to provide a directory service with an adequately large data base and offering cycle times well under 10 seconds. The price of the teletext receiver, frame and line decoders, decoding logic and NTSC formatter, in large quantities, is in the order of $200. The total price, therefore, of the data service may lie in the $220 range.

Table 4.4 summarizes our price estimates for the direct broadcast terminal. Although the band partitioned approach is more costly, it does have the advantage of greatly increased flexibility, both in terms of providing basic and extended service and in terms of future service additions as the need for them emerges or as each DBS client wants to acquire them. Note that major price differences between terminal types can be directly attributed to the additional cost of hardware to deliver FM program service. It is also noteworthy that the prices also include the presence of hardware to interface the direct broadcast terminal directly to currently available domestic receivers.

If domestic receivers were provided with access to the baseband processing circuitry, such as in a video monitor, the cost of the terminal will drop by $60 in both cases since there is no need for the VSB amplitude modulator or the 88-108 MHz frequency remodulator.

Table 4.4 Direct Broadcast Terminal Costs

	Subcarrier Approach	Band Partitioned Approach
Antenna (1.2 m)	\$ 60. - \$ 90.	\$ 60. - \$ 90.
ODU (outdoor unit)	\$150. - \$300.	\$150. - \$300.
IFL (interfacility link)	\$ 40.	\$ 40.
Video tuner and demodulator (with audio)	\$120.	\$120.
VBI teletext processor	\$ 50.	\$ 50.
Stereo FM receiver	\$ 70.	\$120.
High rate teletext receiver	\$220.	\$220.
TOTALS	\$710. - \$890.	\$760. - \$940.

4.4 SIGNAL SECURITY

The subject of signal security is currently very closely associated with the subject of PAY-TV and subscription video signals in general. Commercial users of existing satellite links have essentially only this one method of protecting their signals in an "open-skies" regulatory scenario. For if regulatory agencies cannot prevent the erection of unlicensed ground stations, access to the spacecraft radiated signals is virtually guaranteed. Therefore, it may be in the interests of the signal owners (or perhaps the carriers) to prevent access to the information rather than the signal.

The encoding of an analog signal is generally far more difficult than a digital signal. The quality of a decoded analog signal is proportional not only to the quality of the transmission but also to the ability of the decoder to faithfully reproduce the original waveform. A variety of transmission impairments, particularly during free space propagation, tend to aggravate decoding errors by creating an imperfect mapping between coded and decoded signals. By contrast, data or digital signals can be encoded and decoded very simply and inexpensively. The security aspects of digital transmission, in conjunction with other features such as resilience to propagation impairments among others, make it very attractive for commercial users who want high levels of quality as well as security.

Analog audio coding techniques have for all intensive purposes disappeared with the frequency spectrum inverters used by RCA during World War II. Since digitization of relatively narrowband signals is inexpensive, most audio transmission that needs security encoding is done digitally. Clever generic bit shuffling techniques (pseudo-random sample transmission) have already been developed to handle the coding and security to make the job of would-be signal interceptor next to impossible without expenditure of a great amount of effort and money (or knowledge of the code key).

Digital transmission of wideband signals such as video presents a problem to the general video customer in that the price of very high bit rate equipment is several orders of magnitude higher than conventional analog components. Technologically, video sampling and encoding is feasible and in fact used, but mostly by commercial users and by some common carriers; for instance, Bell Canada's videoconference network. The high cost of components, the high cost of channel rental and the fact that video is still inherently an analog signal has motivated the electronics industry into developing a variety of analog video encoding schemes.

Although the interest level in signal security schemes is currently very high, particularly among subscription TV networks, PAY-TV operators and DBS planners, it is difficult to reach specific conclusions about the type of system that is optimum. In each case it depends on the network operator to predict the market response to a selected scheme. Potential customers usually weigh the cost of the add-on equipment against the benefits that are promised, mostly relating to the program content and quality. Achievements in technology, as well, are advancing very rapidly and may overtake and make obsolete any conclusions made today.

While we see a definite need for signal security techniques on a direct broadcast satellite, we also see a need for some form of standardization among all the possible candidate schemes. It would be of interest that all signal providers adhere to some standard for each signal type to minimize the cost of the ground terminal and to prevent market saturation by many different decoders/descramblers. However, it is the programmer or content generator that is in the best position to ensure the required level of signal integrity and security. It can be foresen that standardization process will not take place without a lengthy debate among all the DBS participants.

5.0 AUDIO SERVICES

5.1 GENERAL

Three broad categories of audio services were identified in Chapter 2 as being viable on a direct broadcast satellite. The three consist of:

- FM Superstations
- Radio networks
- Specialized channels

5.2 FM SUPERSTATIONS

5.2.1 BACKGROUND

Although both AM and high quality FM signals could be delivered to consumers via a DBS, we restricted our analysis to FM broadcasting. FM services are traditionally of a higher quality and current licensing policy allows a higher degree of programming specialization.

Over the ten years between 1967 and 1977, the number of radio stations in Canada increased from 355 to 487. While there has been growth in both AM and FM broadcast undertakings, the number of FM stations grew by 66.2% compared to 30.3% for AM. Despite the rapid growth, FM stations in 1977 still represented only 23% of the total market.

Linguistically, 79% of the FM stations were English speaking, 16% French while the remainder were multilingual. Geographically, Ontario and Quebec are the priviledged provinces having 41.6% and 19.5% of all FM stations, respectively. Table 5.1 shows that on average, each province has 10% of the national total or 11.3 stations per province.

A comparison between French and English FM broadcast undertakings reveals an imbalance in the services supplied by commercial stations and those of the CBC. Independent broadcasters supply 88% of English FM services while only 68% in the French language.

Table 5.1 FM Stations by Province

Province	Number	%
Newfoundland	6	5.3
P.E.I.	1	0.9
Nova Scotia	5	4.4
New Brunswick	2	1.8
Ontario	47	41.6
Manitoba	6	5.3
Saskatchewan	5	4.4
Alberta	8	7.1
British Columbia	11	9.8
Sub-total English Canada	91	80.5
Quebec	22	19.5
TOTAL	113	100.0

While a breakdown of FM stations by category of programming reveals the limited selection of services across Canada, it is not truly indicative because AM stations and TV services may fill the gaps in some parts of the country. It is more illustrative to examine audience access to the available terrestrial services. Tables 5.2 and 5.3 show the percentage of the total number of radio stations. Table 5.2 refers to Quebec and the availability of French FM stations and Table 5.3 contains similar figures for English services across the country. With only 3 French FM stations outside the province of Quebec (Ontario, Saskatchewan, B.C.), there is little point in including this data.

Table 5.2 Percentage of the Quebec Population Having Access to French FM Stations by Number of Stations, 1977

NUMBER OF STATIONS	0	1	2	3	4	5	6	7	8
Population	7.0	93.0	86.2	77.1	75.8	61.3	51.4	4.9	---

Table 5.3 Percentage of the Population Having Access to English FM Stations by Number of Stations and by Province, 1977

# of Stations	0	1	2	3	4	5	6	7	8
Nfld.	44.6	55.4	41.9	-	-	-	-	-	-
P.E.I.	-	100.0	35.8	-	-	-	-	-	-
N.S.	5.0	95.0	57.9	5.8	-	-	-	-	-
N.B.	40.5	59.5	-	-	-	-	-	-	-
Ontario	0.5	99.5	94.3	91.7	87.5	78.3	71.8	61.9	48.3
Manitoba	9.2	90.8	79.4	73.8	60.6	55.7	-	-	-
Sask.	47.0	53.0	20.6	-	-	-	-	-	-
Alberta	8.0	92.0	71.5	29.5	-	-	-	-	-
B.C.	8.2	91.8	82.3	71.3	68.2	11.5	-	-	-
Quebec	17.6	82.4	70.2	60.3	39.7	35.6	-	-	-
Canada	11.2	88.8	75.4	63.0	52.3	41.4	25.7	22.1	17.2

The data in Tables 5.2 and 5.3 show, quite dramatically, that only Ontario and Quebec are truly well served in English and French, respectively. An 'adequately served' classification consists of English Quebec, B.C., Manitoba and possibly Alberta. The Atlantic provinces and Saskatchewan fall into the underserved category since most of their population has too few FM services to choose among.

To demonstrate that FM services and their popularity are steadily growing, Statistics Canada estimates that between 1967 and 1977, the percent of total households equipped with at least one FM receiver grew from 34.4% to 86.1%, despite only a 30% increase in the total number of households. CRTC audience estimates for 1967 and 1977 were analyzed to establish the relationship between:

- average number of available FM stations
- percentage of FM audience versus AM stations

The results of our regression analysis are shown in Figure 5.1. It is clearly seen that a larger audience is attracted to FM services given that a reasonable selection is available. One further feature of the data is that the rate of audience growth over the ten year period has exactly doubled from 1.8% per radio station in 1967 to 3.6% per station in 1977.

