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DIRECT BROADCAST SATELLITE - RADIO MARKET, LEGAL, REGULATORY, AND BUSINESS CONSIDERATIONS

SUMMARY

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NASA PROJECT
MANAGERS

Mr. James E. Hollansworth
Ms. Ann O. Heyward

VOA PROJECT MANAGER
Dr. H. Donald Messer

PREPARED BY

CONTEL FEDERAL SYSTEMS
GOVERNMENT NETWORKS GROUP
15000 Conference Center Drive
Chantilly, Virginia 22021

Dr. Des R. Sood

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PREFACE

This document was prepared by Contel Federal Systems and its subcontractors for the NASA Lewis Research Center under Task Order 5 of the Contract NAS3-25083. Under this contract, Contel Federal Systems provides technical support to NASA for the assessment of the future markets for Satellite Communications Services. Task Order 5, the results of which are reported in this and two companion volumes, addressed the marketing, organizational, legal and regulatory considerations underlying the launch and operation of a Direct Broadcast Satellite-Radio System.

The views expressed in this document are those of the authors and not of their organizations, or of NASA or VOA.

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SECTION 1

EXECUTIVE SUMMARY

A Direct Broadcast Satellite - Radio (DBS-R) System offers the prospect of delivering high quality audio broadcasts to large audiences at costs lower than or comparable to those incurred using the current means of broadcasting, i.e., amplitude modulation (AM) at long wave, medium wave (MW) and shortwave (SW) frequencies, and frequency modulation (FM) at very high frequencies (VHF). The DBS-R concept is not new; it has been advocated in various forms for the last 25 years. However, the maturation of mobile communications technologies, and advances in microelectronics and digital signal processing now make it possible to bring this technology to the marketplace. Heightened consumer interest in improved audio quality coupled with the technological and economic feasibility of meeting this demand via DBS-R make it opportune to start planning for implementation of DBS-R Systems.

The National Aeronautics and Space Administration (NASA) Lewis Research Center, as part of their Advanced Communications Program, and the Voice of America (VOA), as part of their on-going efforts to improve the quality of international audio broadcasts, have undertaken a number of tasks to more clearly define the technical, marketing, organizational, legal and regulatory issues underlying implementation of DBS-R Systems. This report documents the results of a marketing, legal, and regulatory study, and presents an assessment of the business considerations underlying the construction, launch and operation of DBS-R Systems.

1.1 Study Overview

The DBS-R market study assessed consumer demand for improved audio services, and developed a comparative analysis of costs of delivering audio broadcasts via shortwave systems and a DBS-R system. The effort was focused on analysis and assessment of the following major areas:

- Consumer demand for improved audio services.
- Audience measurement techniques and their reliability.

- Audio advertising market and its relation to audience size and segmentation.
- Cost of delivering programming via short wave facilities.
- Practical approach to bringing the DBS-R technology to the marketplace.
- Cost of delivering programming via DBS-R facilities.

The DBS-R legal and regulatory study examined and assessed legal, regulatory, and organizational issues underlying the establishment and operation of DBS-R systems. The effort was focused on analysis and assessment of the following major areas:

- Legal and regulatory issues underlying the establishment of domestic and/or non-US DBS-R systems.
- Access to DBS-R channels.
- Structural alternatives for establishing DBS-R services.

Major findings of these studies are summarized below.

1.2 Major Findings

1. Consumer Demand Trend is Towards Improved Quality Audio Products and Services

   The explosive growth of the consumer electronics market has had a profound effect on cultivating listeners' preference for media that deliver higher audio quality. This is evidenced by the rapid growth in the sale of compact discs (CDs), and concomitant decline in the sale of long playing (LP) records, as well as in migration of radio audiences from AM to FM stations. This trend has also been fueled by the positive feedback between consumers and industry. The industry has dramatically improved the quality of consumer electronics products, and at the same time reduced prices by sharing the benefits of economies of scale with the consumer. The consumers' enthusiastic response had,and continues to have, positive impact on this spiral.

Internationally, the population of radio receivers is increasing. This is particularly true in the developing countries where mass production has resulted in the receiver prices dipping to tens of dollars. However, television (TV) is encroaching on the erstwhile devoted radio audiences. In South America, international broadcasters are losing audience share to emerging domestic FM stations because of the much better audio quality delivered by FM stations vis-a-vis short wave stations. In Eastern Europe, the situation is very fluid in the wake of recent tumultuous political events. However, it is apparent that audiences which regularly listened to international broadcasters for objective views may no longer feel compelled to put up with the poor quality and reliability of the short wave broadcasts.

The consumers all over the world have become habituated to listening to better quality audio products and this trend is irreversible. Radio broadcasters, domestic and international, run the risk of losing their audiences unless the broadcast quality improves to the extent that it is at par with, at least, static-free AM for international and informational broadcasts and FM for music and other cultural broadcasts.

2. <u>DBS-R Systems are Technologically Feasible</u>

A DBS-R System implementation requires coordinated development of space segment, ground segment, and DBS-R receivers. These elements have been proven in applications such as mobile communications which are technically similar to the DBS-R service. The challenge is to meld the available technologies into a DBS-R system, which is viable from the business perspective.

The DBS-R space segment will be comprised of a number of spacecraft providing regional and global coverage over the populated land masses. The technical design of the DBS-R spacecraft will be primarily determined by the capacity requirement, i.e., number of channels per spacecraft, and secondarily, by the spectral band allocated to the DBS-R service. The spacecraft antenna size and power requirements are directly affected by the spectral region. The antenna size decreases and the power requirement increases as the frequency increases. At this time, it appears that spectrum allocation for DBS-R service may be near 1,500 MHz. System concepts advocated to date envisage individual spacecraft capacity as low as 10 channels and as high as 100 channels. A channel for this purpose is defined as one capable of delivering audio quality comparable to AM. In actual practice, a channelization scheme delivering audio quality ranging from AM to CD quality would be more desirable and would offer more choices to listeners.

The lower capacity spacecraft, though more expensive in terms of unit channel cost, is attractive from a business perspective. It not only requires, relatively speaking, lower upfront capital investment, but also a much shorter gestation period permitting the assets to be placed into revenue-generating service in a period of approximately 18 months which is less than half that of a medium or high capacity spacecraft. The cost issue is further addressed under Finding No. 4.

The DBS-R spacecraft will essentially utilize the same technology as already implemented in the International Martime Sateliite (INMARSAT) Organization's spacecraft. Therefore, the development costs and the associated technical risks are minimal.

The DBS-R ground segment is comprised of technical facilities to: (i) monitor and control the spacecraft, (ii) uplink broadcast signals to the spacecraft, and (iii) a terrestrial or satellite-based DBS-R network to convey the programming material from origination centers to uplink facilities. The ground segment will also have administrative and business components to handle the customary business operation functions.

Implementation of the DBS-R ground segment will benefit from many years of operational experience accumulated by operators of satellite communications systems. Because of the specialized nature of the satellite monitor and control function, a business decision may have to be made to lease this service from an established operator rather than to build and staff a dedicated facility. The satellite monitor and control center could also serve as an uplink center. The location of other uplink centers, and design of the DBS-R distribution network, will depend upon the geographical dispersion of origination centers and customers' facilities.

The DBS-R receiver segment presents a challenge. The DBS-R receiver must be capable of receiving satellite signals inside buildings (fixed receivers), in moving vehicles (mobile receivers), and while being carried by a person from one location to another (portable receivers). The DBS-R signal strength must be adequate to overcome attenuation due to buildings, trees and other topological features. The mobile receivers are particularly subject to signal degradation due to transient loss of direct satellite visibility while passing through tunnels, urban canyons formed by tall buildings, or thick vegetation in rural settings. A system-level tradeoff between the satellite power output and the receiver sensitivity will permit system designers to specify receiver technical requirements so as to ensure that audio quality does not degrade even under adverse conditions.

Fortuitously, the receiver technology now being developed for the cellular receivers and the advances in digital signal processing technology hold the promise that DBS-R receivers can be built at a reasonable cost, in the range of $100 to $300 per unit, to meet the needs of the fixed, mobile, and portable receiver markets. Developments in Japan and Europe, particularly in Europe where the digital receiver technology has been demonstrated in field trials, are extremely encouraging. Recently, Stanford Telecom and CD Radio announced the development of an innovative frequency-hopping technique to cope with the signal fade problem, and predicted that the receiver price to consumers will be less than $200 per unit by mid-1990s. The DBS-R receiver technology will also benefit from the personal communication (PC) receiver technology whose goal is to provide ubiquitous access to users to public switched networks (PSNs) on a global scale. In short, the DBS-R receiver technology building blocks are proven, rapidly progressing, and waiting to be integrated into a mass market consumer product.

3. Inherent Limitations of Current Terrestrial Broadcast Systems Preclude Audio Quality Enhancements

The shortwave broadcasters have traditionally relied on increasing transmitter power and simultaneously transmitting the same programming material on three or more frequencies to ensure signal reception reliability. The reliability is marginally improved, though at a great cost. But the goal of improving audio quality and eliminating the annoying shortwave cackle remains elusive. The local AM broadcasters are now mainly limited to news and talk show formats. The FM broadcast quality, though far superior to the local AM broadcast quality, has no room for enhancement.

4. DBS-R System Can Deliver Programming More Cost Effectively Than Shortwave Systems

The DBS-R and shortwave systems are comparable because both cover large regions, generally 100,000 to 200,000 square miles in area. The wide area coverage needs are better addressed by satellites. However, this is not a limitation on satellite technology. By using spot beams, the DBS-R coverage on a single beam could be restricted to a country of the size of France (roughly 200,000 square miles). For the purpose of cost comparison, we have assumed three degree beams providing geographical coverage comparable to some of the largest targeted shortwave systems. It may be instructive to note parenthetically that four 3-degree beams can cover the entire Continental United States excluding Alaska and Hawaii.

The major cost elements that contribute to the day-to-day operations cost of distributing programming material over shortwave facilities are: power, labor, equipment and building maintenance, and building and land lease. The costs vary a great deal from one region to the other because of variations in the cost of power and labor. Table 1-1 shows the cost spectrum. Note that the international broadcasters typically broadcast the same programming material on three different frequencies. Therefore, the cost per program hour is three times the cost per transmitter hour.

It should be noted that the shortwave facilities operations cost shown in Table 1-1 do not reflect the depreciation expense, and cost of money because the capital expenditures for the shortwave facilities are usually written off.

The comparable operations costs for DBS-R Systems with capacities of 15, 45 and 105 AM-quality channels are shown in Table 1-2. Each system is configured to provide 15 three-degree beams and can cover an area as large as the continent of

Table 1-1
Shortwave Facilities Operations Costs

Facility Type	Cost/ Transmitter Hr ($)	Cost/ Program Hr* ($)	Remarks
50 KW, Religious	45	45	Voluntary Labor, Limited Broadcasting Hours
500 KW, Religious	145	145	Voluntary Labor, Limited Broadcasting Hours
Radio Canada International	142	426	
Voice of America	188	564	Average over all domestic and overseas facilities
British Broadcasting Corporation	200	600	
Radio Nederland	197	591	
Niger	84	84	Domestic
Senegal	50	50	Domestic

*Major international broadcasters typically broadcast the same program material on three different frequencies. Therefore, the broadcasting cost per hour is three times the cost per transmitter hour.

Table 1-2

DBS-R System Operation Costs

	SYSTEM CAPACITY (NUMBER OF PROGRAMS OR CHANNELS)*		
	15 CHANNELS (LOW)	45 CHANNELS (MEDIUM)	105 CHANNELS (HIGH)
SPACECRAFT CHARACTERISTICS			
Beginning of Life Weight (Kg)	410	510	711
RF Power Requirement (W)	68	203	476
Solar Power Requirement (W)	478	1,085	2,300
CAPITAL COSTS			
Spacecraft and Launch Vehicle ($M)	56	70	90
Capitalized Interest ($M)	6	16	20
Launch Insurance ($M)	14	14	18
Technical Facilities ($M)	3	5	7
Startup Cost ($M)	3	5	7
Total Capital Cost ($M)	82	110	142
OPERATIONS AND MAINTENANCE (O&M) COSTS/YEAR)			
Technical Operations ($M) (Satellite Control & Uplink Centers)	2.0	3.0	5.0
On-Orbit Insurance ($M)	1.6	2.2	2.8
General & Administrative (G&A) ($M)	3.0	4.0	6.0
TOTAL O&M COST/YR ($M)	6.6	9.2	13.8
O&M Cost per Channel per hour ($) (66% duty cycle)	76	35	23

*AM quality channels (32Kbps). Note that O&M cost per channel per hour for a higher quality channel scales directly in terms of the data rate ratios. For example, FM-mono channel (48 Kbps) cost is 1.5 times that of an AM channel (32 Kbps) cost.

Africa. The 15-channel system characterized as low capacity or 'Entry System' has the capability to simultaneously broadcast a maximum of 15 programs. The program distribution could be one or more programs per beam as long as the maximum number is not exceeded. The 45-channel and 105-channel systems could be characterized as medium and high capacity, respectively, and have the capability to simultaneously broadcast multiple programs in each beam. These systems can reach large audiences - as does the low capacity system - but offer considerably more choices to listeners. The channel quality can be characterized by its data rate capacity. A DBS-R channel comparable to AM radio in quality requires 24 to 32 Kilobits per second (Kbps) data rate capability. A CD quality channel, on the other hand, requires data rate capability approaching 256 Kbps. FM-mono quality channel requires 48 Kbps and FM-stereo to the tune of 128 Kbps. The channel data rate requirements can be related to power, and, hence, to the satellite size and cost. For the purpose of cost comparison with shortwave systems, we have assumed that the DBS-R channel quality is comparable to AM (32 Kbps).

The spacecraft and launch vehicle costs used in Table 1-2 are based on data compiled by the Jet Propulsion Laboratory (JPL). The low-capacity system is more expensive on a per channel basis than a medium capacity or a high capacity system. However, it is believed that a low capacity system catering primarily to the needs of core customers such as international broadcasters with some excess capacity to allow for introduction of satellite-based domestic and regional broadcasting offers the best option from the financial/risk perspectives. The international broadcasters can mitigate the financial risk through outright purchase or long-term lease guarantees. The DBS-R operator is then in a position to obtain financing and implement a channelization scheme offering channels varying in audio quality from AM to near-CD to CD to suit the needs of informational and cultural broadcasters.

The DBS-R System operations and maintenance costs vary from $76 per channel per hour for the low capacity system to $23 per channel per hour for the high capacity system. Because of the higher quality and reliability of the DBS-R transmissions, it is not necessary to broadcast the same material on three different frequencies, as is the case with shortwave transmissions. Therefore, the

DBS-R System O&M costs on a per program hour basis are an order of magnitude less ($600 for shortwave versus $23 for DBS-R) than that for shortwave systems.

The O&M cost of a higher quality channel can be calculated by multiplying the O&M cost of an AM quality channel by a factor equal to the ratio of their data rates. For example, the O&M cost of an FM-mono channel (48 Kbps) is 1.5 times the O&M cost of an AM channel (32 Kbps). For a CD quality channel, the multiplier is 256/32 or 8. A DBS-R operator offering channels varying in quality from AM to CD can apportion costs to channels in ratio of their data rates.

Tables 1-1 and 1-2 compare the day-to-day costs and ignore the depreciation and finance costs that a private system must contend with. The shortwave facilities' useful life is on the order of 30 years compared with the DBS-R spacecraft life which is typically on the order of 10 years. The international broadcasters maintain comprehensive capital improvement programs to upgrade their facilities. For example, VOA's shortwave facilities capital improvement program for the past 10 years has entailed expenditures of roughly $50 million to $100 million per year and is anticipated to continue at the same level for the foreseeable future. Capital expenditures on this order add substantially to the real costs of delivering programming above and beyond that reflected in the day-to-day operations costs shown in Table 1-1.

Revenue requirement projections for a privately financed and operated system, where the capital expenditure is not written off and a reasonable rate of return is expected on capital employed, are shown in Table 1-3. Note that the revenue requirement on a per channel per hour basis assuming 66% utilization varies from a high of $340 for the low capacity system to a low of $89 for the high capacity system. The economies offered by the DBS-R System are dramatic even after all costs, i.e., O&M, depreciation, finance charges, and profit are accounted for. The low capacity system is attractive because it provides a quick entry into a new market with low capital requirement and in a time frame on the order of 18 months. The high capacity system, though it requires more capital and a gestation period on the order of 36 months, is very attractive because of increased flexibility and very favorable revenue requirements. The business decision as to whether to proceed with the low or high capacity system depends upon an entrepreneurial assessment of the risk, market potential, and the business environment.

TABLE 1-3

DBS-R SYSTEM REVENUE REQUIREMENT FOR A PRIVATE SYSTEM

	SYSTEM CAPACITY (NUMBER OF PROGRAMS OR CHANNELS)*		
	15 CHANNELS (LOW)	45 CHANNELS (MEDIUM)	105 CHANNELS (HIGH)
DEPRECIATION COSTS/YEAR			
Space Segment (10 yrs life) ($M)	7.9	10.5	13.5
Technical Facilities (20 yrs life) ($M)	0.15	0.25	0.35
OTHER COSTS/YEAR			
Cost of Money (15% per yr; average) ($M)	6.6	8.8	11.4
Return on Capital Employed (18%; average) ($M)	8.2	11.0	14.2
REVENUE REQUIREMENT PER CHANNEL PER HOUR ($) (66% duty cycle)			
Depreciation Cost per Channel per hour ($)	93	41	23
Other Costs per Channel per hour ($)	171	75	43
O&M Cost per Channel per hour ($) (From Table 1-2)	76	35	23
TOTAL ($)	340	151	89

*AM quality channels (32 Kbps). The revenue requirement for a higher quality channel scales directly in the ratio of data rates. See footnote to Table 1-2.

Revenue requirement for a higher quality channel scales directly in the ratio of data rates. For example, revenue requirement for an FM-mono channel (48 Kbps) is 1.5 times the revenue requirement for an AM channel (32 Kbps). For a CD quality channel, the revenue requirement is 256/32 or 8 times that of an AM channel.

It should be noted that, as previously stated, the shortwave facilities operations costs do not include allowances for depreciation, cost of money, or profit. Since most of the shortwave facilities are owned and operated by either Government or not-for-profit private entities, this practice is not questioned. For a privately-financed and owned system, operated on commercial basis, these expenditures account for a majority of the annual operating expenses (70% in Table 1-2). Therefore, the real costs for distributing programming over shortwave facilities are much higher than shown in Table 1-1.

5. DBS-R System Implementation and Operation Faces Difficult But Resolvable Legal and Regulatory Impediments

The DBS-R service is unique in that it must grapple with bilateral and multilateral issues pertaining to cross border broadcasts, copyright laws, and equitable access to DBS-R channels. The service could be offered under the auspices of established international satellite operators such as INMARSAT or INTELSAT to seek expedited resolution of these issues. However, under this option, DBS-R service will neither have the priority nor the focused organizational support that such an innovative service will require to be successful. It is believed that privately financed and operated systems, subscribing to common technical guidelines established by an international organization, offer the best prospect for bringing DBS-R service to the marketplace. The term 'private' here also refers to organizations such as the European Telecommunications Satellite Organization (EUTELSAT) and Arab Satellite Consortium (ARABSAT) who might be best situated to operate regional systems.

In the United States, the Federal Communications Commission (FCC) might mandate a consortium type of structure, in the event there are several applicants vying for a license to operate the service. The FCC may also require the operator to be a common carrier with access to the DBS-R channel regulated on a common carrier basis. The broadcasters who buy or lease channels will be responsible for the content of the programming material and will be regulated as broadcasters.

Several legal issues remain unresolved. For example, will an international broadcaster, leasing capacity on a US DBS-R system, be subject to FCC regulations? Could bilateral or multilateral arrangements be made to address this issue on the basis of reciprocity? Does the US Government have an obligation to ensure that third world countries are not deprived of access to US DBS-R channels because of predatory pricing? Forums such as the International Telecommunications Union (ITU), and the United Nations Organization (UNO) might be ideal to debate and resolve these issues.