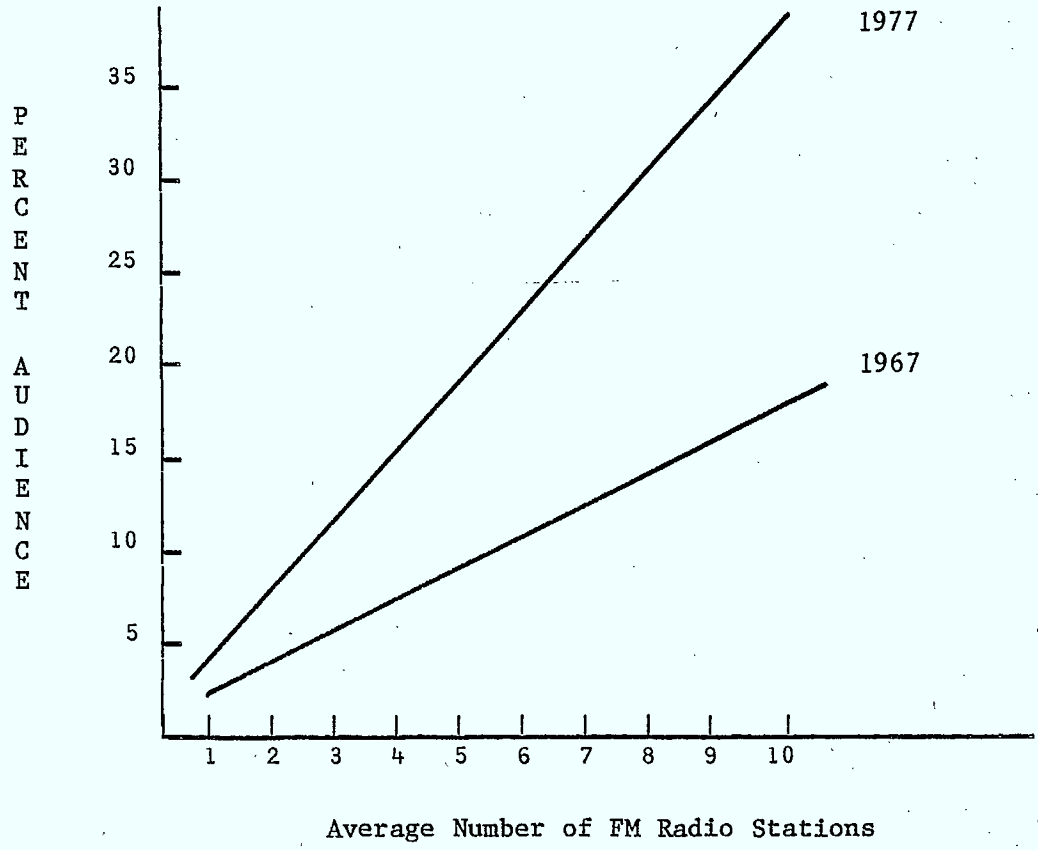


Figure 5.1 Regression Analysis Results

5.2.2 FM SUPERSTATION CONCEPT

The suitability of FM superstations on a DBS is dependent on the program content of the signal. Since FM broadcast policy allows for a higher degree of programming specialization than AM, this allows the program content to be independent of geographical location. The station does not cater to a specific community by carrying local news such as City Hall coverage or rush hour traffic reports but can, forseeably, broadcast regional or provincial news.

From a service delivery point of view, distribution of audio programming is easily handled by a DBS. Service suppliers are licensed FM broadcast undertakings while the audience is the general public so that there are no distribution constraints to be overcome. Addressability, interaction, response time, and security are either not required or not applicable to a high quality audio broadcast.

Signal reception and terminal configuration tradeoffs have been covered in Chapter 4. However, it should be emphasized that operational flexibility of the terminal may have a big impact on the desirability of FM audio services. Multiplexing of independent audio program signals on video subcarriers constrains the flexibility of the terminal, particularly when simultaneous access is desired to a video signal and an audio signal in different transponders. The subcarrier approach also restricts the uplink flexibility by requiring all audio signals to be uplinked from one location, probably determined by the video broadcast centre.

From the user's point-of-view, an SCPC approach is desirable. Not only does it enhance system flexibility and operability but also it eliminates the need for extensive backhaul networks to the main uplink site. The disadvantages to an SCPC mode of operation are lower transponder efficiencies and a modest increase in the receive terminal cost.

Compatibility of DBS delivered services and terrestrial distribution facilities (CATV) is not a problem. In fact, CATV operators can probably justify multiple parallel signal demodulators and distribute their cost among their subscribers. In this case, the operational differences between the subcarrier and SCPC approaches are not significant.

By its nature, an FM superstation generates national programming but due to program content and time zone differences it is desirable to provide the services on a regional basis. Regional or beam oriented structures allow tailoring program material to the Canadian linguistic, cultural and occupational mosaic. Furthermore, since the service will be supported by advertising subscriptions, regional advertisers will supplement national ones to improve the economic feasibility of the services.

5.2.3 PROSPECTS

Our conclusions regarding the carriage of FM superstations on a DBS are as follows:

a) FM superstations have a high probability of success since a good case can be made for a comparison with inadequate TV services in remote and rural parts of Canada.

b) Such services would also be attractive to the cable television industry for whom distribution of FM signals is already a very attractive service in many areas.

c) As far as individual households (equipped with an earth station) are concerned, if the incremental cost of the audio equipment is not more than \$100 to \$150, then the penetration of DBS-FM receivers might grow rapidly to 80% of basic earth stations within a 10 to 15 year period.

d) The above forecast is consistent with a user price of \$1 to \$2 per month for a package of 6 to 8 superstations.

e) The market forecast is based on the fact that major urban areas can support, at most, 8 FM stations to satisfy user demand. Since there is at least one major urban area per beam, in either a four or six beam system, frequency spectrum should be allocated to carry up to 8 FM stereo superstations per beam.

5.2.4 OBSTACLES

a) The Copyright Problem.

Distribution of FM signals via a DBS presents copyright problems which are not insurmountable but are still serious enough to cause concern.

FM stations now carried to distant markets by cable should normally be able to raise their advertising rates because of the larger audience. If this was the case, copyright payments, which are calculated as a percentage of revenues, would also increase. Unfortunately FM stations are not presently able to achieve this objective for the following reasons:

- Measurement techniques still use a diary system which does not lend itself to a valid measurement of audiences, especially when there are a large number of stations in a given market.

- Radio stations, in general, depend on local advertising (in opposition to national advertising) for a large portion of their revenues. These local sponsors would be reluctant to pay higher advertising rates for the increased coverage.

b) CRTC Policy

FM superstations would contravene the present CRTC policy regarding FM signals and would also generate substantial opposition from the radio broadcasting industry, especially in smaller markets. Such obstacles are not insurmountable if some or all of the FM/DBS services consisted of 'new', more specialized services. On the other hand, such specialized services may appear less attractive to both the potential audience and advertisers as well.

5.3 RADIO NETWORKING

5.3.1 INTRODUCTION

In a similar manner to the carriage of FM superstations, a Canadian direct broadcasting satellite could carry point-to-multipoint audio services of a commercial nature. What distinguishes this application from the case of a superstation is that the users of the service are not the general public but rather the members of the radio broadcasting industry. Typical uses are the distribution of audio commercials and the transmission of syndicated news or program material, either in a real-time mode or on a tape delayed basis. There are other possible applications; however, the radio broadcasting industry was chosen for analysis because data is more readily available.

5.3.2 BACKGROUND

Radio networks that presently operate in Canada are used mainly for news services although some regional networks, carrying syndicated programming (other than news services) have also begun to develop.

News services include the following organizations:

- Broadcast News whose voice service is subscribed to by 104 radio stations across the country
- Maclean-Hunter (CKEY) with approximately 40 radio staions, most of them in Ontario
- Standard Broadcasting with approximately 20 stations including one in British Columbia
- CKO All News radio network linking seven (7) company owned stations together.

Radio networks that distribute syndicated programming are, to our knowledge, a more regional phenomenon with emphasis on professional sports. One company, Tele-Media, has been very active in developing such concepts in both French and English speaking markets.

5.3.3 FINANCIAL BACKGROUND

Operating revenues of the radio broadcasting industry grew at an average of 13.5% since 1972 to reach more than $356 million in 1979. Growth of profits was less impressive at 7% annually since 1972; throughout the period, the after tax margin of the radio broadcasting industry has been constantly squeezed. One of the reasons for the lacklustre performance of the industry throughout the period is that it is labour intensive and the growth rate of salaries and employee benefits has been higher than revenues.

This phenomenon has led to increased concentration in the radio broadcasting industry. Even if the first decile accounts for a fairly stable 40% to 41% of operating revenues, its share of profits has risen substantially since 1974, from 59% to more than 84% in 1979.

The only way to pull the smaller radio stations out of this very unfortunate situation is to establish communications links between these stations and larger stations in order to:

- increase advertising revenues
- reduce operating costs and especially salaries

Once smaller radio stations are linked to larger ones through a network, the increase in advertising revenues can come in two ways:

- the program supplier can sell the programs to the affiliates which in turn have to generate their own advertising revenues
- the program supplier can provide the programs for free (or even pay the affiliates for the audience) in exchange for a given number of minutes of network advertising.

Table 5.4 illustrates the structure of radio advertising revenues in Canada. While the importance of national and network revenues has diminished since 1974, their overall importance in the last 5 years seems to have stabilized at around 27% to 28%. Even though the overall industry depends on national advertising for only 27% of its revenues, the situation is very different for the first decile of the industry. This group generates between 35% - 37% of its advertising revenues from national advertising.

While it cannot be argued that radio is essentially a local medium from the point of view of advertising revenues, the importance of national revenues is not negligible.

	First Decile						Total					
	Local Advertising		National and Network Advertising		Total		Local Advertising		National and Network		Total	
Year	$000	%	$000	%	$000	%	$000	%	$000	%	$000	%
1974	44,636	59.9	29,905	40.1	74,541	100.0	127,476	70.9	52,356	29.1	179,832	100.0
1975	51,514	61.2	32,682	38.8	84,196	100.0	147,334	71.6	58,332	28.4	205,666	100.0
1976	59,598	61.2	37,852	38.8	97,450	100.0	173,186	71.7	68,273	28.3	241,459	100.0
1977	70,941	63.6	40,642	36.4	111,583	100.0	195,874	72.9	72,866	27.1	268,740	100.0
1978	79,042	63.5	45,458	36.5	124,500	100.0	222,053	72.8	82,815	27.2	304,868	100.0
1979	90,973	63.1	53,215	36.9	144,188	100.0	256,046	72.8	95,483	27.2	351,529	100.0

Table 5.4 Advertising Revenues of the Private Radio Broadcasting Industry, 1974-1979

5.3.4 POTENTIAL USERS

Information was obtained during personal interviews with the following organizations:

- Broadcast News
- CKO All News Radio Network
- Tele-Media Communications Ltd.
- CFCF Radio

Both Broadcast News and the CKO Network are national operations while Tele-Media is predominantly provincial.

5.3.4.1 Broadcast News

Broadcast News, affiliated with the Canadian Press, distributes various services which are described below:

	English Service	French Service
• BN Wire	263 radio	32 radio
	52 TV	12 TV
• BN Voice	104 radio	12 radio
• BN Cable	80 CATV	28 CATV

The BN Voice network consists of a one way 5 kHz channel from Toronto to the following centres:

- Vancouver
- Edmonton
- Winnipeg
- Halifax

From each of the preceding centres, affiliates are interconnected through a 3 kHz two-way network.

In a brief submitted to the CRTC, (Memorandum of evidence filed on behalf of Canadian Press and Broadcast News Limited, March 13, 1980) Broadcast News presented a fairly detailed economic analysis of satellite versus terrestrial systems to deliver its service. The brief is too long to be described in the present report but there is one crucial assumption made by Broadcast News that merits discussion.

The assumption made is that Broadcast News would own the receiving earth stations. This has two important consequences:

- The cost of the earth station is amortized exclusively over BN services

- the concept put forward by Broadcast News is that of an optimum network which includes satellite reception <u>and</u> local terrestrial distribution (within, say, a forty mile radius of earth station).

Notwithstanding these 'pessimistic' assumptions the results show that while earth stations are being amortized over a five year period, the proposed satellite system is slightly more expensive than terrestrial facilities (15% more). But beginning with the 6th year of operation of the satellite system, when earth stations are completely amortized, BN's expenditure could effectively fall to less than 40% of the cost of a comparable terrestrial system. And the assumption used was that these earth stations would cost $12,000 each!

5.3.4.2 Tele-media Network

Tele-Media's network is shown in Figure 5.2 and presently consists of:

i) A main 8 kHz bidirectional network linking the Montreal station with owned and operated stations in the following cities:

- Hull
- Sherbrooke
- Trois Rivieres
- Quebec

ii) A secondary 2.7 kHz unidirectional network linking the company's owned and operated stations with 'affiliates' of which there are approximately 35.

iii) A 2.7 kHz line from the U.S. to the Montreal station for the Expos' out of town games.

iv) A similar facility (to (iii)) to Quebec City for the Nordiques' out of town games.

The annual operating cost of the network is approximately $133,000 broken down as follows:

- Out of town baseball and hockey $33,000
- 8 kHz network $50,000
- 2.7 kHz network $50,000

Syndicated programming is provided free of charge to the affiliates in exchange for a certain number of minutes of network advertising. In the case of baseball games this would represent approximately 17 minutes per game allocated to Tele-Media for national advertising, while the affiliate retains the rights for 10 minutes of local advertising.

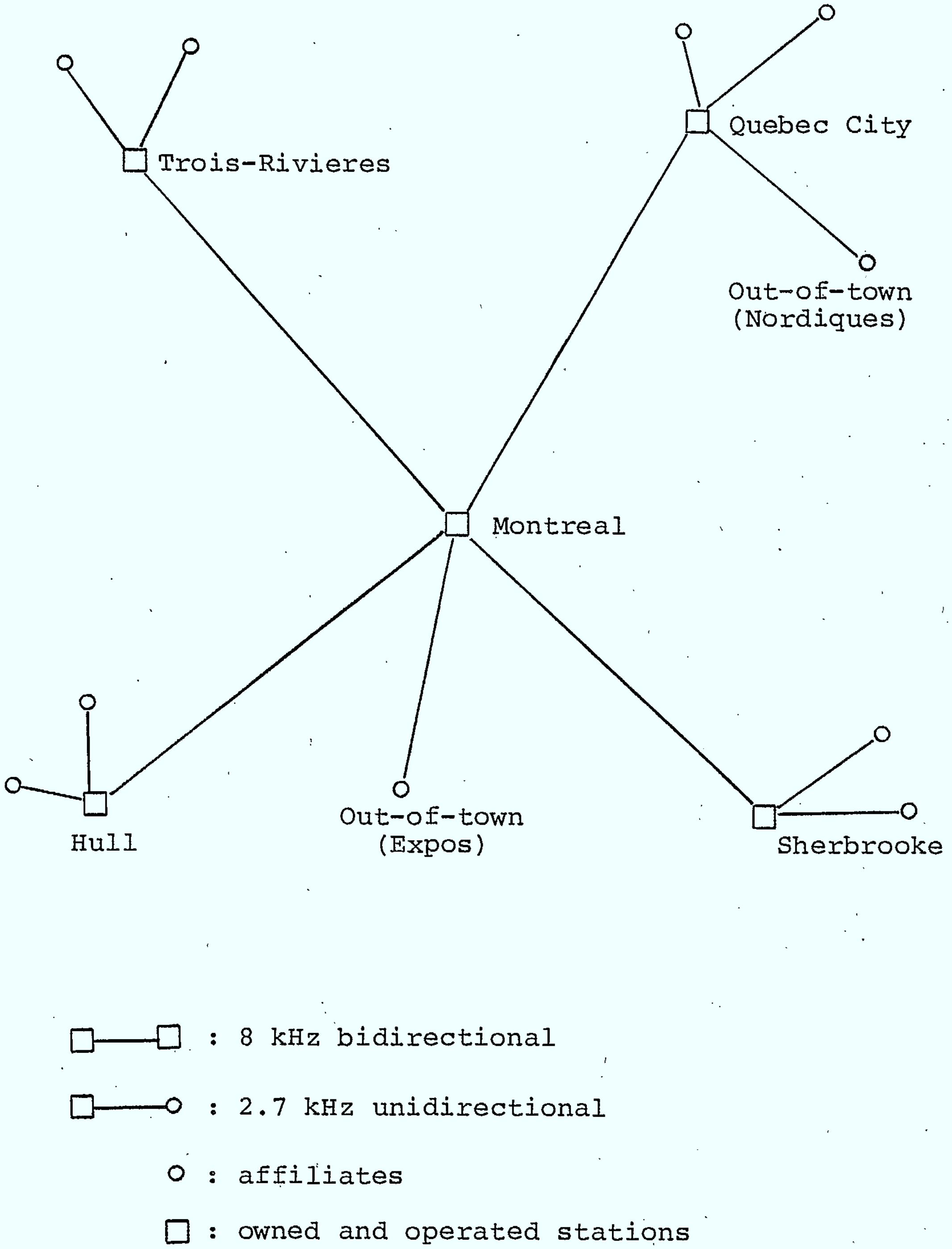


Figure 5.2 Tele-media Network

5.3.4.3 CKO All-News Radio Network

The present CKO network consists of 7 stations linked together by a 5 kHz channel from Toronto to the following cities:

- Vancouver
- Calgary
- Edmonton
- London
- Ottawa
- Montreal

All the network is unidirectional from Toronto, except for the Toronto-Ottawa link which transmits both ways.

There are also plans to extend the network to the following cities:

- Regina
- Winnipeg
- St. John
- Halifax
- St. John's

The network is illustrated in Figure 5.3.

At the present time facilities are leased from CNCP and the annual costs are estimated as follows:

Present network	$125,000
Extension to Atlantic Canada	$ 45,000
Extension to Winnipeg and Regina	$ 8,000
Total	$178,000

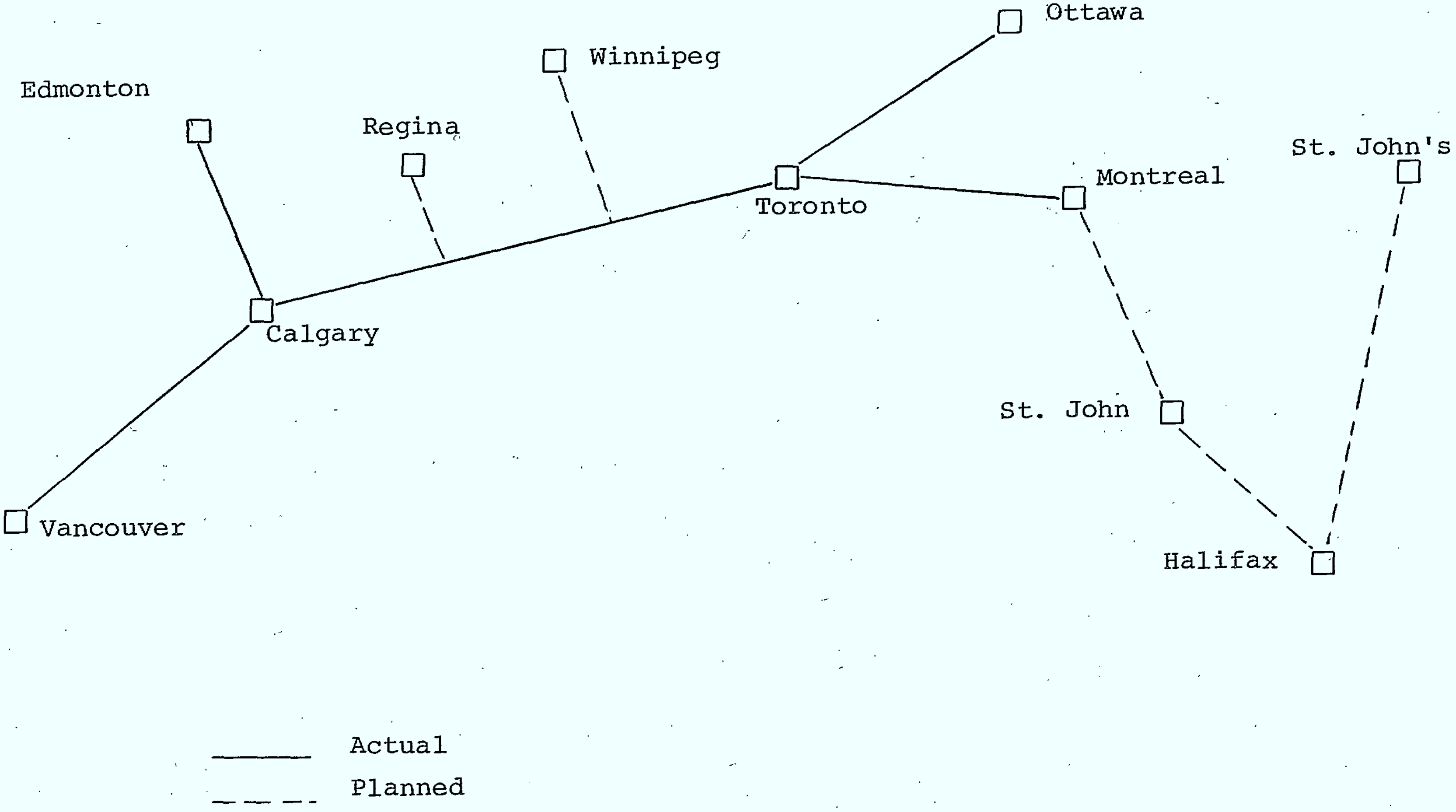


Figure 5.3 CKO Network

In addition, each station transmits approximately 6 to 8 news items to Toronto via regular long distance telephone service. This results in additional annual changes of approximately $40,000 presently and $60,000 when the full network is operational.