6. <u>Staged Implementation, with Capacity Matched to Demand, Offers a Sound Business Approach to the Introduction of DBS-R Service</u>

Satellite systems are capital-intensive, and require upfront investment over a period of 3 to 4 years before the spacecraft is ready for operational service. The DBS-R service has an added challenge of stimulating production and sale of DBS-R receivers to entice broadcasters and advertisers to try this new medium. From a business perspective, it is critical that the upfront lead time and investment be minimized, and an approach developed to stimulate commercial production of DBS-R receivers.

The upfront lead time and capital investment can be minimized by starting with an entry system whose capacity is no more than 15 channels. In terms of spacecraft weight and power requirement, this spacecraft would be characterized as a 'Lightsat'. Lightsat shortens the implementation lead time and reduces capital requirement by integrating spacecraft and launch vehicle into a single package. The entry system would be built around the requirements of core customers such as international broadcasters to provide a solid foundation for the business. This will also help secure financing for the project.

To stimulate commercial production of DBS-R receivers, a 'seed' order in quantities of 100,000 or so may have to be placed with three or four major manufacturers of radio receivers. The introductory DBS-R receivers might be multi-band type offering AM, FM, terrestrial digital, and satellite digital bands. These receivers might also find favor with automobile manufacturers for inclusion in the medium and higher-priced models. The seed order receivers could be distributed free or at cost to community organizations where the public would be exposed to them and experience the difference in sound quality.

1.3 Conclusions and Recommendations

The DBS-R service is poised to redefine and revitalize the terrestrial-based radio broadcast industry by offering consumers not only improved audio quality but also more choice and highly specialized formats. However, translation of the DBS-R concept into an operational reality requires progress on several fronts, namely regulatory, spectrum management, and technical standards. The time is ripe for the Government, the equipment manufacturers, and the radio broadcast industry to mount a cooperative thrust to resolve underlying regulatory and technical issues. The following recommendations are made to NASA and VOA to facilitate and expedite this process.

- Participate in, and contribute to the US preparations for the World Administrative Radio Conference - 1992 (WARC-92). Influence and establish US position on the spectrum allocation for the DBS-R service.

- Publicize the DBS-R technical and operational concept to private industry to stimulate interest, and to other countries to foster cooperation in establishing regional systems.

- Continue current concept development efforts to more clearly delineate system level trade-offs that have to be made between spacecraft and receiver technical capabilities to optimize the system and to standardize the interfaces.

- Keep abreast of the European and Pacific basin developments, particularly in the area of digital signal processing and its potential impact on receiver interface standards.

- Undertake an experimentation program to measure propagation characteristics in the 1.0 GHz to 2.5 GHz spectral bands under realistic conditions such as moving vehicles, inside buildings and tunnels, and under thick vegetation cover. This data will enable system designers to set margin requirements.

- Explore the possibility of stimulating the launch of a privately-funded DBS-R satellite. This approach will permit equipment manufacturers (spacecraft and receivers) to participate in developing standards. It will also enable broadcasters to obtain a more realistic market assessment of the DBS-R service business potential.

1.4 Document Overview

Major findings in the areas identified under the Study Overview are summarized in the remainder of this document. A brief synopsis is presented here.

An assessment of consumer demand for improved audio quality, as evidenced by migration from AM to FM and the switch from LPs to CDs, is presented in Section 2. It is noted that this is a worldwide trend, and that consumer tolerance for poor sound quality is rapidly diminishing as TV and other better audio quality options are profilerating.

The factors that contribute to the cost of delivering programming material via shortwave facilities are presented in Section 3. The costs vary a great deal from one region of the world to other and from broadcaster to broadcaster. However, the day-to-day cost to international broadcasters such as VOA for distributing one hour of programming material is on the order of $600.

The potential of using a DBS-R system to offer advertisement-based broadcasts depends upon the size of the current audio advertising market, and growth projections over the next decade. An assessment of the audio advertising market and per capita expenditure in different parts of the world are presented in Section 4. DBS-R, because of its wider area coverage as compared with terrestrial-based broadcasting systems, holds the prospect of reducing operating costs by fostering growth of 'super stations', and increasing revenues by delivering larger, targeted, audiences to advertisers.

The establishment and operation of DBS-R services are contingent upon resolving regulatory and legal issues to the satisfaction of regulatory bodies such as the FCC in the United States. We believe that a private system operated on a common carrier basis might find favor with the FCC. Internationally, bilateral and multilateral arrangements may have to be negotiated to operate regional systems. The legal, regulatory, and organizational issues are presented in Section 5.

The business considerations underlying launch and operation of DBS-R technical facilities are addressed in Section 6. It is recognized that a rate of return commensurate with the risk must be assured before seeking investment for this venture. It is suggested that an 'Entry System' catering to the needs of established broadcasters, such as international broadcasters, with some excess capacity to permit introduction of private super stations, offers the best prospects for minimizing upfront capital outlays and assuring a steady revenue stream.

The acronyms and abbreviations used in this document are spelled out when first used. A list of acronyms and abbreviations is included in Appendix A.

SECTION 2

DEMAND FOR IMPROVED AUDIO SERVICES

Audio quality has become an important factor in consumers' preference for a radio service. Numerous surveys conducted by, among others, international broadcasters have established that poor sound quality is one of the major reasons for audience migration from a given radio service. Data presented in this Section quantifies this trend, and assesses the impact of competing media such as television (TV) and print on the radio audiences.

2.1 Consumer Attitude Towards Sound Quality

With the advent of higher fidelity systems including FM, stereos, cassette players, compact discs, and digital audio tapes (DAT), domestic and global trends are unequivocal in that individuals are prepared to make higher investments to enjoy better sound quality and, conversely, are growing intolerant to poor sound quality. This growing intolerance for poor reception affects most radio formats excepting news. This exception is most pronounced in the regions of the world where the veracity of the local news has been rendered questionable or a crisis has arisen.

The correlation between audience size and crises was made evident in surveys conducted by the British Broadcasting Corporation (BBC) and other broadcasters in 1987, 1988 and just before the Tiananmen Square events. Even though the survey was incomplete as a consequence of the events, the partial evidence was conclusive with regards to the increase in both VOA and BBC audiences as a result of the activities surrounding Tiananmen Square. Another less reliable indication of this phenomenon is the rate at which listeners send letters to broadcasters during times of regional crises and increased political repressions. Despite excessive jamming of VOA and BBC broadcasts in the USSR before "Perestroika", the audience level and listener endurance for these broadcasts were always very high. The point is that audiences may tolerate poor sound qualitv during periods of political crises or in the regions of the world where information flow is very strictly controlled. However, this is hardly conducive to cultivating sustained audiences on a regular basis on a wider scale.

To guarantee against audience migration, international broadcasters limited to the shortwave medium are looking for ways and means to improve the sound quality of their broadcasts. These improvements are necessary if they are to go beyond crises dependence to maintain the level of their audience and, more importantly, to maintain their share of regular audiences in times of relative tranquility.

2.2 Experience with FM Radio, Compact Discs and Other Technologies

Ongoing research by BBC, VOA, Radio France International (RFI) and others indicates that consumer demand for improved audio service has particularly been influenced by the newer technologies such as FM radio and CD players. These technologies have reduced the amount of time listeners spend tuned to shortwave, even if the actual number reached may have stayed at the same level. Broadcasters who rely on shortwave radio for international broadcasts to such targets as Western Europe, South or North America do not attract many listeners anymore. The main reason for the decline in listenership has been attributed to the dominance of FM and mediumwave transmission capabilities in these parts of the world. The data in tables 2-1 and 2-2 lists the regular audiences for international radio in select African and South American countries. With the growing implementation of FM transmitters in South America, the international broadcasters' audience share has fallen drastically.

Another example of the impact of FM on the audience for shortwave broadcasting can be seen on the continent of Africa. Shortwave is the main means of transmission for international and domestic broadcasts throughout the continent; consequently, Africa is where the audience share for shortwave is expected to be very large. However, at both extremes of the Continent, in Egypt and South Africa, the dominance of FM and mediumwave transmissions has considerably lowered the use of shortwave radio. This same fact was confirmed during a meeting we conducted with broadcasters from Senegal, Tanzania, and Swaziland.

TABLE 2-1
Regular Audiences for International Radio In Selected African Countries Among Adults (all figures in percentages)
Source: Graham Mytton and Carol Forrester
1988

Country, date of survey & language of listening	Africa No. 1	RFI	VOA	BBC	Deutche Welle	Radio Moscow	Radio S. Africa	Other Significant Broadcasters
Cameroon, six towns, 1986, French	59.2	27.9	11.7	3.7	2.4	1.5	n.a.	-
Ethiopia, Addis Ababa, 1987, English	n.a.	n.a.	2.3	5.4	0.5	1.5 (Amharic)	n.a.	-
Gabon, all urban areas, 1984, French	82.0	15.0	6.0	3.0	n.a.	n.a.	n.a.	-
Ghana, Accra English-speaking adults, 1985, English	(21.2) French	n.a.	33.2	40.0	2.8	2.0	3.4	7.3 (ELWA)
Kenya, Nationwide, 1983 Swahili	n.b.	n.b.	1.9	3.8	18.6	1.8	3.1	26.8 (Radio Tanzania)
Mauritania, Nouakchott, 1986 French and/or Arabic	21.3	30.7	27.8	5.3	1.1	5	n..a.	44.5 (Radio Seneg 1.4 (ELWA)
Nigeria, Nationwide, 1983								
English	n.a.	1.1	6.0	7.7	1.4	1.0.3	1.5	1.9 (ELWA)al)
Hausa	n.b.	n.b.	5.4	12.94	5.56	2.4	n.b	
Senegal, Dakar, 1987, French	17.5	39.1	16.2	6.1	4.8	5.4	n.a.	2.4 (Radio Canada)
Sierra, Leone, Freetown, 1985, English	15.2	n.a.	20.2	37.2	2.3	3.0	n.a.	21.6 (Liberia) 15.7 (ELWA)
Zaire, four towns, 1984 French	29.1	27.3	16.1	5.8	10.6	4.7	20.1	26.9 (Radio Brazzaville) 7.6 (Radio Angola)
Zambia, Urbah areas, 1986, English	n.a.	n.a.	4.7	11.3	1.2	0.0	11.5	5.7 (Zimbabwe B.C.) 2.0 (Malawi B.C.)

n.a. = Not asked, n b. - no broadcast

TABLE 2-2

Regular Audiences for International Radio In Selected South American Countries Among Adults (all figures in percentages)

Source: Graham Mytton and Carol Forrester

1988

Country, and language of listening	BBC	VOA	Radio Netherlands	Radio Moscow	Deutche Welle	HCJB	Radio Havana	Radio Canada International	Radio Exterior Espana	Radio France Internationa
Argentina, Spanish	1.2	0.7	0.6	0.5	0.4	0.3	0.3	0.1	0.3	0.1
Brazil, Portuguese	0.8	0.8	0.1	0.4	0.2	n.a.	0.1	0.4	n.a.	0.1
Chile, Spanish	3.7	2.5	0.5	1.7	0.8	0.3	0.4	0.2	0.4	n.a.
Columbia, Spanish	1.1	1.7	0.3	0.4	0.4	0.2	n.a.	0.1	0.6	0.3
Guatemala, Spanish	0.8	2.2	0.4	1.1	0.3	1.0	1.9	0.8	0.5	0.1
Peru, Spanish	4.2	2.7	0.8	1.8	1.6	7.0	2.7	0.9	1.4	0.4
El Salvador, Spanish	2.8	10.0	0.7	0.6	0.1	0.9	1.3	0.7	1.1	0.2
Venezuela, Spanish	0.5	0.5	0.3	0.1	0.0	0.2	0.2	0.0	0.1	0.0

n.a. = Not asked; n.b. - no broadcast

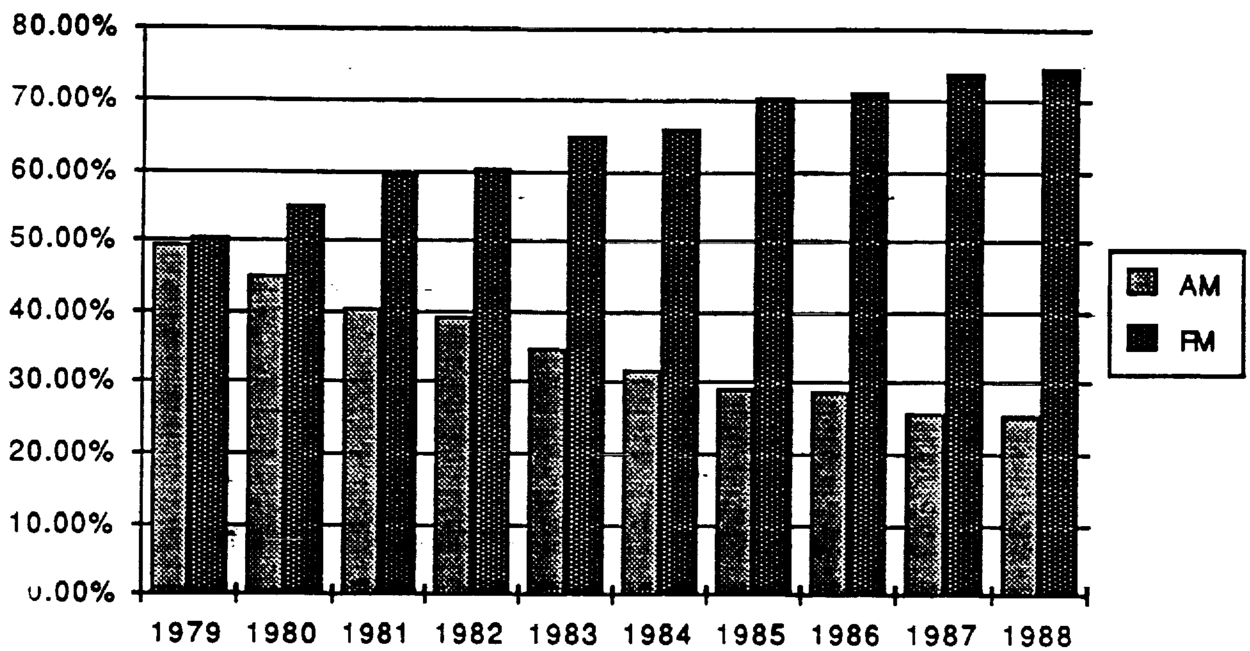
The representative from Senegal told us that surveys conducted by his government and international broadcasters, such as RFI, have found that the largest audiences in French is achieved by the commercial Africa Number One station. This is because Africa Number One has a powerful 500 KW transmitter transmitting to particularly Francophile Africa from Gabon. The signal is much clearer and, as a result, Africa Number One has remained one of the most popular stations in the region.

Another example was furnished by the representative from Swaziland. The Government and commercial stations there are in the process of converting to FM and mediumwave stations to keep up with demand for better sound quality and to increase their audience share.

More precise surveys conducted in the United States have shown that the AM radio audience share has progressively declined as a result of the introduction of FM radio. The following chart (Figure 2-1) compares the relative AM and FM audience shares in the last 16 years. The steady decline in the AM share, and concomitant rise in the FM listenership, offers vivid testimony to the listeners' preference for better audio quality.

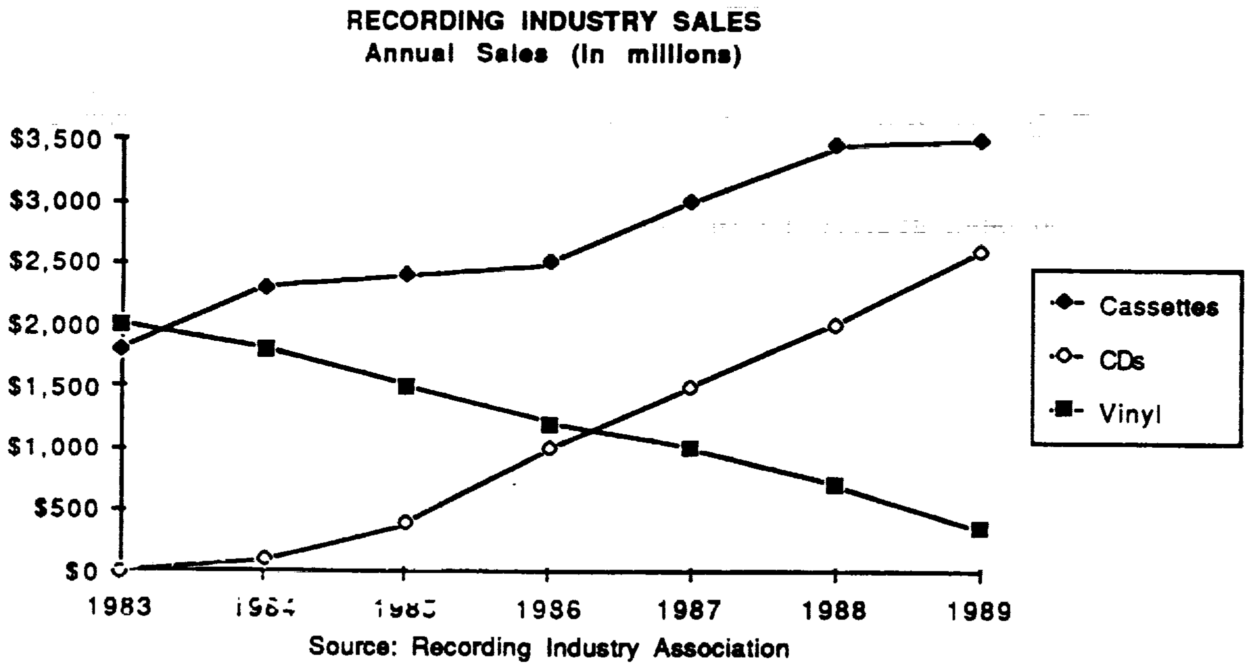
Today, in some parts of the U.S., consumers are paying a service fee to cable operators for better quality digital sound. Preference for higher quality sound has also been spurred by the advent of compact discs which has also increased audience awareness to the benefits of high quality sound. Figure 2-2 compares the sales of cassette tapes and vinyl records with that of compact discs during the period 1983 to 1989. The data is clear with regard to the continued growth of CD

Figure 2-1
AM and FM Audience Share in the United States



Source: R&R Magazine

Figure 2-2
Comparative Sales of Cassettes, CDs and Records
in the United States



sales demonstrating both the consumer preference and demand for better quality sound.

Other technologies that have adversely affected radio listening time are television and video. Figures 2-3 through 2-5 summarize the loss of audiences to television in Bangladesh, Brazil and Uruguay. In most cases, besides the visual component of television and video, the poor sound quality of the existing radio transmission services have also been given as reasons for audience migration.