5.3.5 DISTRIBUTION OF AUDIO COMMERCIALS

The present technology for the distribution of audio commercials to the various radio stations of this country consist of:

i) making copies of a 30 second commercial on a 1/4 inch 'open reel' tape

ii) physical distribution of the copied material to individual radio stations by messenger services

iii) once in the radio station, the material has to be copied again on cassettes that can be easily played during normal programming.

The cost of copies is by itself $6; if one adds delivery charges of $5 to $6 as well, each 30 second national commercial delivered to a radio station will cost approximately $10 to $12. We have deliberately omitted other paper related costs such as accompanying instructions, packaging, etc., which would increase the cost even more.

A case could be made for these audio commercials to be delivered via an addressable DBS system. Since no real time distribution would be involved, such a service could be performed during off peak periods, i.e., on a channel which could be used for other purposes during normal hours.

The feasibility of such a service would depend on a number of factors of which the crucial ones are:

i) the structure of advertising expenditures of major corporations and governments: how many of these have a policy of 'buying' a large number of radio stations in the course of their advertising campaigns?

ii) the frequency of audio commercials: the higher the frequency on a particular radio station for a given commerical message, the more likely the cost of copies will amount to a small fraction of total advertising costs.

iii) the complexity of traffic instructions, although these could possibly be sent separately.

iv) whether radio stations are already receiving other satellite delivered services; the proposed service would then be subject to incremental costs only.

5.3.6 PROSPECTS

Radio networking seems in our opinion, a good candidate for satellite transmission. There will definitely be increased pressure to reduce the negative impact of escalating labour costs with other radio stations. Satellite distribution may also provide an avenue for specialization, in terms of programming, for some stations, that presently have to compete with major established stations carrying similar programming.

For most of the applications we have considered, a multi-beam satellite would seem to have advantages over a single beam satellite although this is not necessarily the case for users such as CKO or Broadcast News. Most of the present networks use limited bandwidth channels resulting in low quality signals. The marginal cost of higher bandwidth channels is generally not proportional to the marginal improvement in quality. If channel rental costs on a DBS were to be less bandwidth sensitive, most of the customers would opt for improved quality transmission. It must be noted that this is a feasible argument since terrestrial common-carrier networks are geared to providing two way service using 3.1 kHz channels in either direction. Larger bandwidth channels and unidirectional transmission can be accommodated as a special service for which there is a commensurate increase in cost. A DBS, however, only provides one way service and is not constrained by the 3.1 kHz elementary channel bandwidth.

We can foresee the need for 3 or 4 channels of 15 kHz bandwidth operating in a portion of one transponder, with access to individual baseband channels via FDM down converters. Although signal security is a modest requirement, it can be offered by the use of fixed band downconverters or putting the onus on the users to provide their own encryption/security systems subject to system compatibility.

The only doubt left, in our opinion, is the trade-off between a true DBS system and an interim DBS one such as Anik C. Because of the relatively small number of earth stations involved, reduction of ground segment cost would probably not offset increased space segment costs.

5.3.7 OBSTACLES

An important obstacle for such services, as before, is the CRTC policy on radio broadcasting in Canada. Radio networking and local programming, in general, are considered to be mutally exclusive undertakings. Of a lesser impact is the potential reluctance of advertising agencies to consider radio as a good 'national' medium, although this obstacle seems to have been overcome by sports programming on some networks.

5.4 SPECIALIZED CHANNELS

A DBS could be used to distribute a number of specialized audio services including backgorund music, programs dedicated to a variety of professionals, etc. One such provider of background music was interviewed during the present research project. A limited amount of information was obtained from the Muzak (Registered Trademark) franchise holder for the Quebec and Maritimes regions; there are approximately 300 such franchises in North America, 6 of them in Canada.

Two distribution methods are currently used by the operators. The preferred method of signal distribution is via the SCA channel of an FM stereo signal. The SCA (subsidiary communications authority) channel is located in the 53-75 kHz portion of an FM stereo baseband and can be accessed only by those clients having the appropriate channel downconverters after signal demodulation. In the absence of FM subcarrier facilities, the service is distributed by audio circuits leased from common carriers. Signal distribution by electronic means is done only at a local level. There is no long haul transmission/trunking of these signals to local distributors.

Crucial factors are the following:

- each separate market is served from distinctive studios equipped with tape playing equipment
- the programming material, heavily researched, we were told, and recorded in New York is physically distributed to the various studios in a sequential order where it is played only once; the tapes are returned to New York where new programming material is recorded.

Distribution costs, including cost of equipment supplied to the subscriber, amount to an average of $8 per month per subscriber. Under these conditions it is difficult to see how a DBS could be cost effective with the present technology.

Since Muzak is already distributed via satellite in the United States there is obviously interest here in Canada. We suspect, however, that the interest is motivated by the possibility of eliminating transportation of tapes and multiplicity of studio facilities in various areas. Hence, a subcarrier of an FM signal on a DBS would be a convenient national distribution technique to the local centres.

6.0 DIGITAL DATA SERVICES

6.1 GENERAL

We have identified two types of service users for the DBS transmission of data. Because of significant differences in the information content of the signals and the easy separability of the market, we have separated services into either a business or household classification.

Many of the services considered can be delivered to the users in a teletext format using the evolving Telidon technology. However, in some cases, particularly in the area of business services, the VBI teletext format may not have any advantages to the users. Current videotex and teletext systems have been associated with television transmission mainly because the TV screen is used to display the information and stable synchronization is available using the NTSC signal format. Given the wide proliferation of TV receivers it then becomes possible to gain access to a potential huge market to supply information services using this technique.

The limitation of the VBI is due to its limited data handling capacity in terms of the magazine cycle time (access time) and the absolute size of the magazine. For the teletext service offering to be attractive to users, the average access time to any given page has to be kept reasonably low, perhaps as low as ten seconds. Given the access time, the service provider can estimate both the maximum cycle time and hence the size of his teletext offered magazine. The maximum cycle time is simply the time required to broadcast the entire database once. This obviously constrains the amount of data that can be handled.

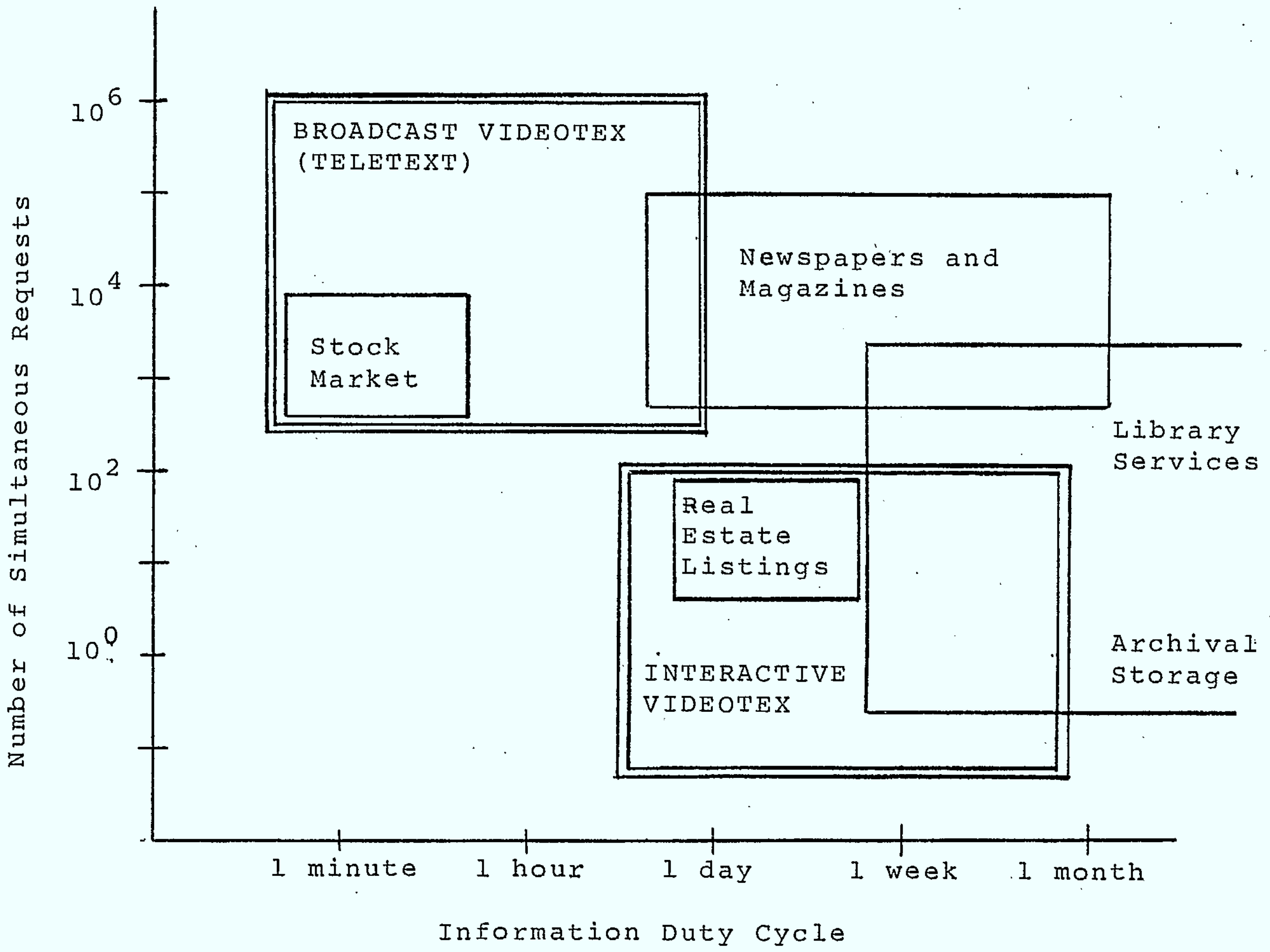
If one desires to improve access time, then the transmission "bandwidth" of the service must be increased. Instead of relying only on the VBI, if the full video bandwidth were used, it decreases the access time by a factor directly proportional to the bandwidth change for the same size of database. In the example outlined in Chapter 4, we identified a decrease factor of 25 in database access time when the transmission channel is the full video bandwidth instead of the vertical blanking interval.