2.3 Consumer demand for better sound quality under different radio formats

Interviews conducted with various broadcasters and radio audience-preference researchers have indicated that the demand for better sound quality is more pronounced with certain radio formats that with others. Generally, as would be

Figure 2-3

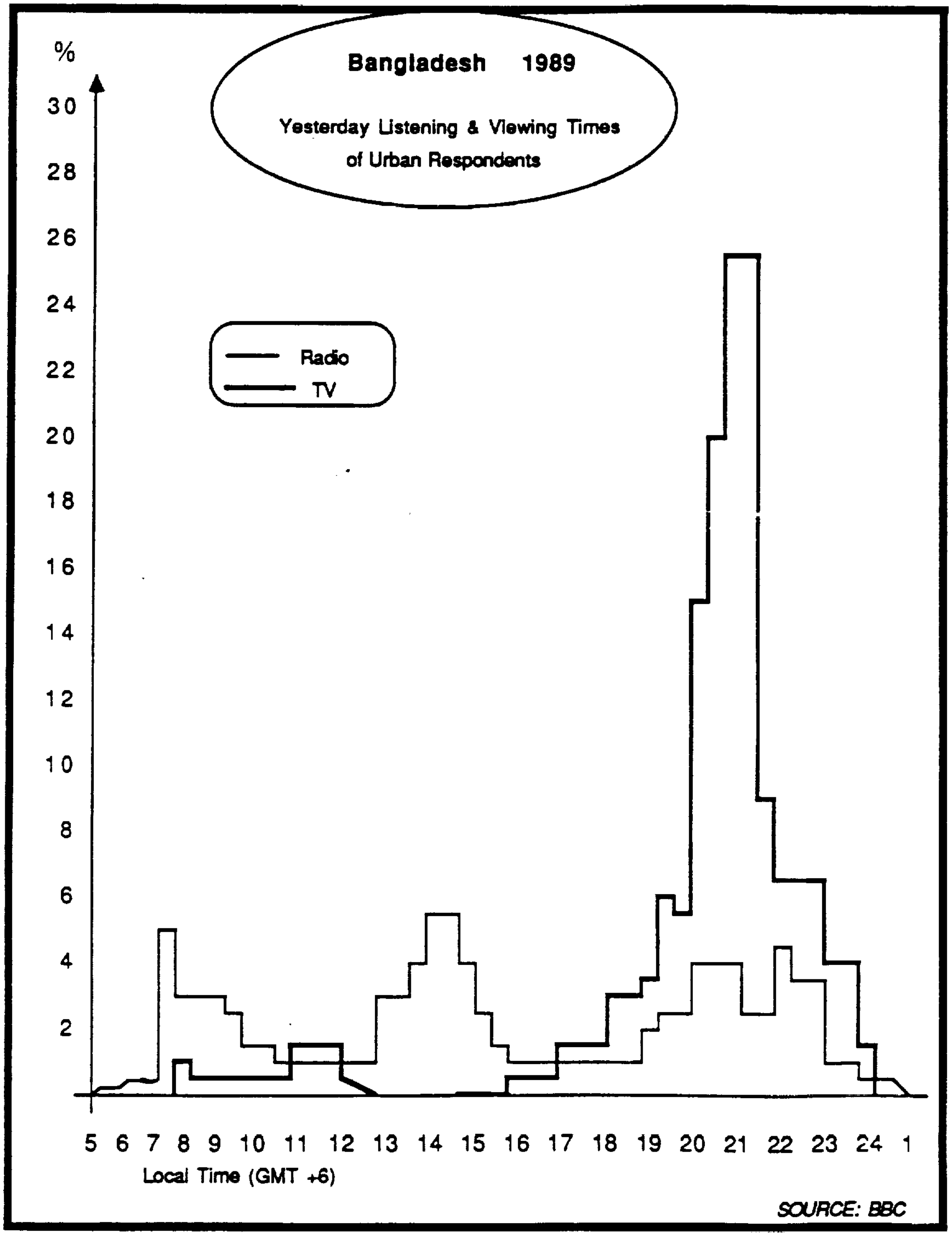
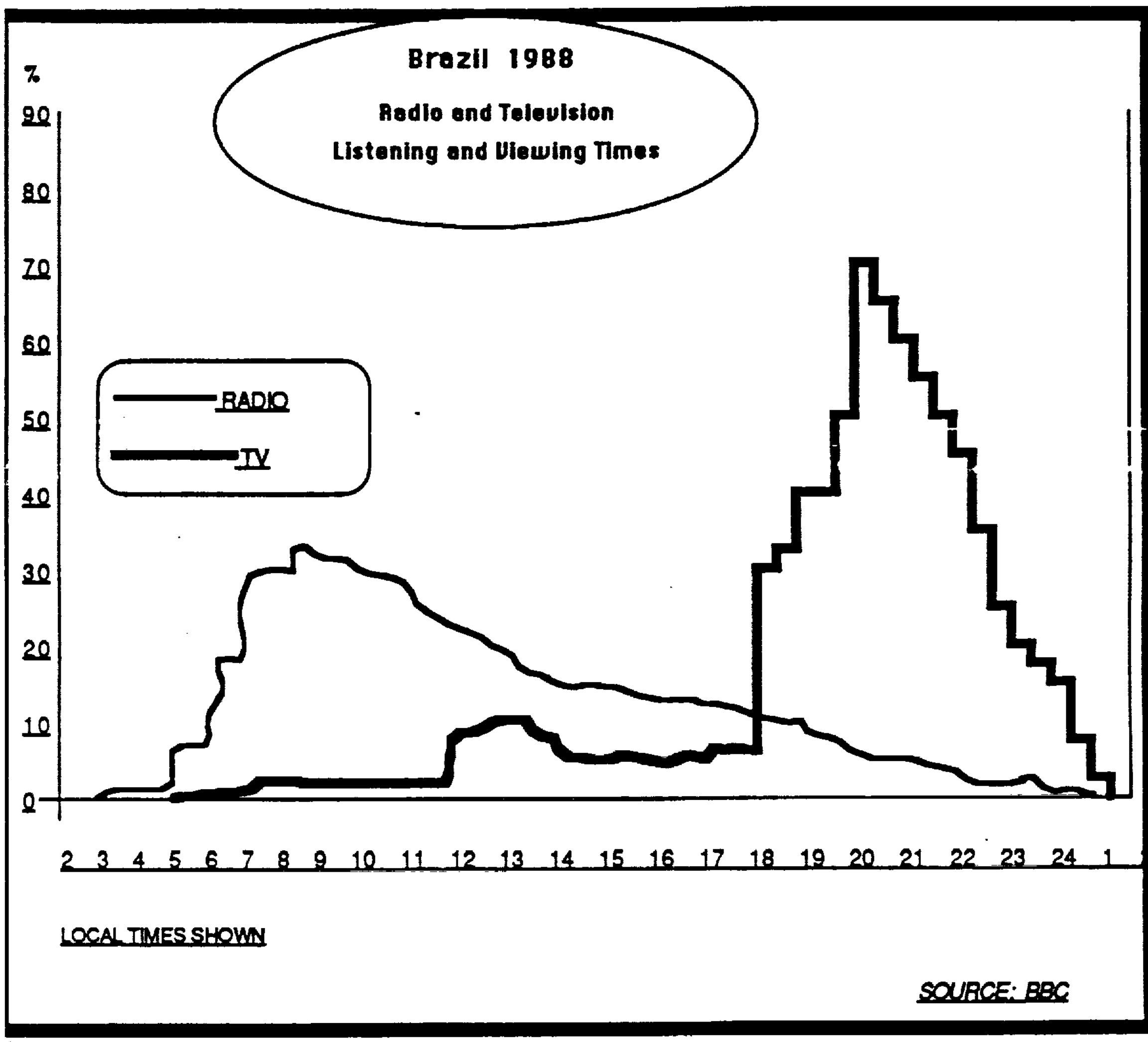
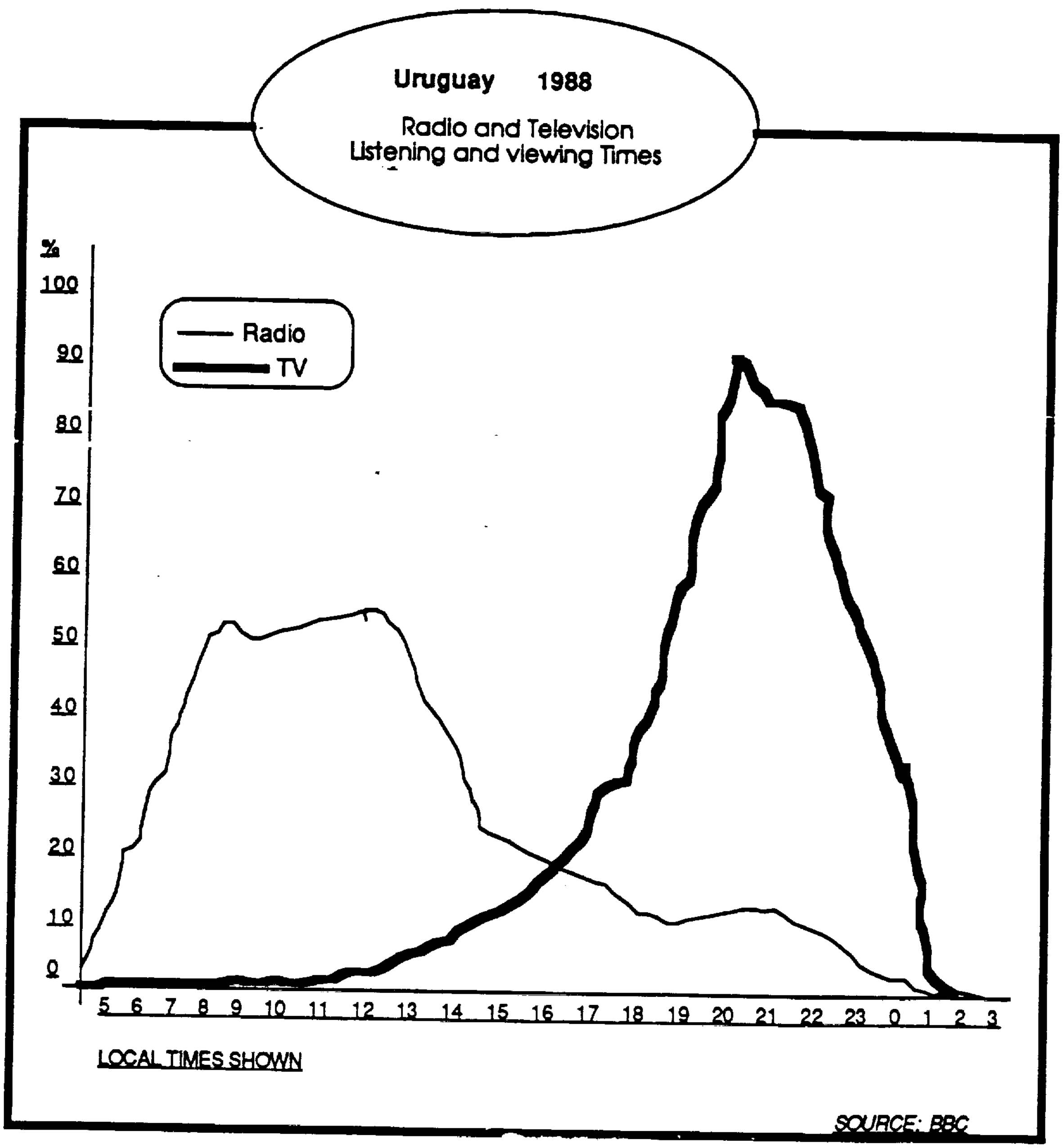

Bangladesh 1989
Yesterday Listening & Viewing Times of Urban Respondents
%
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
Radio
TV
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 1
Local Time (GMT +6)
SOURCE: BBC

Figure 2-4



Brazil 1988
Radio and Television
Listening and Viewing Times
%
90
80
70
60
50
40
30
20
10
0
RADIO
TV
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 1
LOCAL TIMES SHOWN
SOURCE: BBC

Figure 2-5



Uruguay 1988
Radio and Television
Listening and viewing Times
%
100
90
80
70
60
50
40
30
20
10
0
Radio
TV
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3
LOCAL TIMES SHOWN
SOURCE: BBC

expected, it has been determined that the demand for better sound quality is less acute for all-news, talk and sports radio formats. Indeed, a good majority of the domestic and international audience for AM and shortwave is often focused on news, sports and talk radio formats.

Music radio formats have shown an increasing demand for higher audio sound quality. Examples include pop music, rock, jazz, instrumental, easy listening and other variety formats.

The classification or definition of the various radio formats changes with the evolution of the broadcast industry. Table 2-3 shows the US radio station population by format.

2.4 Price sensitivity to new consumer audio products

A reasonable basis for the penetration analysis of new audio products, in general, and the Direct Broadcast Satellite receivers, in particular, is the historical development of the radio and television receiver markets.

Since 1955, the sale of radios continued to climb in tandem with the world's population in the Third World but has outstripped population growth in both the Developed and the erstwhile Communist World. The same trend is evident in the TV sales around the world since its commercial introduction in 1960.

Figures 2-6 through 2-9, demonstrate the trend in both TV and radio sales worldwide. In each case, the sales are plotted against population growth. In the Developed World, sales in Radio and TV have continued to rise both dramatically and faster than the population growth (See Figures 2-6 and 2-7).

Note that the same trend in the more industrialized countries was also evident in the erstwhile Communist Bloc even though the disposable income in the latter group was significantly lower than the countries in Western Europe, North America and some countries in Asia. For both radio and TV, growth in ownership has continued to rise ahead of population all the way through 1990.

Table 2-3

US Radio Station Population by Format

Format	Commercial	Non-Commercial
Adult Contemporary	2,104	16
Adult Standards	361	1
Album Progressive	39	225
Album Rock	255	11
Classic Rock	88	1
Contemporary Hits	892	71
Country	2,451	7
Easy Listening	294	7
Ethnic	35	10
Fine Arts	52	283
Jazz and New Age	40	110
News and Talk	360	66
Oldies	627	0
R&B, Urban Contemp.	298	33
Religious Contemporary	99	34
Religion and Gospel	608	330
Spanish	297	25
Unknown or changing formats	171	91
Variety	131	374
Total	9,202	1,695

156 stations are silent.

760 construction permits are pending.

Source: The M Street Journal, 1990

FIGURE 2-6

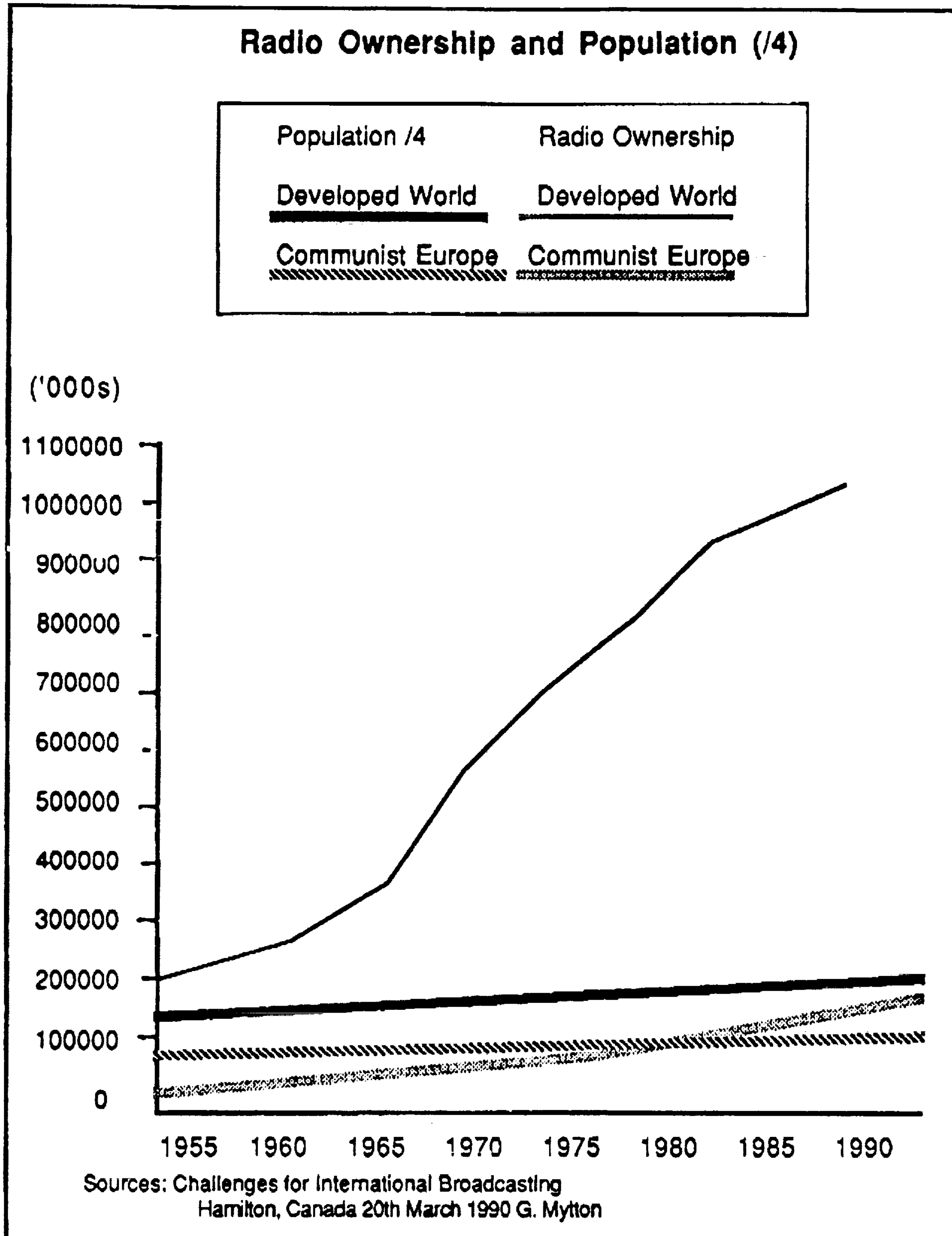
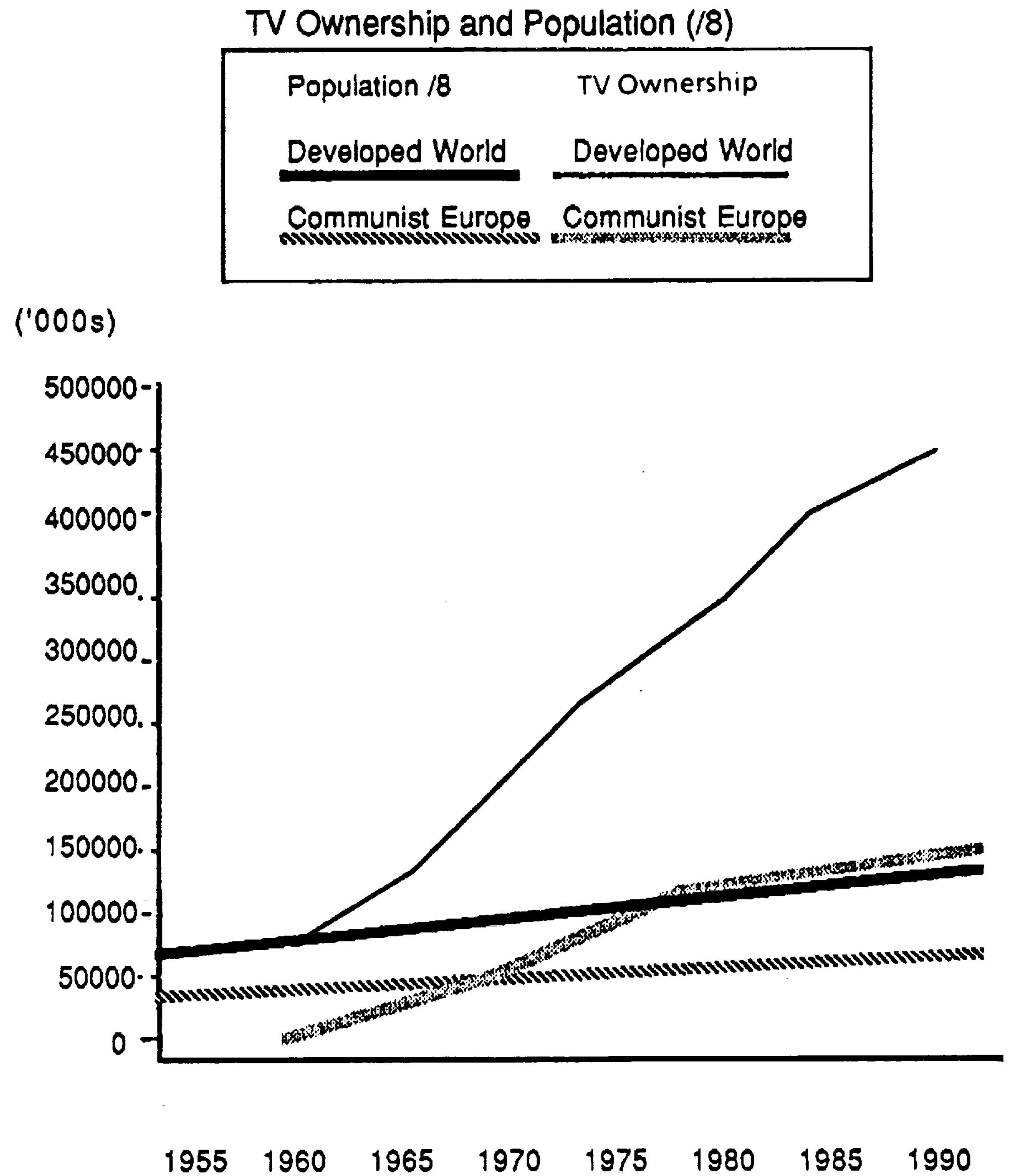