Not only is access time affected by the transmission bandwidth, but also there is an impact on the rate of update of displayed information. Once the user's terminal has grabbed the desired page, stored it, and is reading it out for display at 30 frames per second (60 fields per second), the page search function can operate independently to receive the next occurrence of the displayed page. Any updated information will be read into the terminal memory and the displayed information on the screen will be updated. Although the update time may not be a critical factor for domestic services, it is one feature of the broadcast videotex (i.e., teletext) that may be a key feature for business users.

The suitability of a service delivery method is also related to the number of simultaneous requests for the same information. Within the category of digital data services, virtually any service depending on printed matter may be a candidate service for electronic delivery to the users. Classifying each publication type by information duty cycle and the number of simultaneous requests yields some interesting results when compared to the capabilities of the two prime modes of videotex. Figure 6.1 illustrates the matching of videotex mode and some typical services which have been identified in the literature as possible candidates for conversion from paper to electronic distribution methods.

One of the very interesting features of Figure 6.1 is that it also illustrates a demarcation between predominantly local services and those which are regionally or nationally offered. The separation can be done by considering the ordinate in Figure 6.1 and setting a threshold of roughly 100 simultaneous requests for the same information. Below the line are the local services characterized by large databanks and relatively slow information turn-around times. It does not mean that the number of accesses is small in absolute terms but that the number of accesses per information package are low due to the large database size. Above the threshold, the information services tend to be of a more regional and national nature characterized by higher circulation figures, smaller amounts of information, and in some cases, very short information duty cycles as in stock market quotations. In light of the data depicted in Figure 6.1, we feel that teletext has a strong future both in a terrestrial broadcast and in a DBS scenario. However, the number of services that can be offered is a great deal less than can be supplied by interactive videotex on telephone lines or by traditional printed matter.

Figure 6.1 Digital Data Services



6.2 BUSINESS SERVICES

Potentially feasible business services consist of:

- electronic mail
- stock exchange and other financial information
- newswires
- specialized publications and data banks.

Newswire services were briefly addressed in our discussion of radio networking within the context of distributing syndicated source materials to many centres. The discussion of networking in Chapter 5 is sufficient to cover the operation of newswires, the signal providers and their markets. In terms of DBS applicability, newswire services use essentially narrowband data channels which can easily be accomodated on a DBS to replace existing FSS (fixed satellite system) services or terrestrial distribution networks.

Provision of stock exchange and financial data services in a teletext format has been pioneered by Reuters in the form of their Business Monitor service. At the present time, the service is offered via Satcom I, transponder 18 in the United States and leases Datapac facilities for distribution in Canada. Since the satellite application is of prime interest in this report, we discuss it in more depth.

The Business Monitor service offered via Satcom I is available from 4:30 AM to 8:00 PM and uses the complete NTSC-M frame format for information transmission. The entire Reuters database is encoded and tagged with page identifiers after which it is interlaced with the NTSC sync signal and uplinked to the spacecraft as any other video signal. Service subscribers require a keyboard and a minicontroller (cablehead) to display the information.

Data that is broadcast consists of three parts. Contributed data is generated by major financial houses such as banks, brokerage establishments, and stock exchanges and is subject to fast updates in the order of 10 to 15 per minute. The service is aimed at facilitating real-time trading in bonds, stocks, certificates of deposit and money. The contributed data service is distributed to some 15 to 20 countries, although not via satellite, and including 4 or 5 Communist Bloc countries.

The second service that is broadcast is a Reuters compiled database covering the major North American stock exchanges and related newsfiles. Of primary interest in this service are the commodity wires covering metals, livestock, fibres, grains, oils, petroleum, wood, etc. among others. The data is updated on a daily basis and Reuters plans to base an archival retrieval system around this service.

The third offering consists of stock exchange quotations from the major U.S. centres. Detailed daily listings are available as are statistics and daily summaries for the previous day's trading.

Addressability and encoding of the transmitted data allows Reuters to uniquely identify 10,000 subscribers presently and up to 40,000 in the future. Not only are individual video frames tagged with addresses but also individual lines. The Monitor service presently can transmit up to 9,000 pages of information to cover all three services. The information in Monitor I, the contributed data, is sent often enough among all the other data to enable display updates roughly evey 5 seconds.

The price of the service to business users varies from $500 to $1500 per month depending on the extent of the data bank required by the user. Requests for service expansion are received by Reuters by mail or Telex, but access codes are sent to users during normal broadcast operations. In this way, information segregation is possible since each connected terminal is uniquely addressable. Reuters expects that inexpensive mass-produced terminals for the home market will be available within two years. Assuming a $200 price for the terminal they expect to sell a programming package for approximately $10 per month. Reuters forsees strong growth in the market for reasonably priced data banks available to the public at large.

The most obvious candidates for the Business Monitor services are brokerage firms, banks, and various financial institutions with portfolio management responsibilities. The Canadian market for such services could vary between a few hundred DBS receiver units up to 5000. A reasonable second estimate would place the number between 2500 and 3000 based on the distribution costs including subscriber decoders and the present Canadian market of roughly 5000 subscribers being presently served via Datapac facilities.

Typical other business applications may consider distribution of inventory updates from centralized retail establishments, distribution of classified advertising and provision of business catalogs electronically. Although we contacted a number of national commercial establishments to poll them for their needs, the majority of their communications requirements are for bidirectional data channels with occasional use of a voice circuit. Present needs are satisfied by long distance telephone circuits and packet switching networks such as Datapac and Infonet. We do not forsee a large need for these types of services on the DBS that cannot be met by existing systems or newer TDMA satellite networks such as SBS.

6.3 HOUSEHOLD DATA SERVICES

In the category of household data services we examined the following candidates in more detail:

- government services information
- transportation and travel information
- recreational and cultural services
- electronic newspapers and magazines
- catalogues and other electronic mail.

At the present time, all of the above are available to the Canadian public either in printed form or broadcast via existing radio and TV stations.

The dominant characteristic of these services is that they rely, to a very large extent, on advertising as a source of revenue. Out of an estimated total revenue of $3.7 billion in 1980, roughly $0.4 billion is accounted for by subscriptions while the balance, amounting to almost 90%, was generated through advertising or sponsorship of one kind or another.

During the ten year period from 1970 to 1980, advertising revenues grew monotonically from a little over $1 billion to $3.3 billion for an average annual growth of 13%. A significant portion of this advertising process consists of printed matter and physical distribution to Canadian households. As Table 6.1 shows, the electronic media (radio and TV) represents only 28% of the total advertising revenues. Although this figure is significant, it is only a fraction compared to that generated through newspapers, periodicals, catalogues and direct mailings.

Table 6.1 Canadian Advertising Revenues by Medium

	1976		1979	
	$Million	%	$Million	%
Newspaper and Periodicals	998	46	1345	43
Catalogues and Direct Mail	425	20	642*	21
Radio	242	11	352	11
Television	323	15	527	17
Outdoor and Other	176	8	257*	8
Total	2146	100	3123*	100

Source: Statistics Canada
* Estimated by Tamec Inc.

Since newspapers and periodicals represent a large portion of the revenues, we have chosen to examine their market structure in more detail as an illustrative example. Advertising revenues in this field can be distributed among four constituent publications as shown in Table 6.2. The market is strongly dominated by daily newspapers, most of which primarily provide local coverage with some minor regional or national impact.

With the assumption that general circulation and other magazines are 80% nationally supported and that city directories consist entirely of local sponsorship, Table 6.2 illustrates also the division of national versus local advertising revenues. The figures illustrate, quite clearly, the initial difficulty which a satellite delivered Telidon home service will face. Only 24% of the revenues are non-local which, by an earlier definition, means that these are the only ones to support any DBS offered services in the early stages of system development.

Table 6.2 Advertising Revenues of Newspapers and Periodicals by Recipient, 1979

	National		Local		Total	
	$Million	%	$Million	%	$Million	%
Daily Newspapers	155.5	18.8	672.4	81.2	827.9	100.0
Other Newspapers	35.0	24.8	106.2	75.2	141.2	100.0
Telephone & City Directories	-	-	203.1	100.0	203.1	100.0
General Circulation and Other Magazines	138.2	80.0	34.6	20.0	172.8	100.0
Total	328.7	24.4	1016.3	75.6	1345.0	100.0

Another disturbing aspect of a similar nature concerns the subscription revenues which we have neglected up to now. As Table 6.3 illustrates, these revenues represent only 21% of newspapers' and periodicals' total revenue. Furthermore, the data indicates a downward trend (from 26% in 1970) implying that Canadian households are fairly reluctant to pay for their information services.

Table 6.3 Advertising and Subscription Revenues of Newspapers and Periodicals, 1979

	Advertising		Subscription		Total	
	$Million	%	$Million	%	$Million	%
Daily Newspapers	827.9	79.1	218.4	20.9	1046.3	100.0
Other Newspapers					184.0	100.0
Telephone and City Directories	203.1	97.6	5.0	2.4	208.1	100.0
General Circulation and Other Magazines	172.8	63.1	101.0	36.9	273.8	100.0
Total	1345.0	78.6	367.2	21.4	1712.2	100.0

6.4 CONCLUSIONS

A large portion of the information services available to Canadian households is paper based; that is, it involves mass printing of information for subsequent physical distribution. The process is both labour and energy intensive and given the rising energy costs combined with diminishing costs for high technology electronics, teletext services are bound to become very attractive in the future. Such services will probably encounter initial resistance because of lack of audience familiarity with the potential benefits of the system and because of the requirement for a subscriber paid decoder. The present technology delivers most of these household services free of charge or at a below cost subscription price.