Radio Ownership and Population (/4)
Population /4
Radio Ownership
Developed World
Developed World
Communist Europe
Communist Europe
('000s)
1100000
1000000
9000u0
800000
700000
600000
500000
400000
300000
200000
100000
0
1955
1960
1965
1970
1975
1980
1985
1990
Sources: Challenges for International Broadcasting
Hamilton, Canada 20th March 1990 G. Mytton

FIGURE 2-7



Sources: Challenges for International Broadcasting
Hamilton, Canada 20th March 1990 G. Mytton

FIGURE 2-8

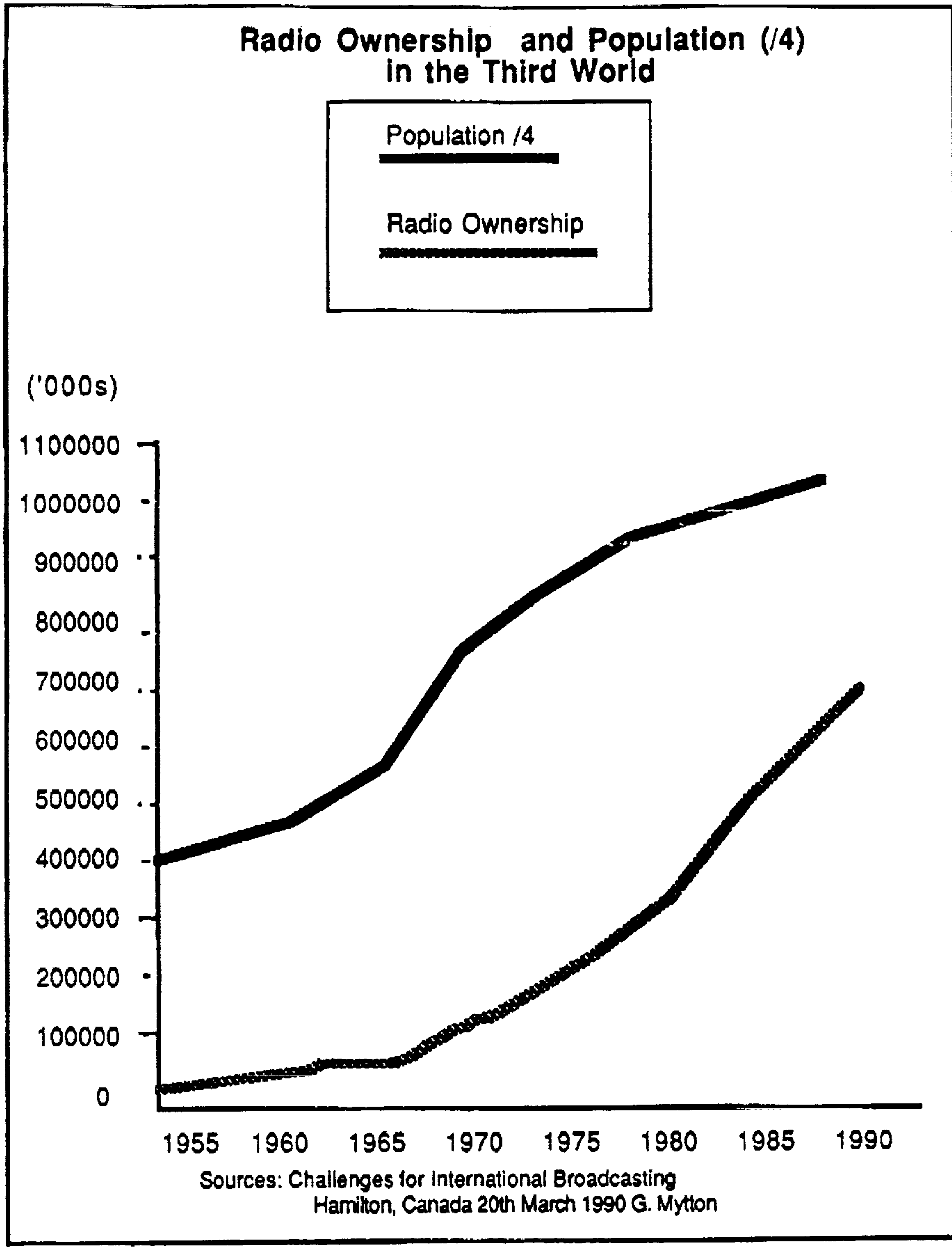
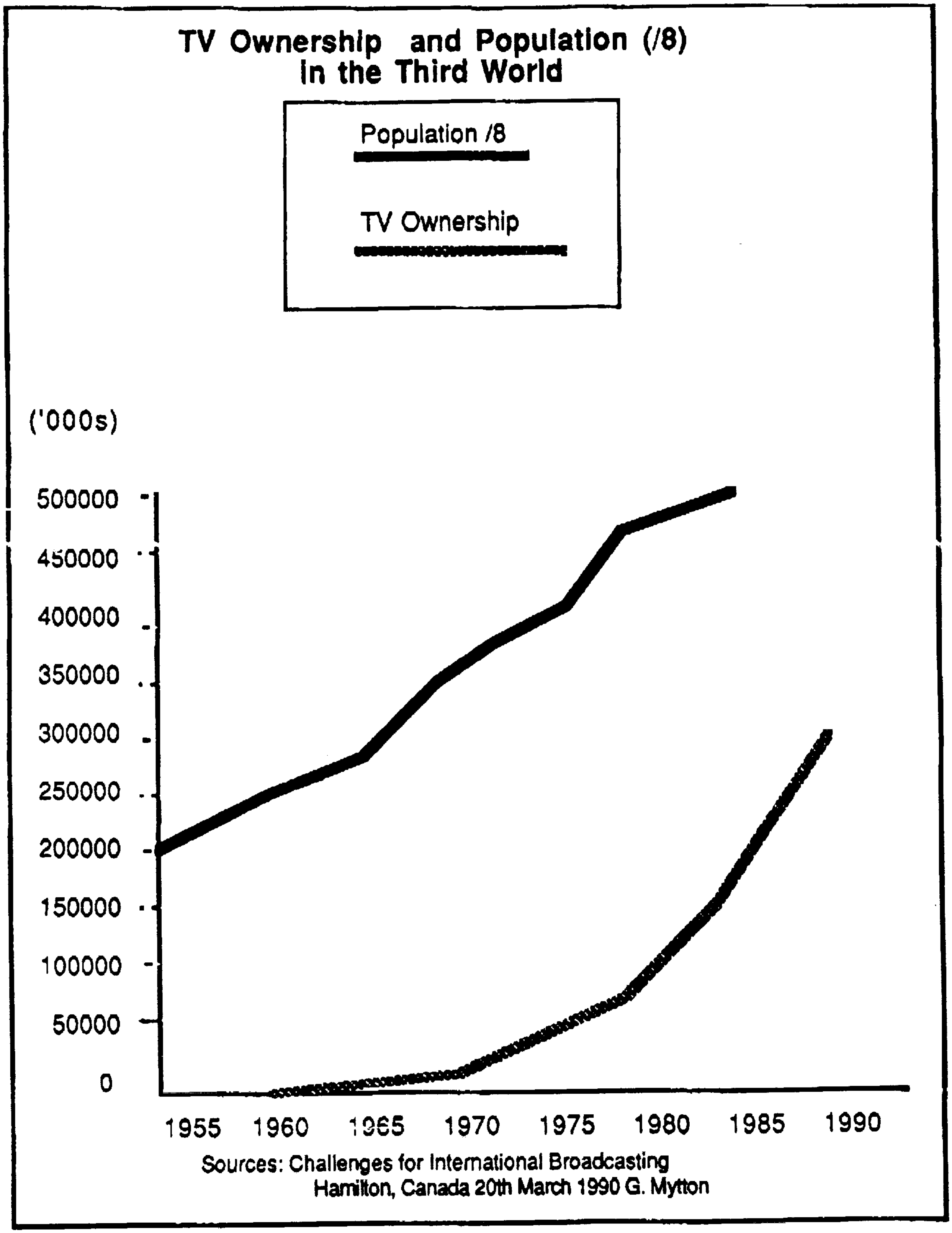

Radio Ownership and Population (/4)
in the Third World
Population /4
Radio Ownership
('000s)
1100000
1000000
900000
800000
700000
600000
500000
400000
300000
200000
100000
0
1955
1960
1965
1970
1975
1980
1985
1990
Sources: Challenges for International Broadcasting
Hamilton, Canada 20th March 1990 G. Mytton

FIGURE 2-9


TV Ownership and Population (/8)
in the Third World
Population /8
TV Ownership
('000s)
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
1955
1960
1965
1970
1975
1980
1985
1990
Sources: Challenges for International Broadcasting
Hamilton, Canada 20th March 1990 G. Mytton

When we look at the trends for TV in the developed and erstwhile Communist Bloc (Figure 2-7), we see a dramatic increase in line with radio sales supporting the view that consumers are not only prepared but also able to spend even more money for broadcast receivers depending on sound and visual qualities as well as the variety of choices which these receivers will deliver.

The same analysis holds fairly well for Third World markets. Figures 2-8 and 2-9 show the radio and TV ownership and population over a period of 35 years. In both cases, the trend in receiver acquisitions has risen in tandem with the population and just as dramatically.

It is apparent from data presented in Figures 2-6 through 2-9 that although disposable income may strongly influence consumers' audio and video products purchase decisions, the need and desire for information and entertainment are equally strong factors. This bodes well for the Direct Broadcast Satellite-Receivers market. It is anticipated that consumers would be enthusiastic about it as they have been with the other consumer electronics products.

SECTION 3

SHORTWAVE FACILITIES OPERATION COSTS

In this section, we look at the costs incurred in distributing radio programs via shortwave facilities. In collecting and analyzing this data, we selected shortwave broadcasters from the U.S. (domestic), North America, Europe and Africa. The spread of stations enabled us to perform a comparative analysis of major components that contribute to the cost of distributing radio programming via shortwave facilities.

3.1 Short Wave Program Distribution Costs

In our more focused research, we have found that costs of distributing shortwave programming is a function of location, the number of hours of operation and two more important variables, namely power and personnel. The VOA's estimate for operating costs range from $100-$200 per transmitter hour depending on the number of hours of operation and the number of crew shifts required. Other estimates are as low as $60 per transmitter hour. Our own focused research has yielded similar results with only a few exceptions.

To make the analysis of shortwave program distribution costs more manageable, we focused on the following broadcasters in terms of their present costs of operating shortwave radio programming distribution facilities.

U.S. Domestic

Missionary Radio Evangelism
Herald Broadcasting (Christian Science Monitor)

North American Broadcasters

Radio Canada International (RCI)
Voice of America

European Broadcasters

Radio Nederland
British Broadcasting Corporation

African Broadcasters

Radio Senegal
Radio Niger

3.2 U.S. Domestic

3.2.1 Missionary Radio Evangelism

Missionary Radio Evangelism operates a 50 kW transmitter out of El Paso, Texas, for a variable broadcast schedule in a given day or week. The targets for the station are Eastern parts of the Soviet Union and the Far East. The cost breakdowns on a yearly basis are as follows:

	$	%
Power	$28,000	40%
Labor	28,000	40%
Other	14,000	20%
Total	$70,000	100%

The costs of Missionary Radio Evangelism are very low compared to other stations we studied. In discussions with the operators of the station, we were told that the main reason costs are kept low is (i) power costs are low, (ii) there is much volunteer labor, and (iii) the hours of transmission are also as low as 6 hours per day, five days a week. Given a non-variable transmission of 6 hours per day, five days a week, the total transmission hours in a year would be 1,560. Divided into the total transmission costs for distributing shortwave programming, this yields $44.87 per hour of transmission.

3.2.2 Herald Broadcasting

Herald Broadcasting Corporation, funded by the Christian Science Monitor, has three shortwave facilities in Saipan, Maine and South Carolina. Each of these shortwave stations broadcasts for 20 hours a day on weekdays and 24 hours a day on weekends. Target audiences are worldwide from Japan, Taiwan, Hong Kong and China to Europe, Africa and the Middle East. The facility in Saipan consists of two 100 kW transmitters; the one in Maine is a 500 kW transmitter; and the facility in South Caroline consists of two 500 kW transmitters. The costs are broken down below per site. The operating costs for the Saipan stations are as follows:

KHBI Saipan, Northern Marianna Islands Operating Costs

	$	%
Power	$ 500,000	50%
Labor	170,000	17%
Other	330,000	33%
Total	$1,000,000	100%

Note that Saipan broadcasts for 148 hours a week, or 7,696 hours a year. Therefore, the operating cost per transmitter hours is $130. Also note that the facility in Saipan has two 100 kW transmitters, whereas the Missionary Radio Evangelism has only one 50 kW transmitter.

The operating costs for the Maine facility are as follows:

WCSN, Scotts Corner, Maine

	$	%
Power	$ 200,000	18.2%
Labor	390,000	35.5%
Other	510,000	46.3%
Total	$1,100,000	100%

The operating cost per hour for the Maine facility is $143. Note that the Maine facility has one 500 kW transmitter, whereas the Saipan facility has two 100 kW transmitters. However, the power cost for the Maine facility, instead of being higher, is 40% of the power cost for the Saipan facility. The variability in the power rates across the United States and the world is a major contributor to the variability in the station operation costs.

The cost breakdown for the South Carolina facility is as follows:

WSHB, Cypress Creek, South Carolina

	$	%
Power	$ 170,000	13.6%
Labor	500,000	40.0%
Other	580,000	46.4%
Total	$1,250,000	100%

The operating cost per hour for the South Carolina facility is $162. Although the South Carolina facility has two 500 kW transmitters, the power costs are relatively low. Almost 50% of the operating cost for the Saipan facility, which has only two 100 kW transmitters, is contributed by power, whereas for the South Carolina facility with 5 times the transmitter power of Saipan, cost of power is only 13.6%. Power and labor are the two most important factors affecting costs, and also the ones that are extremely variable from one facility to the other. A summary of the operating costs for the Herald Broadcasting facilities is presented below.

Maine	$125.91/transmitter hour
South Carolina	$143.09/transmitter hour
Saipan	$114.47/transmitter hour

In comparing the three facilities which Herald Broadcasting runs, we can see how operating costs are a function of location and that the largest of the variables relate to costs of power and labor. In the Saipan facility, 50% of Herald Broadcasting's transmission costs are for power; but only 17% of the total budget is for labor costs. On the other hand, power costs in the U.S.

facilities range from 13.6% in South Carolina to 18.2% in Maine. However, the labor costs in the U.S. are comparatively much higher ranging from 35.5% in Maine (to run one transmitter) to 40% in South Carolina to run a two-transmitter site.

The total costs to Herald Broadcasting for distributing shortwave programming is approximately $3,350,000. Total hours of transmission in these facilities run at 23,088 hours per year. This yields an average cost of $145.09 per transmitter hour to distribute shortwave programming.

3.3 North American International Broadcasters

3.3.1 Radio Canada International (RCI)

RCI runs several facilities in Canada and elsewhere ranging in size from 100 kW to 250 kW transmitters. Targets for RCI are worldwide. Its size is comparable to that of the government funded shortwave broadcasters in Sweden or Switzerland, and like both, RCI broadcasts about 240 hours per week or a total of 12,480 hours of programming annually. The international broadcasters usually broadcast the same material on three different frequencies to ensure reception by the target audience. Therefore, each programming hour is multiplied by three to derive the actual transmitter hours. Its various studio and transmission facilities are linked by satellite. The breakdown of costs for distributing shortwave radio programming for RCI is as follows:

	Canadian $	%
Power	$ 900,000	19.4%
Labor	2,000,000	30.4%
Other	3,674,000	50.2%
Total	$6,432,000	100%

Note that the power costs are even less in Canada than in the U.S. While 19.4% of the total budget is spent on power, the overall output of RCI is much higher than the facilities discussed above. Labor costs are higher as are the "Other" category costs. These are high for RCI because the buildings which house the facilities are rental and there are also additional costs for other communications related (satellite, HF) transmissions. Dividing the total transmission hours annually (37,440) into the total transmission costs renders the per transmitter hour costs for RCI at $171.79 Canadian Dollars or $142.12 U.S. Dollars.

3.3.2 Voice of America

VOA is one of the biggest international shortwave broadcasters, the others include Radio Moscow and Radio Beijing. VOA transmits in excess of 6,000 transmission hours per week which translates to approximately 300,000 transmission hours annually. VOA runs a number of facilities varying in size, number and types of transmitters. Its various studios and transmission facilities are connected by satellite/HF links.

The breakdown of costs for distributing shortwave radio programming for VOA is as follows:

	$	%
Power	$ 11 million	19.4%
Labor	24 million	30.4%
Other	23.5 million	50.2%
Total	$58.5 million	100%

The average (mean) power costs for VOA's worldwide facilities run approximately 10¢ per kW hour, more than double the Canadian costs. Note also the budget for labor is very high for VOA. Dividing total transmission hours into total cost yields $187.50 per hour as the cost of transmitting shortwave radio programming for VOA. Since VOA typically broadcasts the same program on three different frequencies, the cost of broadcasting 1 hour of programming material is $562.50.

3.4 European International Broadcasters

3.4.1 Radio Nederland

Radio Nederland is one of the larger-sized international broadcasters with several facilities in Holland and elsewhere the largest of which is on the Flevo Polder consisting of four 500 kW shortwave transmitters. Like the other major broadcasters, Radio Nederland also transmits to a worldwide radio audience. Radio Nederland transmits a total of 176,477.5 transmitter hours per year and has in excess of 350 employees.

The total cost of distributing shortwave programming for Radio Nederland breaks down as follows:

	$	%
Power	$ 7,700,000	22.2%
Labor	21,418,787	61.8%
Other	5,561,213	16.0%
Total	$34,680,000	100%

While the power costs for Radio Nederland are low, the highest cost is labor representing in excess of 62% of the total budget. Dividing the total budget by the total transmission hours, the price of distributing shortwave programming comes out to approximately $196.50 per hour for Radio Nederland.

3.4.2 British Broadcasting Corporation (BBC)

The BBC runs several facilities in the U.K. and other places equipped with transmitters ranging in size from 100 to 500 kW with different configurations (numbers, types) at each site. The BBC is one of the larger broadcasters competing in Europe with Deutche Welle in size and costs of operations. The BBC operations encompass a total of about 208,000 transmission hours annually.

The breakdown of costs for distributing shortwave radio programming for the BBC is as follows:

	$$	%
Power	$ 20,800,000	52.8%
Labor	11,350,000	28.8%
Other	7,270,000	18.4%
Total	$39,420,000	100%

In our own focused research, we found that the BBC is among a few broadcasters that pay such a high price for power. In excess of 50% of the budget is spent on power alone, but other costs are comparatively much lower.

The cost of distributing shortwave programming for the BBC's worldwide services comes out at $189.52 per hour.

BBC was also asked if they had cost information on a specific target region, as opposed to their worldwide costs. The following is BBC's approximate cost for transmitting shortwave programming to Africa and the Middle East.

The Africa and Middle East Region is served by three BBC facilities on Ascension Island, Seychelles Island and Cyprus. The facility on Seychelles Island is dedicated to cover East and Southern Africa. The other two, on Ascension and Cyprus, cover other parts of Africa and the Middle East, among other places. The cost figures that were obtained are the pro rata costs for transmitting shortwave programming to Africa and the Middle East only.

Note that the costs for power in all three locations are around 50% of total transmission costs. Labor costs vary from 22% to 35%. The other costs, which include satellite transmission costs as well as maintenance, also vary slightly from location to location.

Looking at the total hours of transmission in each location, we calculated the following hourly costs for each location:

	ASCENSION		SEYCHELLES		CYPRUS		TOTAL	
	$$	%	$$	%	$$	%	$$	%
Power	$2,359,000M	48.1%	$1,452,000	53.4%	$1,452,000	47.1%	$ 5,263,500	49.2%
Labor	$1,452,000M	29.6%	$ 598,950	22.0%	$1,089,000	35.3%	$ 3,139,950	29.3%
Other	$1,089,000M	22.3%	$ 671,550	24.6%	$ 544,500	17.6%	$ 2,305,050	21.5%
Total	$4,900,500M	100%	$2,722,500	100%	$3,085,500	100%	$10,708,500	100%
Transmission Hours	72 hrs/day		40 hrs/day		35 hrs/day		147 hrs/day	

Ascension Islands	$186.47 per hour
Seychelles Islands	186.47 per hour
Cyprus	251.53 per hour

The total shortwave transmissions into Africa and the Middle East are approximately 147 hours per day. The cost of transmitting shortwave programming into this region therefore comes out to about $199.58 per hour. Note also that the costs of transmitting to Africa and the Middle East constitute over one-fourth of the total budget of BBC's worldwide service.

3.5 African International Broadcasters

3.5.1 Niger

The government of Niger runs a 20 kW facility in Niame and a 500 kW facility in Korodou. The transmission hours are far fewer when compared to the international broadcasters analyzed above, but comparable to the 50 kW facility of Missionary Radio.

The cost breakdown for Niger are as follows:

	$	%
Power	$ 118,000	54.6%
Labor	26,300	12.2%
Other	71,606	33.2%
Total	$215,906	100%

Even though the overall cost for transmission is low compared to other broadcasters, we were told that the highest component of costs is power related taking up in excess of 54% of the overall budget.

The Niger stations transmit about 6-7 hours per day, for a total of about 2,548 transmission hours per year. The cost for distributing shortwave programming for Niger, therefore, comes out to about $84 per hour.

3.5.2 Senegal

In our interview with the Chief of Transmissions for Radio Senegal, we were told the government funds the operation of a 100 kW transmitter in Dakar. The station operates approximately 10 hours per day and targets the border countries in the region.

The cost breakdown for the shortwave radio station in Senegal is as follows:

	$	%
Power	$ 79,000	42.9%
Labor	39,500	21.4%
Other	65,800	35.7%
Total	$184.300	100%

Note again that while overall costs are low for both the radio stations in Senegal and Niger, it is not clear to what extent government subsidies have depressed the cost breakdown shown above. However, the major cost elements are both power and labor. In Senegal in particular, labor costs are higher reflecting a higher wage structure. Power costs represent almost 43% of the total budget.

Given a 10 hour per day transmission, the total cost for distributing shortwave programming in Senegal is $50.63 per hour.

3.6 Short Wave Radio Programming Distribution Key Cost Elements

Table 3-1 summarizes shortwave facilities operations cost data. A perusal of the cost data for the domestic and foreign broadcasters shows that power and labor are the key elements that contribute most heavily to the day-to-day costs for operating shortwave transmitter facilities. The 'other' category includes cost elements such as building and equipment maintenance, facility lease charges, and the costs associated with delivering the programming material to transmitter site (s), usually via satellite. Here, we present a qualitative picture of the programming distribution costs and the reasons for their variability from one region to the other.

The major cost elements which contribute to the costs of distributing shortwave radio programming can be categorized as capital and operation and maintenance (O&M) costs. The capital costs pertain to expenditures on such items as antenna, transmitters, and attendant equipment complement. The capital cost may also include cost of land, land improvements, buildings and the equipment installation costs. The O&M costs include the ongoing expenditures associated with O&M of the transmitter facility and are composed of elements such as the following:

- Power (fuel) costs
- Building lease/up-keep costs
- General maintenance costs
- Labor costs

Table 3-1
Shortwave Facilities Operations Costs

Facility Type	Cost/ Transmitter Hr ($)	Cost/ Program Hr* ($)	Remarks
50 KW, Religious	45	45	Voluntary Labor, Limited Broadcasting Hours
500 KW, Religious	145	145	Voluntary Labor, Limited Broadcasting Hours
Radio Canada International	142	426	
Voice of America	188	564	Average over all domestic and overseas facilities
British Broadcasting Corporation	200	600	
Radio Nederland	197	591	
Niger	84	84	Domestic
Senegal	50	50	Domestic

*Major international broadcasters typically broadcast the same program material on three different frequencies. Therefore, the broadcasting cost per hour is three times the cost per transmitter hour

Other related costs with regional and trans-oceanic transmissions are costs associated with the communications link (satellite/HF, etc.) to achieve stronger signal re-broadcasts to target regions.

Cost structures for shortwave broadcasting are difficult to generalize because of the number of variables that are introduced in accounting and system implementation approaches, as well as the differences in power and equipment costs from country to country. In the interviews held with various broadcasters from different parts of the world, we found an additional cost differential resulted if the broadcaster was dependent on another entity (e.g. PTT) to operate the transmission system. Transmission costs are sometimes inflated two to three times in countries where the transmitter operation is undertaken by entities other than the broadcasters. Similarly, power costs in places such as the UK are very high, constituting about 50% of the total transmission costs. In other places such as Canada, power represents a fraction as low as a fifth of total transmission costs.

A number of factors contribute to the costs of installation of a shortwave transmission capability. These include the costs of the transmitters, antennae, cables, central circuitry, RF switching matrix, and other attendant equipment. To ensure flexibility, normally, at least three (3) antennas per transmitter are installed. There is also a need to locate a reliable power source from the public utilities, or on-site generators may have to be provided. Another cost factor is the need for a fair acreage of land to construct the transmitter and antennae sites. For a medium size site containing anywhere from six to seven transmitters, up to 300 acres of land may be required without including the additional acreage needed for a buffer zone to eliminate hazards. Interviews with various broadcasters from the BBC, Voice of American, Radio Canada and Radio Nederlands have indicated that the estimated cost for setting-up a "virgin" site is in the order of $20 to $25 million per transmitter; a site containing six transmitters could therefore cost anywhere from $120 to $150 million.

The power costs, as previously stated, vary from country to country, and, obviously, depend on the cost of electricity and fuel in a given country. Another factor that affects power costs is the efficiency of the transmitter. We were told that the best transmitters today are about 60% to 67% efficient. Cost of power around the world varies from 0.05¢ to 0.25¢ per kilowatt hour.

The cost of construction of the site is also a variable that changes from region to region depending on the climatic conditions. Radio Canada's antenna structure, for example, has to be twice as large to "pack" sufficient weight, so that it is not affected by the worst icing conditions. The antenna structure in a hot climate area, on the other hand, is less cumbersome and, therefore, less costly.

Building up-keep relates to the normal costs associated with running industrial sites including the maintenance of safety features and having the proper tools and safeguards to fight fire hazards.

The major maintenance cost associated with shortwave broadcasting is the replacement of transmitter parts such as the tubes, blocking condensers, mechanical aspects (the gears and moving parts associated with the running of dynamic operations) and other preventive types of maintenance.

Finally, an equally important cost element in running shortwave broadcasting is the labor cost for the technical, administrative and other (security, etc.) staff. Again, there is a large variable in these costs. The amount of time the transmitters are running, salary rates of the given country in which the station is operating and even the management philosophy are all factors that vary both the labor pool and costs associated with distributing shortwave radio programming domestically, regionally and globally.

SECTION 4

AUDIO ADVERTISING

This Section examines the radio advertising market in selected countries/regions of the world and describes how radio advertising rates are set. This information would be of interest for gauging the revenue potential of a DBS-R System catering to the needs of commercial broadcasters.

4.1 Market Categorization

The radio advertising market is directly linked to the area population, i.e., the size of the market. Thus, a radio market could be classified differently in different countries or regions but would generally fall under some population-related designation. For example, a "Major Market" may, in a given country, be defined as an area with a population of 500,000 or more inhabitants; a secondary market may encompass an area with, say 200,000 plus inhabitants; a tertiary market may be designated as an area with less than 200,000 inhabitants; and, finally, a non-competitive market may be described as having a population of less than 60,000 or, even a larger population but with too many radio stations competing for the same market thereby excessively fragmenting the total audience reach of any one station.

Audience information obtained from audience measurement data is matched against product buying data. Stations whose ratings show that they can and have reached an audience that matches the profile of a market for a given product are selected for advertising that product.

As an example, suppose an automobile manufacturer wants to advertise a given car model. The first step in analyzing the radio advertising market in this case would be to analyze the automobile market, its size as well as the buyer profile (who buys, when and where). The next step would be to analyze the type of radio format most likely to appeal or to match the buyer profile for the industry as well as the specific model. Data from radio audience measurements which categorize the radio audience in terms of various demographic and psychographic categories would yield information on the radio format that would appeal to the target audience. Based on this information, the stations that provide that type of format in the target region are selected and an advertising "package" developed accordingly. The success often depends on the degree to which the radio audience data has been cross tabulated with the product usage information.

4.2 Advertising Market Size

Figure 4-1 compares the actual dollar expenditures on radio advertising in nine developed countries using 1988 figures. The figure also indicates the percentage which radio advertisements represented out of the total advertising expenditure for the year 1988.

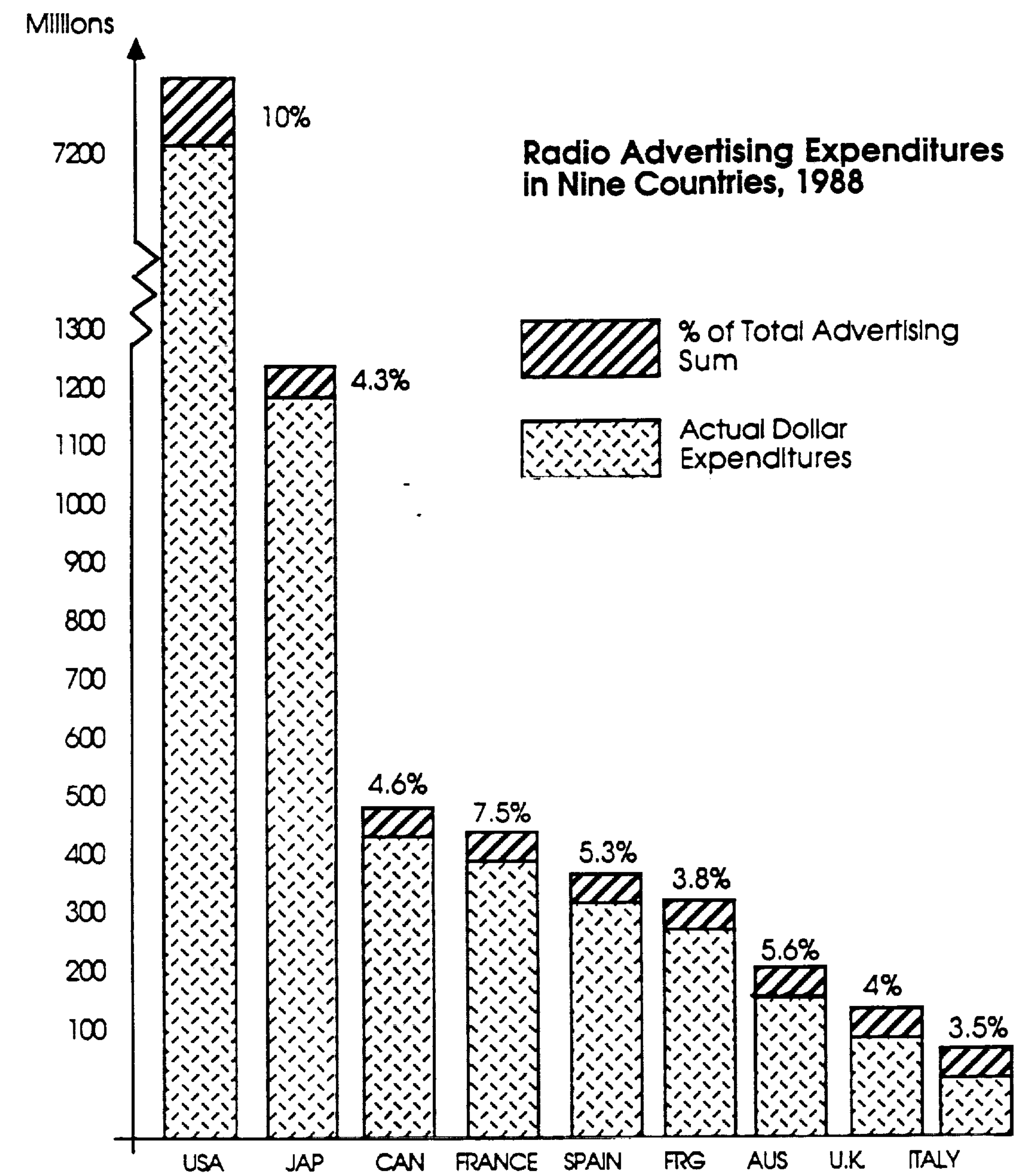
Figure 4-2 shows the breakdown of advertising expenditures in four different countries between outdoor and cinemas; radio, TV, magazines, and the press. Note the common elements between the countries analyzed in all cases: TV and the press attract the largest expenditures ranging from 33% to 45%. The differences are in the role radio and magazines play in the different countries.

There are significant common elements between the countries analyzed: TV enjoys around a third of all advertisement revenues, and press attracts 40-45% in each case. The main differences between countries relate to the roles of radio, magazines (here including business/professional publications), and cinema and outdoor advertising. The role of cinema and outdoor advertising is very minor.

Table 4-1 presents radio listening from the advertising perspective in four different countries: Australia, New Zealand, the U.K. and USA. The data and associated notes 1-6 compare radio usage, listening time, commercial station's shares and the commercial radio reach for these countries.

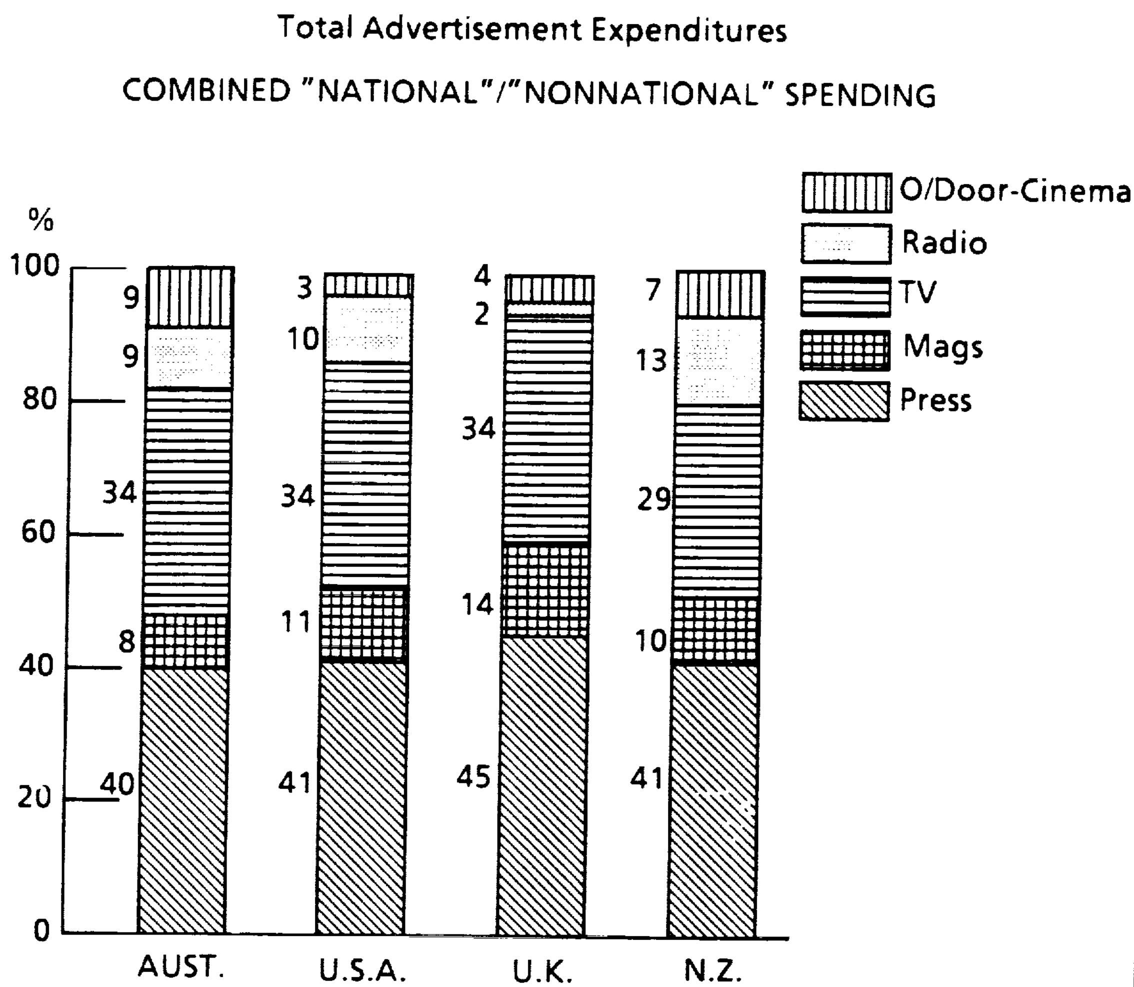
At the end of 1988, the US had almost 10,000 commercial radio stations while Australia had 141 and the U.K. 44. Of Australia's 141, thirty-four were in the five mainland state capitals. Australia and the U.S. have multi-commercial station markets.

Figure 4-1



Source: Federation of Australian Radio Broadcasters

Figure 4-2



Source: Federation of Australian Radio Broadcasters

Radio continues to account for a smaller volume of advertising expenditures than do print and television. Table 4-2 shows the radio advertising expenditures for Brazil and countries included in Figure 4-1. It may be interesting to note that only eight countries reported radio expenditures of more than $200 million, and only two others reported a radio budget of $100 million or over. The global radio advertising budget is estimated to be approximately $1.5 billion.

Per capita radio expenditures in 1988 were over ten dollars in seven countries and exceeded five dollars in six other nations. Table 4-3 shows the per capita expenditures.

Table 4-1
Radio Listening
(At end of 1988)
SOURCE: Media Measurements in Australia, David Jones Communications Research Services

	1	2	3	4	5	6	
			(See notes below)			1 wk	2 wks
Australia	(5 capital cities include about 60% of total Aust. pop.)						
5 main capitals	18%	22 hrs	84%	50%	86%	41%	60%
United States	16%	21 hrs					
All markets	18%	23 hrs					
Top 10 cities	18%	22 hrs	95%	22%	95%	35%	60%
100 cities	18%	22 hrs	95%	28%	95%	50%	71%
United Kingdom							
All 43 markets	15%	19 hrs	31%	31%	43%	35%	50%
New Zealand							
All markets	20%	25 hrs	87%	70%	86%	48%	72%

Notes:

1. People using radio in the average of 1/4 hour 6 am to midnight expressed as a percent of potential. Australia PPL 10+; USA PPL 12+, U.K. PPL 15+, N.Z. PPL 10+. (PPL Stands for people)
2. Time spent listening is the weekly average for all people (including non-listeners).
3. All commercial share is the combined total of all commercial stations.
4. Share top 3 stations indicates the combined share of the top 3 commercial stations.
5. Total commercial reports the combined weekly commercial radio reach.
6. Schedule reach indicates an approximate reach for a gross schedule per week over one week and after four weeks.