Another reason for predicting initial resistance to household teletext services via a DBS is that a large proportion of the information is local in nature; whereas, satellite caters to those having more national appeal. One of the disturbing aspects of DBS-teletext advertising is the user selectivity feature which would allow individual users to avoid "pages" of advertising. Present household services, whether in the form of the printed or electronic media, combine entertainment/information programming with advertising in a manner that even if the consumer tried to be selective and ignore the advertising, the sensual appeal (visual or audible or both) would at least be presented to the consumer. These features may be more difficult to accomodate in either teletext or interactive videotex offered services.

As far as space segment costs are concerned, the use of the vertical blanking interval of a TV signal would provide very low space segment costs but at the expense of a limited data bank, if access time is to be kept reasonable. On the other hand there is the possibility of using the full bandwidth of a TV signal to distribute a much larger volume of information, with a reasonable access time. Since this approach would involve substantial space segment costs, an 'early' introduction of such a service seems improbable until penetration of the decoders within Candian households has been built up to a significant number. Most probably, most domestic services will use the VBI initially and the full video signal will be used by business oriented subscription services. Once the technology and service potential has matured, we see the possibility of distributing "large" data banks such as catalogues of national retailers using the full bandwidth. This type of advertising is less sensation oriented and is characterized as a catalogue shopping operation.

Between the two extremes (vertical blanking interval versus full bandwidth of a TV signal) there are also numerous possibilities of using less than full RF channels to distribute data in a Telidon or other teletext format. These options currently seem less attractive. While this may be true today, future success of the NABU concept will undoubtedly reopen this question. The present obstacle to service-tailored Telidon offerings is the lack of low cost interfaces between individual households and information repositories. Unless these interfaces become available over short period of time and at an acceptable cost, the transition from an experimental to a commercially viable operating mode may be a major impediment to the success of the concept. The structured, top-down approach and objectives of NABU hold enormous potential to the evolution of mature digital data services.

7.0 IMAGE SERVICES

7.1 INTRODUCTION

Image services, by our definition, encompass any type of signal that is capable of producing a picture at the users receiving equipment. Withing this category we have identified four services, namely:

- education - lectures, seminars
- videoconferencing
- fascimile and still pictures
- high definition television

On the supply side, there is a continuum of transmission techniques to satisfy the demands. Among them, we postulated the following potential candidates:

- full rate video
- reduced rate video (or motion adaptive)
- slow scan video
- facsimile
- high definition television.

7.2 EDUCATION

Tele-education, as an application area of modern communications technology, developed as a portion of the Wired City concept and has its roots in the saying that "a picture is worth a thousand words". In the many cases that one may examine, lectures, seminars and professional workshops depend on visual material to aid in the understanding of concepts or ideas.

The need for tele-education is presently being satisfied, on a small scale, primarily in local areas. However, the attractiveness of tele-education is that it is not constrained by geography as was demonstrated by the Stanford-Carleton curriculum exchange experiment during the active days of CTS. Not only were students capable of exchanging ideas with their distant counterparts, but also they benefited from the advice and experience of an internationally recognized authority in a particular field. We can forsee a demand for this type of curriculum sharing to supplement presently offered programs in the Canadian primary, secondary and post-secondary educational establishments.

To meet the demands of society for these types of services, we are partial to the application of reduced rate video techniques. There are a number of reasons for this preference over live (30 frame/sec.) video transmission. Lecture, seminar, etc., program material is traditionally sedate as regards the speed of motion of the image. Reduced rate video is ideally suited since it matches the occupied bandwidth to the rate of change of the portrayed image. By reducing, per image, the occupied bandwidth, the technique allows insertion of another or possibly two other totally independent signals into the transponder. This technique increases the utilization of one video RF channel by a factor of 2 or 3 depending on the multiplexing scheme. Alternatively, one can say that the cost of delivering one signal is reduced by the compression factor.

In cases where there is a need for a "2 blackboard" presentation, the reduced rate video scheme easily provides this capability using only one video channel. Other displayed images, in addition to the lecturer, can frame steal from the live video under the lecturer's manual control. The result is, that in the remote classroom, students can have several information displays which support the lecturer's presentation thereby recreating the atmosphere of a live classroom.

The multiplexing scheme can be accomplished either digitally or in an analog fashion depending on the format of the signal. Digital processing, at the present time, is expensive (in the order of $150,000), due to the requirement of high bit rates and complex, nearly instantaneous "flash" analog-to-digital converters. By contrast, inexpensive (approximately $10,000) analog techniques are available which work on the basis of field or frame multiplexing.

Despite the relatively low cost of analog receivers for the multiplexed transmissions, their cost is not compatible for individual household reception and is suitable for reception by a cable headend or by a school serving a larger segment of the population. Northern and rural schoolboards would be prime candidates for educational services ranging from the elementary school levels through to undergraduate course offerings and trades' schools. Given the number of schools in Canada, there is a potential market for up to 30 video channels across Canada and possibly several thousand dedicated ground terminals. The number of RF channels required is purely speculative and could in fact easily extend up to 100.

7.3 VIDEOCONFERENCING

The concept of videoconferencing is not dissimilar to that of tele-education. Both rely significantly on the transmission of video signals, most of which depict low motion levels. The general definition of videoconferencing encompasses a variety of corporate, professional and academic uses, thereby covering the tele-education application. Two modes of operation have been envisaged; the internal application designed specifically for the private needs of a corporation or institution and the external, event oriented conference. The internal video conference typically operates on a closed circuit in which there is no public access. The external mode normally refers to a broadcast video conference (no return path) or could be a teleconference in which limited return capability is provided. In a DBS environment, with its point-to-point characteristic, the internal videoconferencing mode is less attractive than the event oriented form unless major corporate users require national coverage. An appropriate coverage threshold would require at least one downlink channel per beam to be considered a feasible service on a DBS. Otherwise, it may be more efficient to use fixed satellite services with terrestrial backhaul to the destination.

The issue of program supplier distribution is, however, an awkward feature with which the DBS architecture has to contend with. Unlike the entertainment broadcast mode of operation where coverage works on the time zone principle, videoconferencing applications are real time. This means that one uplink feeds multiple downlinks. The feature can be readily accommodated if a switch matrix can reconfigure uplink to downlink channel/beam mappings, otherwise the DBS planners would have to build-in a national, fixed route signal channel to meet this demand. This issue needs to be resolved among all the videoconferencing users and broadcasters to evaluate the degree of use of a fixed channel to ensure maximum use of the full satellite transponder capacity. The same argument is applicable to both internal and external users although users of the external mode can forseeably tolerate the one hour delay imposed by time zone staggered transmissions.

The event oriented videoconferencing operation would be aimed at not only a portion of the academic market but also to carry major political, governmental, national interest items to viewers across the country. Typical examples are major announcements being made by car manufacturers, newsmaking events, live coverage of major conventions appealing to both the mass market and subsets of the overall market.

Videoconferencing traditionally has implied the need for a bi-directional video link, as developed during the Wired City work. Many potential applications could be served just as efficiently if the return channel from the consumer to the sending end were a simple audio link. The constraint of narrowband return channel would most likely be felt by the corporate user whose need relies on an exchange of graphically supported arguments in both directions. However, audio return paths for event-oriented videoconferences and classroom environments are considered acceptable; the only limitation being the ability of a speaker or lecturer in dealing with a large number of questions or comments as is the case with any large gathering.

Forecasting transponder usage in the video meeting business is extremely difficult due to the relative mass market novelty of it. The number of transponders required to meet the demand arising in future years is a function of both the number of event-type videoconferences, excluding tele-education applictions and the usage statistics, or the probability of channel overloads/conflicts by the demands. Historically, if one examines the number of national videoconferences, recent years (1979, 1980) probably yield figures in the order of 10-20 events per year. For 1981 and later, a reasonable projection may be 30-50 conferences per year and after 1985, some business executives have predicted numbers ranging between 100 and 500.

To meet the predicted demand, one approach would be simply to guess at the number of transponders which could be utilized for videoconference applications with unused time allocated to other users. Another approach could model the videoconference demand schedule as a stochastic process. Not being aware of each user's frequency of demand or the service duration time, a one hour per week per user requirement means that one transponder would be fully booked during business hours by 40 users. If a return video path is needed, then 2 transponders would be occupied.

Such a fixed schedule is applicable to corporate users, and it does not necessarily meet the needs of the event oriented videoconference. Modelling these types of events as a stochastic process is currently unrealistic given the lack of firm data and our feeling is that at most 2 full transponders capable of carrying video signals should be made available to carry specialized program material on a reservation basis. In fact, these 2 transponders will probably be sufficient to meet the demands of both the event oriented videoconference and academic interests (the prime user). Specialized programming could be carried on an as-needed basis while the educational application would be used to supplement regular classroom material using a scheduled format (1 or 1.5 hour duration per program).

While we are predicting an initial requirement of two video transponders to satisfy video conferencing needs, this application area appears to be on the verge of extremely rapid growth. We feel that both the educational and event oriented video conferencing requirements are just beginning their climb on the S-curve and could escalate dramatically in a short period of time. Our prediction of two channels, at the present time, may easily increase by an order of magnitude within a very short time.

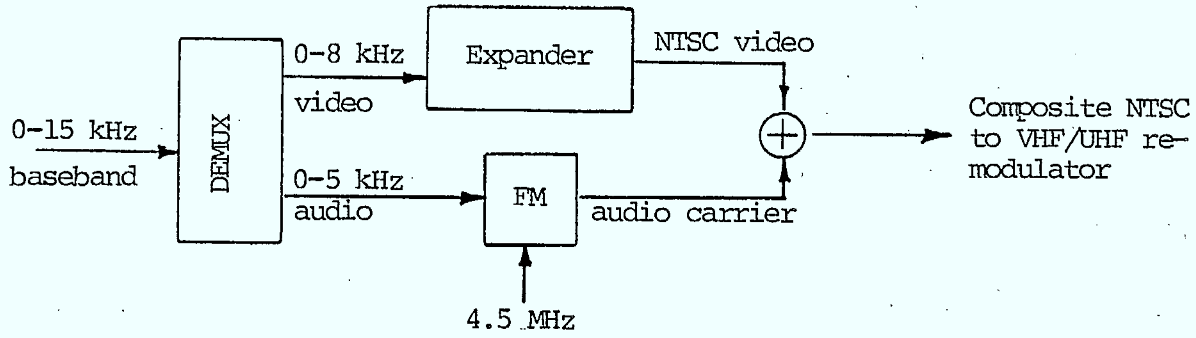
7.4 FACSIMILE AND STILL PICTURES

Facsimile and still picture transmission fall into the same grouping mainly because both are most efficiently handled by slow scan techniques. They do not particularly correlate with video techniques because of the great bandwidth difference and their capability is restricted to motionless images.