Table 4-2

1988 Advertising Expenditures for Radio

Country	(In Millions of U.S. Dollars)
United States	$7,798.0
Japan	1,466.3
Canada	553.3
Spain	525.4
France	497.7
Germany, Fed. Rep.	451.4
Australia	305.3
United Kingdom	247.6
Brazil	184.5
Italy	175.2

SOURCE: FEDERATION OF AUSTRALIAN RADIO BROADCASTERS

As a proportion of total measured media advertising expenditures, radio trailed considerably behind both print and television. Radio accounted for more than twenty percent of the total measured media in only four countries as shown in Table 4-4.

Note that the percentage of advertising dollars spent on radio is much less for U.S., Japan, and European countries (see Figure 1) than for less developed countries as shown in Table 4-4.

4.3 Advertising Rates and How They are Determined

Radio advertisement rates are primarily driven by ratings in the developed world. Audience measurement organizations such as Arbitron, Birch

Table 4-3

1988 Per Capita Radio Advertising Expenditures
SOURCE: Marketing Pulse, New York (Private Communication)

Country	(In U.S. Dollars)
United States	$31.8
New Zealand	24.2
Canada	21.2
Australia	18.5
Spain	13.5
Austria	12.3
Japan	12.0
Puerto Rico	9.7
France	8.9
Germany, Fed. Rep.	7.3
Finland	6.5
Israel	6.5
Ireland	6.0

Scarborough or BBM develop station reports or ratings which estimate the number of people listening to the station for some time segment (usually for a quarter of an hour). The audience measurement data can be categorized in many ways. The categories could be socio-economic or demographic.

The measured audience is normally translated into time periods (quarter hour, half hour, etc.), providing information on how many and what types of listeners tuned into a given station at a designated hour. The information could be cumulative or broken down into certain demographic categories. It could also provide information as to where such listening took place (car, home, other, etc.).

The data would also provide pertinent information on the audience profile. The characteristics (work status, occupation, sex of head of household, education, household size, media equipment owned, etc.) would define the total

Table 4-4
Percent of 1988 Measured Media Advertising
Expenditures Allocated to Radio
SOURCE: Marketing Pulse, New York (Private Communication)

COUNTRY	
Dominican Republic	28.5%
Jamaica	26.6%
Guatemala	24.4%
Trinidad and Tobago	21.2%

audience in terms of the types of persons reached and times so reached. The station report would include total hours comprising the total listening to a station in a week; the station's share of weekly hours given as a percentage of all the hours spent listening by the total population within the reach of the station; and the average weekly hours which show the average time a person would have tuned into the station in that week.

Based on the analyses of these data, a radio market profile is developed by station and by radio format. The rating is used by an advertiser to determine which station would be best qualified to target his audience.

The station in turn would develop nominal prices for the different segments of the radio station's program hours. However, the actual prices for a 5 to 60 second time or "spot" especially in the U.S. is sold almost in an auction type of an environment: the station may start at its ratings-determined nominal price, but the paid price would be determined by, among other things, the following factors:

- The number of spots sold;
- The number of spots remaining;
- What other stations are charging;
- When the "program" is going on the air;
- The day of the week (more on Friday than Monday);
- The radio format, etc.

In so far as the ratings of a station and the product profile are the main determinants for the time and spot rate classifications, we can be certain that an advertiser's objective in placing a radio advertisement is to reach an anticipated audience; and the basis for developing the spot or time rate is predicated on the number and profile of the listeners involved.

Tables 4-5, 4-6 and 4-7 compare the time spot rate classification between two radio companies in the U.S. and one in Tokyo. Note that in Table 4-5 the various rates are presented in a descending order of rates depending on the time availability. Thus, for example, if an advertiser wishes to go on the air on short notice between 5:30 - 10:00 am (classified as AAA for WHUR) and the radio station is forced to preempt another customer, the rates are determined under Grid 1. Conversely, if the time slots have not been sold, the grid level for determining the spot rates may be either 8, 9 or 10.

Table 4-6 provides a basis for comparing the audio market between stations in different cities. Note that the rate for the morning "spot" on the popular KYW Radio of Philadelphia is more than double the afternoon rates, although both rates are justified on the basis that there are more listeners as people drive to and from work.

Table 4-7 presents radio advertisement placement fees for a radio station in Tokyo. Time classification is based not only on 30 and 60 second rates, but is also extended to periods of up to 5-30 minutes. A given company could therefore buy several radio spots amounting to a total of 5-30 minutes to advertise its products over days/weeks and at a certain time period (morning, evening, etc.).

4.4 Advertising Costs and How They Relate to Radio Formats

The radio advertising market, in the United States and elsewhere, has become target market specific. This has become the basis for niche formatting to target audiences.

A product advertiser may develop a data base to determine the profile of the buyers that would be interested in his product. Radio stations, in turn, develop

Table 4-5

Time Classifications

WHUR, Washington, D.C.

AAA 5:30 am - 10:00 am (Monday-Saturday)
3:00 pm - 8:00 pm (Monday-Friday)
7:00 am - 11:00 am (Sunday)

AA 10:00 am - 3:00 pm (Monday-Friday)
10:00 am - 8:00 pm (Saturday - Sunday)

A 8:00 pm - 12:00 midnight (Monday-Sunday)
B 12:00 midnight - 5:30 $35.00

Weekly Plan

	AAA		AA		A	
SEC→	:60	:30	:60	:30	:60	:30
Grid # 1	$300	$270	$250	$225	$200	$180
Grid #2	$225	$200	$190	$171	$145	$131
Grid #3	$200	$180	$180	$162	$140	$126
Grid #4	$190	$171	$170	$153	$130	$117
Grid #5	$175	$158	$155	$140	$125	$113
Grid #6	$160	$144	$140	$126	$120	$108
Grid #7	$145	$131	$125	$113	$110	$99
Grid #8	$130	$117	$115	$104	$103	$82
Grid #9	$120	$108	$105	$95	$95	$86
Grid #10	$110	$99	$95	$86	$85	$75

General Information

1. Grid levels based on available inventory. Grid subject to pre-emption.
2. All schedules subject to make good privileges in comparable time periods.
3. All spots will rotate within appropriate time periods or fixed positions rate will apply.
4. Fixed position - add 10% to Grid 1.

Source: WHUR, 1990

Table 4-6

	MONDAY-FRIDAY	SATURDAY	SUNDAY
AM DRIVE 5AM-10AM	$800	$400	$300
DAYTIME 10AM-3PM	$220	$200	$200
PM DRIVE 3PM-8PM	$300	$150	$150
EVENING 8PM-1AM	$100	$100	$100

SPONSORING SPECIAL REPORTS: 20% PREMIUM
NARROWED DAYPARTS: 30% PREMIUM

SOURCE: KYW Newsradio, Philadelphia/September 1990

Table 4-7
A Tokyo Radio Station

5:00–6:00	6:00–1:00	1:00–2:00	2:00–5:00
B	A	B	C

Time Classification

Time Rate (Unit: Yen)

	A Time	B Time	C Time
30 minutes	540,000	400,000	260,000
25 minutes	450,000	330,000	220,000
20 minutes	380,000	280,000	190,000
15 minutes	330,000	240,000	160,000
10 minutes	280,000	210,000	140,000
5 minutes	240,000	180,000	120,000

Spot Rate (Unit: Yen)

20 seconds	90,000	65,000	45,000

their own data base through focus-group researchers and other means on the types of music that appeal to various groups with particular demographic characteristics. Based on their research, radio formats are developed and targeted to reach the intended audience. Audience measuring organizations then measure the degree to which a given format has attracted or maintained the target audience. By utilizing this product and media data, the radio advertising market has increasingly become format dependent.

While the actual prices that different formats command is a variable that differs from station to station, and from day to day, it can generally be said that different formats command different prices. For example, the classical music format targets a qualified audience and in turn justifies higher rates. Similarly, radio formats that appeal to certain women between the ages of 35 and 45, or formats targeting college audiences also command specialized rates that are commensurate with the perceived buying power of the targeted audience. These format-dependent specialized rates are justified in anticipation of a given audience and the actual rates are computed on a per-listener basis extrapolated from the station ratings performed by audience measurement organizations.

Table 4-8 provides the percentage of AM (total commercial: 4,975) and FM (total commercial: 4,269) stations that provide the various radio formats in the U.S. Again, the pricing of the radio time (or spot) is predicated on the type of audience reached and the numbers reached.

Table 4-8

FORMAT	AM	FM	TOTAL AM/FM
Adult Contemporary	15.6%	28.5%	24.0%
Country	23.6	22.7	22.4
Religion/Gospel	11.9	3.8	8.1
CHR/Top 40	2.7	15.8	8.0
Oldies	8.4	4.5	6.5
Middle of the Road	7.7	2.2	5.2
Talk	6.8	0.2	3.9
AOR	1.0	6.2	3.2
Easy Listening	1.5	5.4	3.1
News	5.4	0.2	3.1
Spanish	3.2	1.0	2.2
Big Band/Nostalgia	3.4	0.7	2.2
Urban Contemporary	1.4	2.2	1.7
Diversified	2.3	0.8	1.6
Classic Rock	0.6	2.5	1.4
Black	1.9	0.7	1.4
Agricultural	1.6	0.8	1.2
Jazz	0.5	0.9	0.6
Classical	0.4	0.8	0.6

SOURCE: Radio Broadcasting Bureau, 1990

SECTION 5

LEGAL AND REGULATORY CONSIDERATIONS

This section presents a summary discussion of the international and domestic legal and regulatory issues concerning the establishment of a global system for DBS-R service. The primary issues in this regard are: (1) frequency allocation and associated procedures for establishing and protecting DBS-R; and (2) the comparative viability of the various structural alternatives for establishing such a system.

5.1 DBS-R Frequency Allocation and Associated Radio Regulations

To date, no frequencies have been allocated for DBS-R Service, nor have procedures been specified for the establishment and protection of this service. The Agenda for WARC - 92 includes consideration of allocating frequency bands for DBS-R, and for complementary terrestrial sound broadcasting usage within such allocation. The Agenda also references resolutions from previous WARCs which call for the development of procedures for protection of DBS-R and reaccommodation in other bands of terrestrial services which may be affected.

Currently, the ITU Radio Regulations make no definitional or procedural distinctions between DBS-R and DBS for television. Further, no distinction is made between DBS for fixed service applications (e.g. direct broadcast to homes) and DBS for mobile service applications (e.g. direct broadcast to automobiles). The frequency allocations and technical appendices that have been adopted for DBS video to date all apply exclusively to BSS television.

The procedures for DBS-R, once they are developed, can be integrated with the Radio Regulations: (1) as a new Article; (2) as part of existing Articles, or (3) as a resolution dealing specifically with DBS-R. The primary concern of adding DBS-R to the Article dealing with DBS television is that the associated appendices might be used as precedents to plan bands for DBS-R.

5.2 Structural Alternatives for DBS-R Systems

Structural alternatives considered in this study are:

- A private satellite system
- An intergovernmental satellite organization sponsored system
- A private system managed by an intergovernmental organization
- Global interconnection of different satellite systems.

5.2.1 Private DBS-R System

A private DBS-R system is one in which a private corporation or other legal entity owns the system, obtains financing, and all necessary government approvals, and offers the DBS-R services to the public. The basic distinction from the intergovernmental-sponsored system is that it is not established pursuant to international treaty. The U.S. is one of the few nations in the world that currently allows private (non-government sponsored) satellite systems. Other countries that permit such systems are the United Kingdom, Hong Kong, Japan and Luxembourg.

To successfully implement a private global DBS-R system, it is imperative that strategic partners and favorable forums be selected to minimize regulatory impediments. For a private system, the following regulatory issues must be considered.

5.2.1.1 System Authorization

5.2.1.1.1 Authorization in the U.S.

Pursuant to the Communications Act of 1934, 47 USC §101 et seq, the FCC has regulatory jurisdiction over all commercial use of the electromagnetic spectrum. This would clearly include the provision of DBS-R by private entities in the U.S. In developing a regulatory scheme for DBS-R, the FCC must: (1) allocate sufficient frequency spectrum to DBS-R; (2) determine who should receive licenses for DBS-R; and (3) determine how such licensees should be regulated.

The amount of spectrum allocated will drive the other determinations to be made by the FCC concerning the regulatory scheme. DBS-R, like the Mobile Satellite Service (MSS), requires omni-directional reception, precluding frequency re-use by satellites at different orbital locations. If the FCC allocates only enough spectrum for one DBS-R system, as it did with MSS, the following regulatory determinations are likely. First, if there are multiple applicants for authorization to establish and operate DBS-R systems, they will probably be directed to form a single consortium as opposed to requiring the applicants to compete for the single system license via comparative hearings, lottery, or some other mechanism. This was the FCC's approach in MSS. Second, if there is only to be one DBS-R system, the DBS-R operator likely will be regulated as a common carrier. The rationale is that with limited access to this type of service, the public interest is best served by making the system's capacity available to all qualified users on a nondiscriminatory basis in accordance with the FCC approved tariffs. If the DBS-R system operator leases channels to DBS-R service providers, then it is likely that the service providers will be regulated as broadcasters.

If, on the other hand, the FCC allocates sufficient spectrum for multiple systems, each space segment operator might be permitted to choose whether to be regulated as a common carrier or as a broadcaster. The FCC adopted this approach with DBS television applicants in 1982, with the form of regulation based on the type of service to be offered.

Regardless or whether the space segment operator is a common carrier or broadcaster, the Communications Act of 1934 places significant restrictions on the amount of permissible alien ownership and control over the system. These restrictions could impact the ability of U.S. and foreign companies to establish jointly owned satellite systems for provision of DBS-R internationally.

To the extent that a U.S. entity intends to establish an international DBS-R system, additional steps must be taken. International frequency allocations for DBS-R must be established, and relevant Radio Regulations specified. The FCC must then submit the appropriate technical information to the ITU to notify other administrations of the proposed system and coordinate with affected administrations. Consultation with INTELSAT and notification of INMARSAT will also be required prior to establishing the system. Further, it is likely that the FCC will require the U.S. DBS-R applicant, among other things, to obtain agreement from at least one foreign country within the system's planned footprint to participate in the service offering.

5.2.1.1.2 Foreign Government Authorization

If a private system is to be implemented on a global basis, several different countries likely will need to authorize the construction of DBS-R satellites. This is for both political and practical reasons. It would not be politically palatable to have a DBS-R system, authorized only by U.S., broadcasting throughout the world. Moreover, it is highly likely that the legal support of several nations will be necessary if a DBS-R system is to be implemented on a global basis. This Report focuses on three countries in addition to the United States: India, Singapore and Nigeria. These countries present very typical regulatory structures that would need to be addressed when implementing a global DBS-R system. In particular, each of these countries have a very powerful state broadcaster that controls almost all television and radio programming within the country. The opportunities for private broadcasters are either very minimal or non-existent. Also, these countries each have very powerful Postal, Telegraph, and Telephone (PTT) monopolies who control the telecommunications infrastructure within these countries. The opportunities for private satellite operators to establish systems in any of these countries do not exist. Consequently, if a global system is to be implemented to cover any of these countries, the cooperation and participation of the host government would be mandatory.

5.2.1.1.3 Private DBS-R System Implementation Considerations

When considering how to implement a global system, the DBS-R proponent must carefully assess as to which country would provide the most hospitable business and regulatory environment. Certainly, some countries would welcome such a venture with open arms. They may allow a privately owned system or may invest in a system through the state broadcaster or the PTT. On the other hand, some countries would reject all DBS-R systems because of the competitive threat provided to the PTT and the state broadcaster.

In addition to the basic entry regulatory environment, the DBS-R proponent must examine each potential country's laws on advertising, trade, copyright, program content, political advertising/equal time and local broadcasting to determine how hospitable it will be to DBS-R. This overall analysis should result in the identification of three or four countries from which to initiate a global system.

5.2.2 Intergovernmental Organizations Sponsored System

There are five existing intergovernmental satellite organizations capable of establishing or participating in a global or regional DBS-R system. These are: INTELSAT, INMARSAT, EUTELSAT, ARABSAT, and the Soviet Satellite system INTERSPUTNIK. Each of these organizations is based on intergovernmental Agreements among the participating member countries. Each Agreement sets forth its objectives, including the types of services it can provide, and the legal, technical and operational manner in which such objectives are to be accomplished. Here, we evaluate and compare the ability of each organization to provide DBS-R on a commercially viable basis.

5.2.2.1 INTELSAT Provision of DBS-R

5.2.2.1.1 INTELSAT Options

INTELSAT's prime objective is to provide the space segment for the commercial and non-discriminatory offering of international public telecommunications services worldwide. INTELSAT's charter also permits the organization to use its space segment for specialized services such as DBS-R, but only to the extent that the provision of public telecommunications services is not impaired. The terms and conditions required to establish this assurance would make DBS-R a secondary service in every respect, and therefore make this option unattractive.

An an alternative, INTELSAT's charter permits it to finance and own satellites as part of the INTELSAT space segment for specialized services such as DBS-R, as long as all members of the organization agree. The issue of DBS-R status is not completely resolved under this option, but presumably it would be taken care of in the context of the organization's unanimous decision to make such a commitment. However, since specialized services do not enjoy the same protection against competing systems as do international public telecommunications services provided by INTELSAT, the financial risk factor and market uncertainty is likely to weigh heavily against the membership deciding to pursue this option.

5.2.2.1.2 INTELSAT DBS-R System Authorization by U.S. Signatory

To the extent that INTELSAT decides to provide DBS-R under either option, Comsat, as the U.S. Signatory to INTELSAT, would have to obtain permission from the FCC to participate. Its role would be that of a common carrier, pursuant to the 1962 Satellite Act and the 1934 Communications Act. As such, it would be subject to traditional rate and service regulation. Since DBS-R would be a service separate and distinct from Comsat's other Signatory service offerings, Comsat would have to isolate the capital and expense associated with INTELSAT's provision of DBS-R, establish separate accounts for computing rates to users, and to file a complete description of its accounting system and cost allocation procedures with its tariffs.

Comsat's participation as U.S. Signatory in INTELSAT DBS-R services will probably be challenged by U.S. competitors as beyond the scope of Comsat's Signatory responsibilities. However, the INTELSAT Agreement, which entered into force subsequent to the 1962 Satellite Act which established Comsat, specifically provides for such a service offering. Further, the FCC has already determined that Comsat's Signatory role within INMARSAT includes the provision of aeronautical services, and the legal basis for that decision is much more subject to challenge than a decision permitting provision of DBS-R service would be.

5.2.2.1.3 INTELSAT DBS-R Authorization By Foreign Signatories

The INTELSAT organization consists of almost 120 member nations from all over the world. All but a few of these countries participate in INTELSAT through the government owned and operated PTT. Since most countries' domestic telecommunications are also government operations, including broadcasting, implementation of DBS-R via INTELSAT would most likely be handled by the existing government operators.

The Soviet Union and a few other Eastern European countries are not members of INTELSAT, but efforts by parties concerned are underway to change this. Nevertheless, non-member countries could provide and receive DBS-R services via INTELSAT DBS-R through their authorized telecommunications entities.

5.2.2.2 INMARSAT Provision of DBS-R

5.2.2.2.1 INMARSAT Options

INMARSAT was established to provide space segment for maritime communications services. Since its inception, its charter has been expanded to include aeronautical communications, and new amendments are pending to permit land mobile services. Maritime and safety and distress services have priority over aeronautical and land mobile services.

The land mobile amendments appear broad enough to permit the organization to provide DBS-R service over land. INMARSAT has already instituted maritime services with broadcast characteristics, including fleet call services, and slow scan broadcast television, which is accessible to vessels by subscription.

This option is unattractive for one major reason, i.e., the secondary status of DBS-R within the land mobile services category. Technically, INMARSAT may be very qualified to operate the DBS-R service. However, organizationally, the DBS-R will represent a major departure from INMARSAT's original and primary objective, i.e., maritime services.