The basic technique used in generating and transmitting slow scan images is to sample ("frame freeze") the image or source signal in some form of memory and read it out over the transmission link at a much lower rate. For instance, a sampler/compressor grabs a frame from a TV signal at the regular NTSC frame rate and transmits it or reads it from memory at a rate that can be accommodated in a narrowband channel. The receiver records the signal in its memory at the incoming rate and subsequently displays it on a television set at the expected rate of 4.2 MHz. The process exploits the time-bandwidth characteristic of the signal by increasing transmission time to force fit the signal into the available bandwidth.

A typical application of the slow-scan video technique is the augmentation of audio programming transmitted on narrowband channels. Both the audio and slow-scan video signals are frequency division multiplexed into the 15 kHz baseband using a 5 kHz bandwidth for the audio signal and 8 kHz for the video or image signal. The receiver demultiplexes the 2 signals, expands and stores the previously compressed video signal while the audio signal frequency modulates a 4.5 MHz carrier. As shown in Figure 7.1, the two are then added to form the composite NTSC video signal compatible with standard household television receivers. Because the video signal is transmitted in an 8 kHz bandwidth, transmission time is proportionally longer, being in the order of 525 seconds per frame rather than the normal one-thirtieth of a second.

Figure 7.1



Facsimile transmission is similar in concept but is usually employed to convey printed information via 3.1 kHz telephone channels. The scanning time for a single pageis either 3 or 6 minutes depending on the desired fidelity of the end product and requires human operator interface at both ends of the transmission.

The nominal cost of slow scan equipment is in the order of $5000 to $6000 in addition to a satellite receiving system which is forecast to cost under $1,000. This additional cost places most services offered by these means out of reach of the majority of DBS subscribers unless they are business users or receive their satellite signals indirectly via a local cable system. From a functional perspective as well, facsimile services have traditionally been point-to-point oriented and would probably be not feasible on a direct broadcast satellite.

Slow-scan video may have a future in feeding local cable systems. A service of this type is currently being offered by United Press International called "Newstime" on a video subcarrier on transponder 6 of Satcom I. UPI uses the system to augment their audio broadcasts with still pictures. Cable companies strip away the subcarrier, demultiplex and expand the video signal and convey a video signal at 30 frames per second to their subscribers on a spare cable channel.

After eliminating the market for facsimile, the market for slow-scan will probably be modest. Where the satellite is concerned, this service type makes very little impact on spacecraft or receiving terminal design and if offered by a broadcaster, can be accomodated easily on a subcarrier.

7.5 HIGH DEFINITION TELEVISION (HDTV)

We briefly examined the current state of developments in the field of transmission of high definition television (HDTV). Although the Satellite Television Corporation application to the FCC proposes to allocate bandwidth to future HDTV service, no firm market has been defined and so far, there has only been speculation as to the date of introduction of a complete commercial HDTV system.

HDTV is a visual display medium that promises to deliver high precision and high resolution images to the viewing public. The motivation for research and development in this field has been ascribed to the needs of an "image oriented society" whose appetite is continually growing conditioned by improvements in receiver design, greater resolution and the enormous advances made in electronic technology.

Three areas of application of HDTV have been forseen: (i) in the home, (ii) for the projection of television programs in theatres and (iii) in the production of motion pictures. One of the issues for HDTV offerings for the home is the lack of compatibility between the new service and that which is in existance at the time of introduction of the new service. The SMPTE Study Group report on HDTV (41) failed to identify the means by which full compatibility could be achieved. They went on to state:

> "The transition from the existing public color service to such an improved HDTV color service would, it seems, be fraught with so many political, social and economic impediments that it might never succeed in attracting a sufficient audience to justify the heavy cost of its development."

In attempting to define a noncompatible system for home application, the study group found that before establishing system standards and specifications, a large screen, high aspect ratio, bright, durable and inexpensive HDTV display device has to be developed and demonstrated. It thus appears premature to attempt to define quantitatively the essential elements of a domestic system.

Theatre projection and motion picture production of HDTV signals seem to be reasonable applications that would concentrate the capital costs of acquisition with that sector of society which could afford it. Although an HDTV system was found quality competitive with current 35 mm film, much apparatus development remains. Included are cameras, telecine apparatus, VTRs, as well as digital converters and processors.

Within the context of a direct broadcast satellite service, an HDTV channel would initially aim at replacing the present distribution system for 35 mm feature films copies. Assuming a 90 minute film with 24 frames per second, and copy costs of between $1300 and $1900 depending on the number made, normalized costs are between 0.09 $/ft. to 0.13 $/ft. With a DBS, distribution of films could take place via the satellite directly to movie theatres via the HDTV channel to elminate film costs and those associated with distribution by physical, terrestrial methods.

Most of the work in defining standards for HDTV has occurred in Japan where a variety of proposed systems have been, and still are, in the process of evaluation. Generally speaking, the transmission of HDTV is an incidental issue, with most of the current research concentrating on:

- psychophysical factors such as viewing distance and required picture quality
- picture format including picture size, aspect ratio, chrominance coding
- scanning standards encompassing the number of scan lines, interlace ratio, frame/field frequency
- signal standards such as luminance/chrominance bandwidths, signal type, S/N ratios

in both analog and digital domains. Compatibility with current broadcast standards (NTSC, PAL, SECAM) has also been considered.

NHK and the Japanese Ministry of Posts and Telecommunications have field trialed an HDTV satellite broadcasting system in the 12 GHz band. Table 7.1 shows the results. It should be noted that the total RF bandwidth occupied was 105 MHz with a per channel EIRP of 57 dBW. Current studies are considering the tradeoff to be made between peak frequency deviation and satellite EIRP. To decrease the RF bandwidth, peak frequency deviation has to be reduced. To compensate, RF power on the satellite has to be increased by at least a factor of 4 for every halving of the peak deviation. At the present time, there have been many proposals made to deliver HDTV by digital techniques in order to minimize bandwidth requirements. In spite of the compression capabilities of digital encoding techniques, we feel uneasy about the potential cost of a system, particularly the receiver portion, which would entail both extremely high speed processing and a complex decoding algorithms. Although they are undoubtedly technically feasible, the present cost of this technology may well place HDTV techniques beyond the threshold of household economic feasibility.

Our conclusions on satellite HDTV have been extracted from the SMPTE Study Group on HDTV (41). Their summary and recommendations relevant to this study are:

i) an HDTV compatible with existing domestic services (compatible in the same sense as NTSC colour to monochrome) is not feasible by any means or envisaged by the study group.

ii) A non-compatible system could become feasible only after prolonged exposure of the public to theatre HDTV systems.

iii) It appears premature to attempt to define quantitatively the essential elements of a domestic HDTV system since much more R&D is required.

iv) Costs of domestic HDTV systems are unknown and it is not certain whether high definition displays are producible at costs acceptable to the mass market.

As far as film distribution is concerned, HDTV via a DBS is interesting from an economic point of view, but much more technical development is required before this technology can be exploited.

Table 7.1 Satellite HDTV-FM Transmission
(Reference 42, Table 11)

	Luminance	Chrominance
Carrier Frequency	12.0875 GHz	11.9625 GHz
Video Bandwidth	20 MHz	6.5 MHz
Type of Modulation	FM	FM
Frequency Deviation	40 MHz	12 MHz
Radio Frequency Bandwidth	80 MHz	25 MHz
S/N Ratio (Unweighted)	42.5(38.6) dB	44.5(40.6) dB
C/N Ratio (99% of time)	16.7(12.8) dB	22(18.1) dB
Receiving Antenna Diameter	2.5 m (1.6 m)	
Receiver Noise Temperature	660 K	
Satellite Transmitting Antenna Gain	37 dB	
Satellite Transmitter Power	100 W	100 W

8.0 SUMMARY AND CONCLUSIONS

Our conclusions regarding alternate services on a direct broadcast satellite have been catalogued under six topics to lend cohesiveness while maintaining cause-effect relationships. The six essential headings are:

- feasible services and characteristics
- prospects for services
- impact on present status quo
- implications to DBS system architecture
- compatibility of new technology and future services
- obstacles.

The first three are heavily interrelated by action-reaction dynamics within the framework of the Canadian communications industry and its position within society.

8.1 FEASIBLE SERVICES

A logical outflow of this study is a list of DBS compatible services which are feasible, both technically and economically for delivery by satellite. While there are many aspects which have to be satisfied, our intent has been to highlight some of the more crucial ones and establish a framework for evaluating tradeoffs and determining priorities.

Our algorithm has been outlined, in considerable detail, in Chapter 2 of this report. On the basis of our consolidated service list, we have identified and quantified, where possible, which services are definite candidates to be considered in the DBS planning process and the demands imposed by their carriage.

Our overall assessment of the services considered in this study is summarized in Table 8.1. The most promising services at the present time appear to be:

- FM superstations
- radio networks
- household data services
- financial information services.

These services exhibit one or more of the following characteristics:

- fairly large market
- modest competition from alternative methods
- modest technological requirements
- reasonable hardware/software costs.

An impediment to the carriage of these service on a DBS is that they would face regulatory and institutional obstacles associated with present CRTC policy and the possible opposition from established providers of such services.

Other service categories covered by this study are:

- specialized audio channels
- some business data services
- videoconferencing (tele-education)
- high definition television.

Although these services do not appear, at first glance, to be hampered by serious regulatory and institutional obstacles, their overall attractiveness is subject to a number of constraints:

- smaller market or more difficult to define at the present time
- potentially tough competition from alternative methods of signal delivery
- complex technological requirements and the need for additional development
- expensive costs.