5.2.2.2.2 INMARSAT DBS-R System Authorization by U.S. Signatory

As with INTELSAT, if INMARSAT intends to offer DBS-R, Comsat has to formally request permission from the FCC to participate in the "service offering". Comsat's role would be that of a common carrier, subject to the same regulatory requirements as described in the paragraph concerning its responsibilities as U.S. Signatory to INTELSAT.

As previously noted, the limits of Comsat's Signatory role in INMARSAT have been challenged on the basis that the INMARSAT Act does not specifically confer to Comsat U.S. Signatory status beyond maritime service activities. Nevertheless, the FCC has determined that the Act does not prohibit Comsat's provision of other INMARSAT services in the context of its Signatory role as long as such services are ancillary to and supportive of Comsat's provision of maritime service. This determination was made in the context of Comsat's application to participate in INMARSAT's aeronautical service offering. A strong argument could be made that it would extend to DBS-R as well should INMARSAT decide to offer the service.

5.2.2.2.3 INMARSAT DBS-R Authorization by Foreign Signatories

INMARSAT consists of approximately 55 member nations. The Soviet Union and other Eastern European countries are also members of INMARSAT. As with INTELSAT, the INMARSAT Agreement permits lease of space segment by authorized telecommunications entities of non-member countries, but not investment or participation in decision making.

5.2.2.3 EUTELSAT Provision of DBS-R

5.2.2.3.1 EUTELSAT Options

EUTELSAT was established to provide space segment required for public telecommunications services throughout Europe. As with INTELSAT, the EUTELSAT space segment may also be made available for the provision of specialized services such as DBS-R within Europe, provided that the provision of public telecommunications services is not unfavorably affected and the arrangements are otherwise acceptable from a technical and economic standpoint.

EUTELSAT may also provide separate satellites for specialized telecommunications services, and the provision of such services is not specifically limited to European territory. As with INTELSAT, EUTELSAT can finance such a satellite if there is unanimous consent of the membership. Additionally, the issue of secondary status for DBS-R appears to be less relevant on a separate EUTELSAT satellite established specifically for DBS-R than if DBS-R is to be provide on EUTELSAT's primary space segment. One distinction between EUTELSAT and INTELSAT with regard to this option is that unanimity would be far easier to achieve since the membership is so much smaller.

5.2.2.3.2 U.S. Domestic Issues

The United States is not a member of EUTELSAT. However, the EUTELSAT Agreement specifically permits the telecommunications administrations or entities to negotiate and enter directly into agreements with EUTELSAT. Although it does not specify whether such administrations or entities must be under the jurisdiction of member countries, it appears that telecommunications entities of non-members could negotiate such agreements with EUTELSAT.

U.S. private entities wishing to access EUTELSAT to transmit or receive DBS-R programming must obtain FCC authorization to do so. Although there have been no direct precedents for such access as yet, the U.S.

transborder and separate international systems policies serve as useful analogies. These analogies must be carefully considered in the context of U.S. broadcast regulations under Title III of the 1934 Act.

5.2.2.4 ARABSAT Provision of DBS-R

5.2.2.4.1 ARABSAT Options

ARABSAT's charter is to provide a communications satellite system for the provision of general and specialized services to Arab states. The definitions of these types of services are analogous to public and specialized services, respectively, as defined in the INTELSAT Agreement. The distinguishing factor, however, is that the ARABSAT charter does not differentiate between these services in terms of status or priority. In fact, DBS-R is specifically recognized as an important service to be provided by the organization in meeting its objectives.

Although ARABSAT's primary purpose is to serve the telecommunications needs of the Arab states, its charter permits it to engage in any other activities that serve the objectives of the corporation. Presumably, therefore, the ARABSAT membership could permit access to the system by non-member countries and their telecommunications entities if they determined it in their interest to do so.

5.2.2.4.2 U.S. Domestic Issues

As with EUTELSAT or any other foreign satellite system, U.S. private entities wishing to access ARABSAT to transmit or receive DBS-R programming must obtain FCC authorization to do so. The same issues discussed for EUTELSAT are applicable here.

5.2.2.5 Private System Managed By International Organizations

An attractive option is the management of a private DBS-R system by an intergovernmental satellite organization. The intergovernmental organization would provide the political framework necessary to obtain landing rights in countries throughout the world, while the private system could generate financial support without political impediments associated with intergovernmental organizations.

The charters of both INTELSAT and EUTELSAT can generally be interpreted to permit those organizations to serve in a management capacity for a private system, as long as there is no adverse economic or technical impact to that organization. The private system would pay an appropriate management fee as compensation for such services.

5.2.2.6 Global Interconnection of Different DBS-R Systems

Another option is that multiple regional systems, either private, governmental, or a combination of both, could establish joint operating agreements to provide global DBS-R services. These systems, which independently would cover different geographic areas, would not have to be established at the same time.

Unless the FCC determines otherwise (for reasons arising from the joint operating agreement or some other factor), the U.S. regulatory regime would depend on the degree of reciprocity that the system operators would be willing to entertain. New ground may have to be broken as far as regulation of foreign broadcasts into U.S. is concerned. However, the FCC is likely to encourage rather than inhibit progress in establishing systems to facilitate cultural exchanges.

5.3 Observations on DBS-R Legal and Regulatory Issues

The legal and regulatory issues identified here are based on the assumption that NASA and VOA do not intend to be DBS-R owners or operators. Rather, NASA's interest is in assisting the development of technology for DBS-R to a point that it can be transferred to the private sector for use in commercial systems. VOA's interest is in identifying options that facilitate its ability to access, as a customer and service provider, systems capable of providing space segment for international DBS-R services on a commercial basis.

We have explored the legal and regulatory aspects of the range of options available to meet the above stated requirements of NASA and VOA within two basic categories: (1) private non-treaty organizations; and (2) treaty organizations. Following is a summary of the observations.

5.3.1 Private Non-Treaty Organizations

A private non-treaty based organization would be in the best position to expeditiously develop and implement a financial and business plan for DBS-R. This can be done with a minimum of internal administrative barriers. However, the private non-treaty organization will likely need to resolve a multiplicity of regulatory issues in a variety of countries. In order to minimize these impediments, it will be necessary for the private organization to strike strategic alliances with state broadcasters and telecommunication entities who have significant political clout to break down the regulatory and legal barriers to DBS-R. It will also be necessary to analyze and select political forums that are hospitable to DBS-R. We have identified the United States as one forum that would be hospitable for DBS-R. Further research analyzing legal and regulatory issues in a number of countries will need to be conducted before other forums can be accurately identified.

In order to implement a private non-treaty system, a partnership or corporation should be established whose purpose is to develop and implement a DBS-R system. Equity in this entity should be spread among parties that can contribute technology or political clout to the DBS-R system. VOA's role in the system should be limited to leasing transponders from the satellite operator. In this regard, a transponder lease is likely to be used to provide collateral for the project's underlying financing. This presents a special problem for both VOA and the DBS-R operators because VOA as a government agency has limited ability to make long-term contractual commitments. Since it is likely that a number of the initial DBS-R transponders will be leased by existing international government broadcasters, means must be found for governments to guarantee the leases. Otherwise, it will be extremely difficult for the DBS-R operator to obtain the financing necessary to construct, launch and operate the satellite system.

5.3.2 Treaty Organizations

Within the category of treaty organizations, we have concluded that a new treaty organization for DBS-R service is not a realistic option, because of the politics and amount of time required to establish such an organization. With regard to existing treaty organizations, both INTELSAT and INMARSAT have current legal constraints on their ability to provide DBS-R service. However, the extent to which these legal constraints are an impediment to either of these organizations' provisions of DBS-R, on a commercially viable basis, is largely a function of that organization's membership's desire to enter the DBS-R market.

5.3.2.1 INTELSAT

INTELSAT's charter permits the organization to use its space segment for specialized services such as DBS-R, but only to the extent that the provision of public telecommunications services is not impaired. The terms and conditions required to establish this assurance would make DBS-R a secondary service in every respect, and therefore make this option unattractive.

As an alternative, INTELSAT's charter permits it to finance and own satellites as part of the INTELSAT space segment for specialized services such as DBS-R, as long as all members of the organization agree. In this context, the term "satellites" could mean completely separate spacecraft, or it could mean transponders that "piggyback" on INTELSAT spacecraft planned for public telecommunications services. Even in this case,however, neither the separate spacecrafts or piggyback options for DBS-R could be permitted to adversely affect INTELSAT's provision of public telecommunications services in any way. Conditions of use would be established by the Assembly of Parties and included in the terms of contract between INTELSAT and any users of the DBS-R space segment.

Discussions with Comsat indicate that the current INTELSAT system has existing IBS offerings that might be suitable for DBS-R to fixed points for further distribution via terrestrial means. It is possible that the use of spread spectrum techniques at Ku-band might be capable of providing high quality small antenna introductory services. These discussions further indicate that a DBS-R transponder could be incorporated into the INTELSAT VIII series of satellites, but that the technical characteristics of the INTELSAT VIII series, as currently defined, are unsuitable for implementing such a modification.

5.3.2.2 INMARSAT

INMARSAT's charter permits the provision of DBS-R services in the maritime environment, but does not permit such services to be provided over land. The pending land mobile amendments to INMARSAT's charter do not appear broad enough to remove this limitation. Despite its current limitations, the prospect of a near-term amendment to permit INMARSAT to provide DBS-R over land should be considered a viable option. The organization's membership has twice demonstrated (with aeronautical and land mobile services) its ability to quickly amend its charter when convinced that such amendment is in the best interest of the organization.

Despite the current limitations of its charter, INMARSAT's current space segment is used to provide DBS-R services for AFRTS and a group of islands in the Pacific Ocean Region. The current system could be used for additional experimentation and testing of DBS-R services. With regard to the next generation INMARSAT space segment, Comsat has stated that it might be possible to include an experimental transponder for DBS-R services on these spacecraft, which are currently entering the design phase.

5.4 Conclusions from Legal and Regulatory Perspective

The DBS-R service is unique in that it must grapple with bilateral and multilateral issues pertaining to cross border broadcasts, copyright laws, and equitable access to DBS-R channels. The service could be offered under the auspices of established international satellite operators such as INMARSAT or INTELSAT to seek expedited resolution of these issues. However, under this option, DBS-R service will neither have the priority nor the focused organizational support that such an innovative service will require to be successful. It is believed that privately financed and operated systems, subscribing to common technical guidelines established by an international organization, offer the best prospect for bringing DBS-R service to the marketplace. The term 'private' here also refers to organizations such as the European Telecommunications Satellite Organization (EUTELSAT) and Arab Satellite Consortium (ARABSAT) who might be best situated to operate regional systems.

In the United States, the Federal Communications Commission (FCC) might mandate a consortium type of structure, in the event there are several applicants vying for a license to operate the service. The FCC may also require the operator to be a common carrier with access to the DBS-R channel regulated on a common carrier basis. The broadcasters who buy or lease channels will be responsible for the content of the programming material and will be regulated as broadcasters.

Several legal issues remain unresolved. For example, will an international broadcaster, leasing capacity on a US DBS-R system, be subject to FCC regulations? Could bilateral or multilateral arrangements be made to address this issue on the basis of reciprocity? Does the US Government have an obligation to ensure that third world countries are not deprived of access to US DBS-R channels because of predatory pricing? Forums such as the International Telecommunications Union (ITU), and the United Nations Organization (UNO) might be ideal to debate and resolve these issues.

SECTION 6

BUSINESS CONSIDERATIONS

Market research on the domestic and global radio audiences, and a marked trend in consumers' preference for higher quality audio products unequivocally suggest that the DBS-R system presents an opportunity to an entrepreneur. The enabling technology is at hand. However, the technological feasibility is only one of several determinants in assessing the viability of a DBS-R system from the marketplace perspective. An entrepreneur must make a persuasive case to convince investors that their rate of return on such a system will be commensurate with the risk they are taking.

In this section, we present a summary of the market, technical, and cost factors that are pertinent to developing a business case for the DBS-R system.

6.1 DBS-R MARKET NICHE

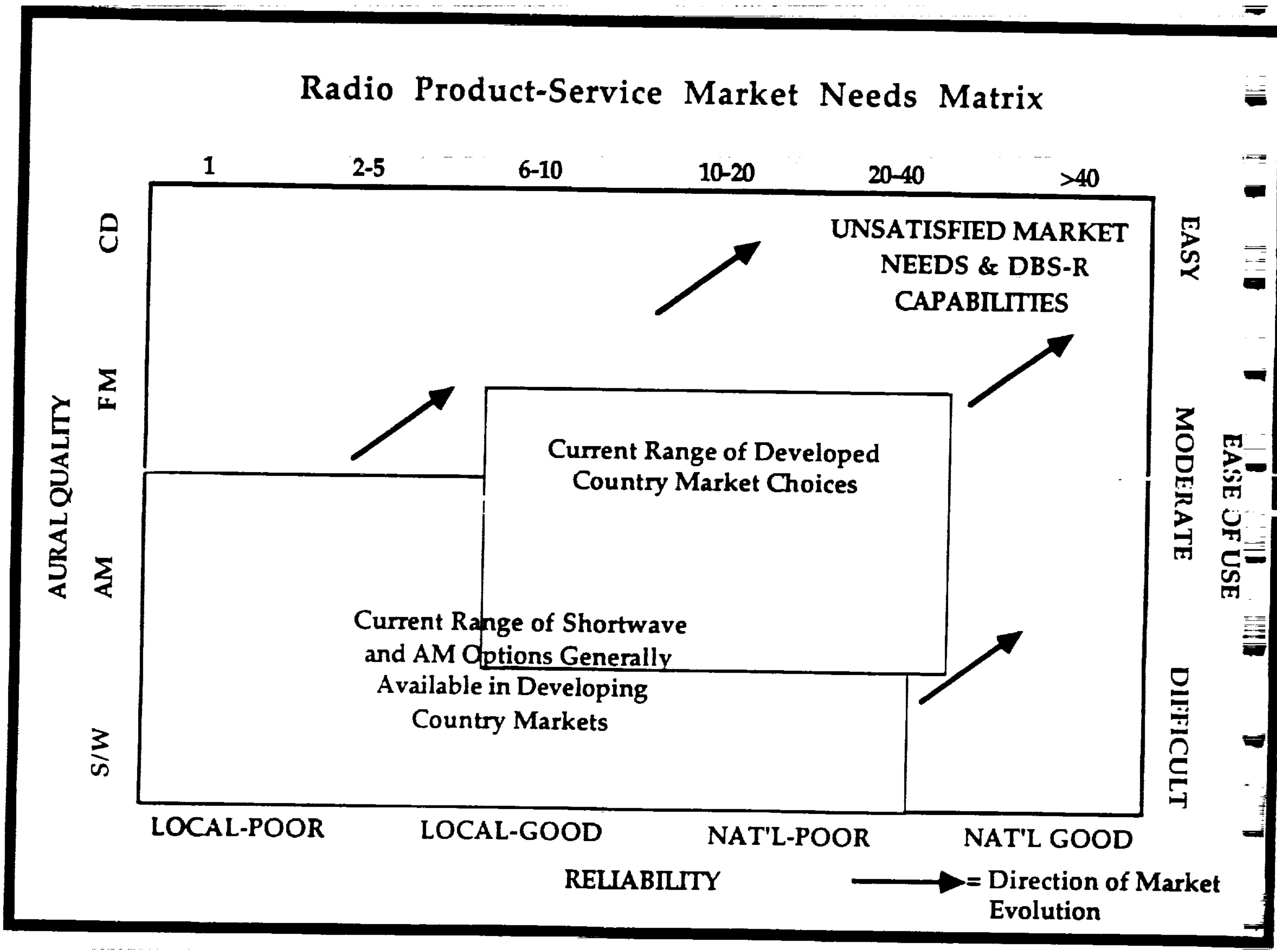
Figure 6-1 is a Product-Service Market Needs Matrix highlighting the unsatisfied market needs that DBS-R can uniquely address. Note that the direction of market evolution is clearly from:

- a few channels of poor quality and problematic reliability which are difficult to tune, typified by shortwave broadcasts typical in some developing countries; to

- a dozen or so channels of shortwave quality available nationally, complemented by a few local AM channels, neither of which are conveniently tunable, typical in more economically advantaged developing countries; to

- a mix of FM and AM quality signals, with up to forty channels available in developed urban areas, but lacking compact disk quality or reliable inter-urban coverage; to

Figure 6-1


Radio Product-Service Market Needs Matrix
1
2-5
6-10
10-20
20-40
>40
CD
FM
AM
S/W
AURAL QUALITY
UNSATISFIED MARKET NEEDS & DBS-R CAPABILITIES
Current Range of Developed Country Market Choices
Current Range of Shortwave and AM Options Generally Available in Developing Country Markets
EASY
MODERATE
DIFFICULT
EASE OF USE
LOCAL-POOR
LOCAL-GOOD
NAT'L-POOR
NAT'L GOOD
RELIABILITY
= Direction of Market Evolution

- two to three dozen compact disk quality channels, easily tuned with uniform quality across nationwide areas.

The DBS-R market objective is to penetrate and eventually dominate the 2+ billion existing terrestrial radio sets with new digital satellite radios.

6.2 DBS-R RECEIVER MARKET PENETRATION

The benefits of DBS-R are, of course, entirely dependent on the number of DBS-R receivers in the market. Without a large base of receivers, it will not be cost effective to provide any programming. A conservative approach is to use actual growth rates for radio sets in the Third World as the basis for estimating satellite radio receiver market penetration. The assumptions and considerations for using this historical radio sales data are as follows:

- It is assumed that market behavior for purchasing shortwave, AM and FM radios will reflect market behavior for purchasing comparably priced DBS-R receivers.

- It is assumed that satellite radio receivers will incorporate one or more other radio bands to maximize their market potential, especially during the initial transitional period.

- It is assumed that the lack of familiarity with DBS-R service and satellite radio receiver is comparable to the newness of terrestrial radio receivers during the market comparison period (1955-1990).

- The effect of modern technology and modern market distribution mechanisms for consumer electronics, which enables faster diffusion of new products, is considered an enabling factor in the DBS-R receiver penetration of the market.

With these caveats in mind, Tables 6-1 and 6-2 provide the estimated market build-up of satellite radio receivers for developing and developed countries assuming DBS-R facilities are emplaced during 1993-95. Tables 6-1 and 6-2 were developed by extrapolating the data presented earlier in Figures 2-6 and

TABLE 6-1

PROJECTED DEVELOPING WORLD SATELLITE RADIO SETS IN USE BASED ON HISTORICAL DATA FOR GROWTH OF TERRESTRIAL RADIO SETS

Terr. Radio:	1955	1960	1965	1970	1975	1980	1985	1990
Sat. Radio:	1995	2000	2005	2010	2015	2020	2025	2030
Sets in Use:	10M	50M	100M	150M	200M	300M	400M	600M

TABLE 6-2

PROJECTED DEVELOPED COUNTRY SATELLITE RADIO SETS IN USE BASED ON HISTORICAL DATA FOR GROWTH OF TERRESTRIAL RADIO SETS

Terr. Radio:	1935	1940	1945	1950	1955	1960
Sat. Radio:	1995	2000	2005	2010	2015	2020
Sets in Use:	1M	50M	100M	150M	200M	300M
Terr. Radio:	1965	1970	1975	1980	1985	1990
Sat. Radio:	2025	2030	2035	2040	2045	2050
Sets in Use:	400M	600M	700M	800M	900M	1 Bil

2-8. For both sets of countries, the historical growth rate has been a remarkably consistent 10 to 20 million radio sets per year. Even the worst-case data, that for erstwhile Communist countries where government controls interfered with radio set acquisition, demonstrate a historical growth rate of 5 million radio sets per year.

The difference in absolute numbers of radios owned between developed and developing countries reflects the 20 year "head-start" developed countries had in putting radio transmission facilities in place. This "head-start" is unlikely to be a factor for DBS-R because of the much greater ease of initiating services as contrasted with terrestrial services requiring emplacement of extensive facilities.