Table 8.1 DBS Alternate User Service Assessment

Service Category	Service Group	Market Size	Competition	Prospects	Type of Channel	Number of Channels/Beam
Audio	FM Superstations	medium to large	little or none	good	FM stereo (53 kHz)	6 - 8 maximum
	Radio Networks	medium	FSS, terrestrial microwave	fair to good	8 - 15 kHz	3 - 4 5 maximum
	Specialized Channels	medium to low	terrestrial networks	fair to good	5 - 15 kHz	1 - 2
Data	Electronic Mail	large	postal service computer networks (e.g., ARPA)	poor	2400 - 9600 bps	No prediction
	Financial Information Services	medium to large	digital networks (Datapac, etc.)	good	NTSC video teletext	1

Table 8.1 DBS Alternate User Service Assessment

Table 8.1 (continued)

Service Category	Service Group	Market Size	Competition	Prospects	Type of Channel	Number of Channels/Beam
Data (continued)	Newswires	medium	terrestrial networks	good	5 kHz	5 - 6
	Specialized Publications	small to medium	publishing industry postal system	poor	VBI teletext	1 - 2
	Directories Indices	large	paper industry	excellent	VBI teletext	1 - 2
	Electronic Newspapers and Magazines	large	very strong publishing industry	fair	VBI teletext	5
	Catalogues Advertising	large	printed matter	good	NTSC video teletext	1

Table 8.1 (continued)

Table 8.1 (continued)

Service Category	Service Group	Market Size	Competition	Prospects	Type of Channel	Number of Channels/Beam
Data (continued)	Education (programmed learning)	medium to large	printed matter postal system micro-processor accessories	good	VBI teletext or 3.1 KHz	10
	Education (corres-pondence)	small to medium	postal system	good	VBI teletext or 3.1 kHz	3 - 5
Image	Education	medium to large	films tapes	excellent	reduced rate video	5
	Video-conference	medium to large	travel	excellent	NTSC video	2
	Facsimile Slow scan	small	terrestrial networks	poor	3.1 to 15 kHz	1
	HDTV	potential huge	NTSC video	uncertain	25 MHz baseband	uncertain

At the outset of this study we postulated that technological considerations would have minor influence on the feasibility of a given service such that the committment whether to offer a service on the DBS will be made on the basis of market demand and lack of competition or alternative methods of delivery. We feel that this assumption has been shown to be valid since most of the problems that have been encountered focus on financial, regulatory, and institutional factors apart from the ultimate criterion of user demand.

The prospects for each of the services shown in Table 8.1 evolved from a qualitative assessment of all the technical, economic and institutional factors as outlined in Chapter 2 and subsequently discussed. The evaluations are applicable in the short to intermediate time frame after having considered the impact of increasing levels of user acceptance, technological progress and the dynamic, sometimes volatile, nature of the communications environment that seems to have been spawned by the technical state of the art. A note of caution is required to emphasize the short lifetime of our predictions especially in light of the growth rate in the field of information technology.

8.2 IMPACT ON ESTABLISHED INDUSTRIES

The impact of a direct broadcasting satellite on the traditional broadcasting industry, particularly that segment offering video and high quality audio programming, is not expected to be major. Given that uplink and downlink spectrum is a finite resource, DBS offered services may lead to the creation of two strata in the broadcasting industry; the conventional terrestrial segment with a restricted coverage area and the "superbroadcaster" with a potentially much larger service area. Delivery of alternate user services, those that this study has considered, may lead to some of the same issues plus contributing to the further segmentation of electronic information distribution networks such as broadcasters, cable operators and the common carriers.

The impact of a DBS will be felt not only in the communications industry but also in the segment of our society which deals with information dissemination and distribution. An abridged list would include:

- electronic media
- paper based media
- publishing industry
- common carrier networks
- terrestrial broadcasters
- cable networks
- fixed satellite service
- physical distribution (postal system, courier)
- advertising industry.

It is important to recognize which elements would be most affected by a DBS and which could be reoriented or maintained to complement DBS delivered services. Much of the analysis needed in support of an integrated information network will depend on identifying the method of service financing. Inexorably linked to the feasibility of a given service and its method of delivery is the type of information or software that is supplied.

There will be no major disruptions within the communications industry providing that the following conditions are met. The services to be offered on the DBS must be complementary to those delivered by presently available methods. This implies that there will be no overt competition among the DBS, cable, broadcast and common carrier networks. The DBS will function as a national or regional distributor of information with local distribution being the responsibility of the other networks. In addition, the DBS will fill in the gaps which are not adequately served by terrestrial methods.

Within the media and publishing industries, the DBS, by itself, is no threat to their future. Growth in these fields is more a function of technological growth as can be seen in the implementation of Telidon videotex/teletext systems. Although electronic mail is on the horizon, it is not compatible with DBS capabilities and therefore will have to rely on other delivery methods.

It has been shown that the financing of most services is done through advertising with a small proportion depending on subscription or user payments. For the mixture of services that we have considered, we see some being predominantly advertiser supported with subscription financing supplementing those in which the advertising is oriented towards a purely local level. A regional DBS architecture tends to favour advertisers. This may well be one of the questions that requires much more study before the eventual launch of a DBS.

8.3 DBS SYSTEM ARCHITECTURE

Most of the alternate user services that we consider feasible on a DBS require either narrowband channels or can be configued to use a complete transponder as for a video signal. The one exception to the above is making room for the possible introduction of high definition television at some future time. Assignment of a fairly large number of channels, all of which require different IF bandwidths due to performance requirements, is a somewhat complex task, particularly since present schemes are geared to providing wideband service such as television and high rate digital channels.

Assuming that the assignment of video channels, their required bandwidths and the EIRP of each will be determined by a system or spacecraft feasibility study, then the system will have been configured for wideband services. Accommodating narrowband services in this type of system seems dependent on resolving whether the narrowband services should be readily accessible to the user or whether they should use spacecraft resources in the most efficient way. Our conclusion is that narrowband services, particularly a series of radio channels should be grouped together in one transponder and should access that transponder using an FM-SCPC method. Although a video subcarrier technique may be most efficient from a technical point of view, the independence of video and audio signals should be ensured to maximize both signal accessibility by the user and system flexibility in the future. This conclusion can be extended to include all like services. Separation of unrelated program material may furthermore add to the attractiveness of individual DBS services by avoiding "package deals" linking strong market contenders with weaker ones or services destined for business or household use.

In terms of the feasible services that we identified, this means that all audio channels will be carried in their own transponder. The ground receiver design is simplified since all it has to be able to do is to tune through one band and the user is not required to pretune a video channel to gain access to a subcarrier. This problem is not a factor in services offered in a teletext format since the television screen is required to display information and therefore the user will have to make an exclusive choice between video or teletext programming.

Some consideration should be given to offering teletext services in only one or two transponders rather than distributing a large data base among vertical blanking intervals (VBI's) in several different video signals. This refers, in particular, to databases which are fundamentally broadcaster independent such as government directories, catalogues, advertising and public service channels. An aggregate teletext channel, using the full video bandwidth is attractive also because it will more readily accommodate both large and small databases whereas the VBI is more tightly constrained by database size in relation to cycle time.

To handle HDTV signals, a great deal more RF bandwidth is required (100 MHz) than the nominal 18 or 36 MHz required for NTSC video signals. Our conclusion is that the first DBS should carry at least one superwideband transponder for experimental purposes. Judging by the developments in the HDTV field, we foresee introduction of this technique into movie theatres in roughly 5 to 10 years, determined mainly by the time to develop and productize HDTV generation and reception equipment. The single experimental transponder serves to cover this possibility. Our conclusions about HDTV in the domestic market are less optimistic and, at present, individual household reception and processing of HDTV seems highly speculative in light of technical requirements.

A decision to adopt a regionally distributed system architecture, we feel, will serve not only the alternate user well, but also the video broadcasters. This means that each region of Canada will be capable of generating its own software to cater to some of the special needs that it has of a cultural, linguistic or occupational nature. National interests will be served by either on-board switches or by hardwired channels responding in all beams to only one uplink.

8.4 UNRESOLVED ISSUES

Throughout the course of this study we encountered a number of possible obstacles which may affect the feasibility of individual service offerings or may be critical to the entire DBS issue. In many cases, these problems were identified in the relevant subsections, so that the following discussion serves to cover some general issues.

8.4.1 VBI OWNERSHIP

Current operational teletext services use parent television signals as carriers of the data signals in the vertical blanking interval. While there are no problems in the present scenario in which broadcasters transmit directly to households, the question of VBI ownership may arise when the video signal is delivered via a distribution network such as the DBS or even a cable system. If the VBI of a given signal is not used, should the distributor be allowed to use it for a subsidiary purpose or does it remain under control of the original broadcaster? If signal modification is allowed, then there has to be some form of payment system devised to compensate the broadcaster for the use of the VBI to avoid possible legal problems.

8.4.2 THE CONCEPT OF FACILILTY OR SERVICE

A major difference between the United States and Canada is the competitive nature of the communications market. The United States ascribes to the facility concept where a user leases a satellite transponder from RCA Americom, for instance, and essentially does what he pleases with it. If this user cannot utilize the full bandwidth or the full daily period, he may offer to sublease part of the transponder for any time period agreed upon by the prime lessee and the alternate user.

The Canadian communications industry practices the service concept in which the common carriers provide satellite services to users and regulate access to the transponders. For example, a contract with TCTS for transmission of a video signal and its accompanying audio signal excludes, by implication, the presence of an additional subcarrier without the knowledge of the service provider and the ensuing amendment of the orignal contract, if approved.

Although regulations in a direct broadcast satellite system should specify minimum standards, we feel that the trade-off between capacity and quality of services offered should be a decision for the service provider. Defining who the service provider will be in the direct broadcast satellite system and whether the service provider is also the content provider remains to be resolved.

8.4.3 DBS OPERATION

Further research is required to resolve both institutional and jurisdictional issues facing the introduction of DBS commercial operations. While the repeal of current regulations may not be desirable insofar as the established communications industry, regulatory changes are needed to rectify current inconsistencies and possibly create a set of guidelines to correspond more closely to the unique nature of a direct broadcast satellite system.

The day-to-day operations of DBS system have to be defined from the operator's point of view. Prior to performing this task, some thought must be given to who the administrator/operator will be.

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