Also, differences in the economic conditions between developed and developing countries are automatically built into the count of total radios in use. Although developed country per capital gross national product (GNP) is much higher than that in developing countries, the developing countries enjoy a 5:1 advantage in total population. Were economic conditions similar, one would expect developing countries to have many more radio sets in use. Instead, as Table 6-1 shows, developed countries generally have 2 to 3 times as many radio sets as developing countries.

6.3 Technical Considerations

Technical considerations for a DBS-R system include providing for its constituent space, control and user segments. All necessary technologies for these three segments currently exist and have been demonstrated in non-DBS-R applications. The key technical consideration is to accomplish an optimal and smoothly integrated combination of the necessary space, control and user segment technologies.

6.3.1 DBS-R System Technological Feasibility

Although no DBS-R system exists today, the necessary technical, market, operational, financial and management elements have each been demonstrated in other instances. The challenge of the DBS-R entrepreneur is to combine these proven elements in a new way to serve the vast public market for radio programming service.

Technically, the concept of satellite-to-user direct broadcast transmissions has been demonstrated in practice since the early 1970's in NASA experiments. Today, both Japan and Western Europe enjoy commercial direct satellite broadcast television systems. Although a DBS-R system will require smaller (and even mobile) satellite antennas, unlike the fixed-mount dishes of DBS-TV, such handheld and mobile satellite antennas are in routine use today by the GPS Navstar, Geostar and INMARSAT users.

Marketwise, radios represent the most ubiquitous communications medium available. Whether the market is the United States, where the radios outnumber telephones by a margin of more than 2 to 1, or Africa, where at least one in seven persons owns a radio, there is no doubt concerning the existence of a robust radio market. Although DBS-R radios will need to co-exist and eventually dominate existing AM, FM and shortwave radios, there is ample evidence from the recent replacement of LP record players with compact disks players that the public is willing to rapidly switch technologies to better address their listening needs.

Operationally, there are several success stories worldwide of new satellite systems, operated as businesses. Among these stories are JCSat in Japan, Telesat in Canada, Astra in Europe, PanAmSat in the Atlantic Region, and AsiaSat in the Far Pacific. Hence, there is a relatively well-worn path to business success via operating a satellite system on a commercial basis. It should be noted that the above-mentioned examples include systems which have grown from entrepreneurial funding.

One of the significant risks facing a satellite system is acquisition of the necessary financial capability to achieve initial operations. While this milestone has been accomplished from entrepreneurial roots by several companies -- Geostar, PanAmSat, Astra, British Satellite Broadcasting -- there have been other companies that have failed to achieve satellite financing -- National Exchange, United States Satellite Broadcasting, and Comsat's Satellite Television Corporation. The keys to success appears to lie more with management's astuteness in financial development and business staging, than in the inherent aspects of the satellite technology. Hence, effective management is one of the most important ingredients for DBS-R business success.

6.3.2 Space Segment Technical Considerations

DBS-R space segment technical considerations pertain to system capacity or number of channels, and the geographic coverage area. As with most any telecommunications system, the greater the capacity, the greater the cost. It is axiomatic to business planning that one not install greater capacity than is necessary for near-term demand. This axiom leads to the business planning conclusion that DBS-R space segment technology should focus, in the near-term, on small capacity satellite technology, which minimizes capital outlays.

Budgetary quotes obtained from spacecraft manufacturers have resulted in delivery-to-orbit costs for the smallest increment of satellite sound broadcasting capacity of $70-80 million, inclusive of satellite construction, launch and insurance. The level of capacity provided by this entry level system is consistent with the lower range of data rates shown in Figure 6-2, which is compiled by the Jet Propulsion Laboratory (JPL). These data rates would support approximately 10 channels of varying quality programming (from several AM-stereo to a couple CD) to a continental coverage area such as North America, South America, Africa, Europe and European Russia, South Asia or Oceania.

6.3.3 Ground Segment Technical Considerations

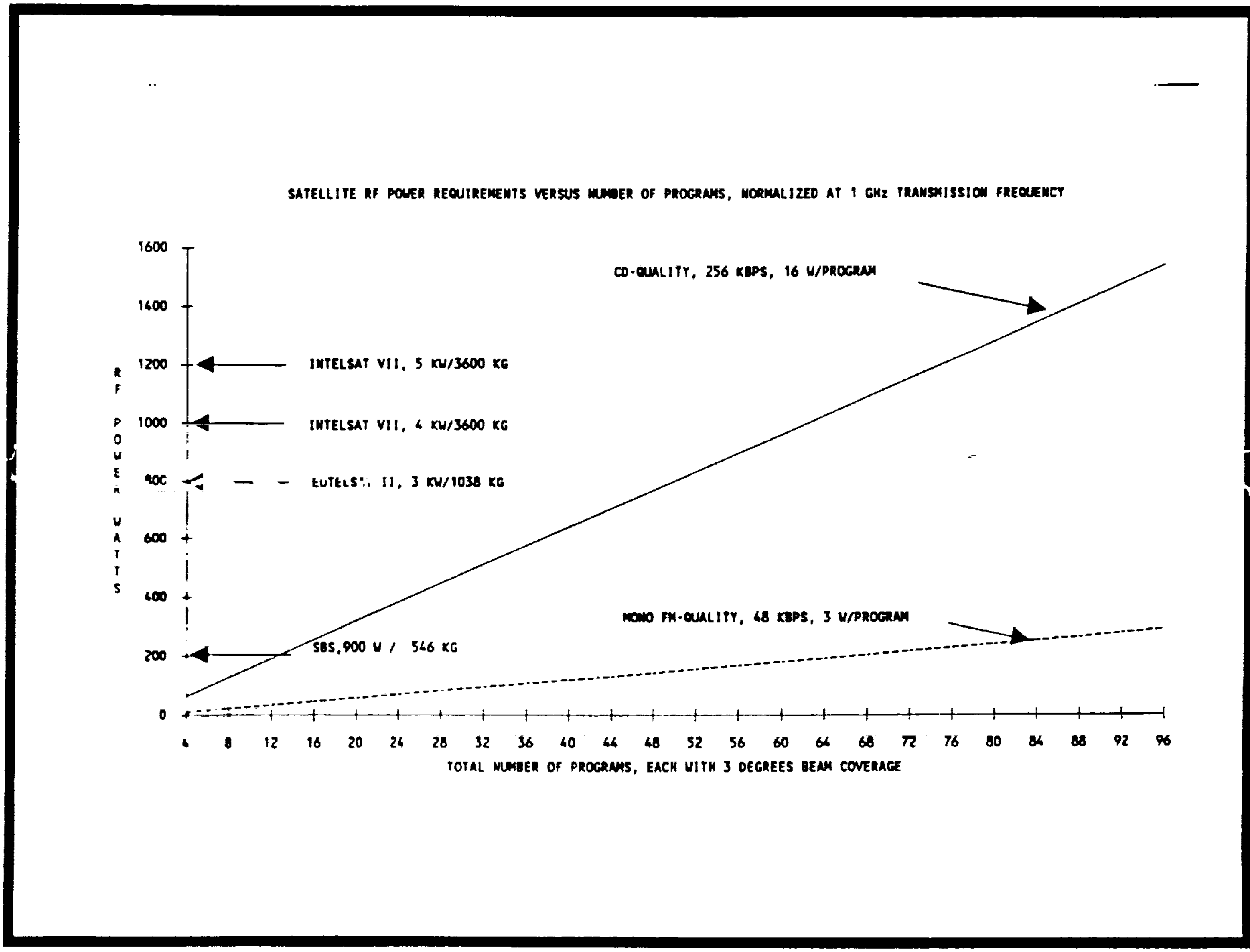
The purpose of the DBS-R ground segment is to feed (uplink) programming to the satellites for distribution, and to control the technical status of the satellite. There are no unique technical challenges in this area insofar as many thousands of hours of satellite uplinks have been accomplished worldwide for television and indirect sound distribution. The key technical considerations for the ground segment are:

- Geographic location of tracking, telemetry and command (TT&C) Center;
- Geographic location(s) of uplink centers; and
- Frequency bands for ground segment functions.

Geographic location of TT&C is important because any interruption of TT&C could result in a total loss of the DBS-R satellite. Hence, the highest priority must be given to technical integrity and physical security of the TT&C facility.

Geographic location of program uplink facilities is important because extra costs will have to be incurred in delivering programming to the uplink centers. However, the availability of relatively low-cost INTELSAT and private

Figure 6-2



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OF POOR QUALITY

channels for audio bandwidth transmission enables the uplink center(s) to be anywhere in the world as long as they can access the INTELSAT and/or private satellite system.

Frequency band choice is important because many frequencies do not propagate well through the atmosphere. Since degradation in the program uplink affects the quality and reliability of a transmission to all of the DBS-R listeners, paramount consideration must be paid to ensuring a well-propagated uplink.

From a cost standpoint, experience with other satellite systems has repeatedly shown that satellite ground facilities cost 5-15% of total space segment costs, and require a commensurate level of annual expenditure for operations. Accordingly, for the small satellite baseline being considered here, a control center can be expected to cost on an average $3 to 4 million per satellite, plus a comparable level of annual expenditures for salaries, general, administrative and other operating costs. An attractive alternative would be to acquire control services from an established satellite system operator who already has the infrastructure in place.

6.3.4 DBS-R Receiver Segment Technical Considerations

The receiver or user segment for a DBS-R system consists of the various types of low-cost satellite radio receiver sets. Key technical considerations and trade-offs for such radio sets are:

- Frequency band of operation
- Data rate (sound quality)
- Size and power (for portables)
- Number of channels tuneable
- Fixed or variable data rates
- Modulation/transmission standards

Because of the inter-dependence of space and user segments, it is essential that system requirements and their allocation to space and user segments be carefully considered. It is imperative that propagation measurements be made at the spectral band allocated to DBS-R to ensure that link margins are optimal.

Preliminary research indicates that the basic materials costs of DBS-R receiver are less than $150 in 25,000 lot quantities, less than $100 in 100,000 lot quantities, and less than $35 in 1 million lot quantities. The most expensive part (s) will be customized Application Specific Integrated Circuits (ASICs) to do the digital information and signal processing. Labor for devices similar to a DBS-R receiver is less than $3-10 per unit, and overhead amortization ranges from $5-30 per unit, depending on local factory conditions. These numbers are consistent with retail prices for a DBS-R receiver of $150 to $350, depending on lot quantity, local factory production conditions, and competition among suppliers. Yet lower prices would result from production levels consistent with current radio set production (greater than 20 million per year).

6.4 DBS-R System Operations Costs

The space systems, being capital-intensive, require careful upfront assessment to ascertain their viability from a business perspective. The DBS-R has the added challenge of creating and stimulating the commercial production of a new product, i.e., the DBS-R receiver.

The cost of revenue projections for DBS-R must follow the customary business practice where costs are broken down into capital and operations and maintenance (O&M) categories. Business considerations dictate that the revenues must exceed cost of revenue by a healthy margin to assure investors a rate of return commensurate with the risk that a business venture such as DBS-R entails.

The DBS-R system capital costs are the upfront costs incurred to purchase spacecraft, launch vehicle(s), launch services, launch insurance, and the capitalized interest charges accrued until the assets can be placed into revenue-generating service. The size of the spacecraft depends upon the capacity, i.e., the number of channels, and the number of spacecraft depends upon the desired geographical coverage. For example, an Entry System capable of offering 15 AM quality channels to cover the continental United States would be characterized as a small satellite system referred to as "Lightsat". Such a spacecraft would have power output requirement on the order of 70 watts. On the other hand, a spacecraft capable of covering the entire continental United States with four 3-degree beams and offering up to 50 channels, would be characterized as a medium sized satellite with power output requirement on the order of 200 watts. The spacecraft size and cost can be directly inferred from the spacecraft power.

The launch vehicle costs depend upon the weight of the spacecraft and any appendages such as the apogee kick motor, that must be lifted off the ground. Traditional launch vehicle manufacturers such as General Dynamics, Martin Marietta, and McDonnell Douglas in the United States, and Arianespace in Europe offer launch vehicles capable of launching medium and heavy satellites. Charges per spacecraft launch typically exceed $40 million and average around $50 million. Recently, the Peoples Republic of China has successfully demonstrated its capability to place satellites into the geosynchronous orbit via its Long March rocket at prices around $30 million per spacecraft. Several other private companies notably Orbital Sciences Corporation and Space Services Inc. are developing launch vehicles to launch relatively smaller satellites at prices much less than the traditional manufacturers'. For the DBS-R entry system, dubbed Lightsat, these vehicles offer an extremely attractive price/performance ratio.

The launch insurance rates which averaged around 5% prior to the Challenger disaster in early 1986 had risen to 25% by 1988 following a series of launch vehicle failures suffered by Arianespace, Martin Marietta, and General Dynamics. At the present time, following several successful launches, the rates have gravitated downward to 15 to 20 percent depending upon the history of the launch vehicle performance.

The O&M costs pertain to day-to-day operations costs. For the DBS-R system, these costs include the cost of maintaining and operating technical facilities such as the telemetry, tracking, and command (TT&C) center and uplink center(s) to uplink programming material to the satellite. The satellite monitor and control function requires a specialized facility staffed with engineers and technicians skilled in orbit determination and control and several spacecraft engineering disciplines. For a small capacity DBS-R system hosted on a Lightsat, it might be more cost-effective to lease these services from an established satellite operator.

Table 6-3 shows the capital and O&M costs and Table 6-4 shows revenue requirements for DBS-R systems. For the purpose of this exercise, we have assumed spectrum allocation in the 1.5 GHz region. The costing data will be favorably impacted if the spectrum allocation is in the 1.0 GHz region but will be adversely impacted if it is in the 2.5 GHz region. It can be seen from Table 6-4 that for a low capacity system, the DBS-R operator must charge a minimum of $340 per channel per hour to assure 18% rate of return on the capital employed. For a medium capacity system, i.e., 45 channels the capital cost is likely to be $110 million. Revenue requirement per channel per hour for $110 million investment reduces to $151. For a high capacity, i.e., 100 channel spacecraft, the capital employed is on the order of $140 million, and the revenue requirement per hour per channel reduces to $89.

Table 6-3

DBS-R System Operation Costs

	SYSTEM CAPACITY (NUMBER OF PROGRAMS OR CHANNELS)*		
	15 CHANNELS (LOW)	45 CHANNELS (MEDIUM)	105 CHANNELS (HIGH)
SPACECRAFT CHARACTERISTICS			
Beginning of Life Weight (Kg)	410	510	711
RF Power Requirement (W)	68	203	476
Solar Power Requirement (W)	478	1,085	2,300
CAPITAL COSTS			
Spacecraft and Launch Vehicle ($M)	56	70	90
Capitalized Interest ($M)	6	16	20
Launch Insurance ($M)	14	14	18
Technical Facilities ($M)	3	5	7
Startup Cost ($M)	3	5	7
Total Capital Cost ($M)	82	110	142
OPERATIONS AND MAINTENANCE (O&M) COSTS/YEAR)			
Technical Operations ($M) (Satellite Control & Uplink Centers)	2.0	3.0	5.0
On-Orbit Insurance ($M)	1.6	2.2	2.8
General & Administrative (G&A) ($M)	3.0	4.0	6.0
TOTAL O&M COST/YR ($M)	6.6	9.2	13.8
O&M Cost per Channel per hour ($) (66% duty cycle)	76	35	23

*AM quality channels (32Kbps). Note that O&M cost per channel per hour for a higher quality channel scales directly in terms of the data rate ratios. For example, FM-mono channel (48 Kbps) cost is 1.5 times that of an AM channel (32 Kbps) cost.

Table 6-4

DBS-R System Revenue Requirement for a Private System

	SYSTEM CAPACITY (NUMBER OF PROGRAMS OR CHANNELS)*		
	15 CHANNELS LOW	45 CHANNELS MEDIUM	105 CHANNELS HIGH
DEPRECIATION COSTS/YEAR			
Space Segment (10 yrs life) ($M)	7.9	10.5	13.5
Technical Facilities (20 yrs life) ($M)	0.15	0.25	0.35
OTHER COSTS/YEAR			
Cost of Money (15% per yr; average) ($M)	6.6	8.8	11.4
Return on Capital Employed (18%, average) ($M)	8.2	11.0	14.2
REVENUE REQUIREMENT PER CHANNEL PER HOUR ($) (66% duty cycle)			
Depreciation Cost per Channel per hour ($)	93	41	23
Other Costs per Channel per hour ($)	171	75	43
O&M Cost per Channel per hour ($) (From Table 1-2)	76	35	23
TOTAL	340	151	89

*AM quality channels (32 Kbps). The revenue requirement for a higher quality channel scales directly in the ratio of data rates. See footnote to Table 1-2.

6.5 DBS-R and Shortwave Broadcasting Cost Comparison

The only comparable radio broadcasting facility with which to compare DBS-R operating costs is shortwave, because both uniquely cover large, continental-size regions. Comparisons with local AM and FM broadcasting are not meaningful since these facilities cover a relatively small fraction of the geographic area served by a satellite facility.

Using operating cost per transmitter hour as the metric, the data provided above imply the following operating costs per transmitter hour per continent for DBS-R facilities:

Lightsat	$76 per channel per hour
Medium Capacity	$35 per channel per hour
Large Satellite	$23 per channel per hour

By comparison, data on shortwave operating costs range across the following values:

50 KW Religious	$44.87 per transmitter hour
500 KW Religious	$145.09 per transmitter hour
Radio Canada Int'l	$120.94 per transmitter hour
VOA	$187.50 per transmitter hour
Radio Nederland	$195.50 per transmitter hour
BBC	$189.52 per transmitter hour
BBC-Regional	$199.58 per transmitter hour
Senegal	$50.63 per transmitter hour

Note that transmission hour figures are based on actual hours of transmitting, nearly always less than full-time and greater than half-time, and are averaged over the various facilities that each broadcaster operates. Based on typical shortwave facility construction costs, including transmitter, antennae and buildings, the shortwave costs per transmitter hour should be increased by 10 to 20% for depreciation and amortization. Furthermore, implicit government subsidies result in an underestimating of shortwave operating costs by an indeterminate amount.

The DBS-R System operations and maintenance costs vary from $76 per channel per hour for the low capacity system to $23 per channel per hour for the high capacity system. Because of the higher quality and reliability of the DBS-R transmissions, it is not necessary to broadcast the same material on three different frequencies, as is the case with shortwave transmissions. Therefore, the DBS-R System O&M costs on per program hour basis are an order of magnitude less ($600 for shortwave versus $23 for DBS-R) than that for shortwave systems.

Tables 3-1 and 6-3 compare the day-to-day costs and ignore the depreciation and finance costs that a private system must contend with. The shortwave facilities' useful life is on the order of 30 years compared with the DBS-R spacecraft life which is typically on the order of 10 years. The international broadcasters maintain comprehensive capital improvement programs to upgrade their facilities. For example, VOA's shortwave facilities capital improvement program for the past 10 years has entailed expenditures of roughly $50 to $100 million per year and is anticipated to continue at the same level for the foreseeable future. Capital expenditures on this order add substantially to the real costs of delivering programming above and beyond that reflected in the day-to-day operations costs shown in Table 3-1.

Revenue requirement projections for a privately financed and operated system, where the capital expenditure is not written off and a reasonable rate of return is expected on capital employed, are shown in Table 6-4. Note that the revenue requirement on a per channel per hour basis assuming 66% utilization varies from a high of $340 for the low capacity system to a low of $89 for the high capacity system. The economies offered by the DBS-R System are dramatic even after all costs, i.e., O&M, depreciation, finance charges, and profit are accounted for. The low capacity system is attractive because it provides a quick entry into a new market with low capital requirement and in a time frame on the order of 18 months. The high capacity system, though it requires more capital and a gestation period on the order of 36 months, is very attractive because of increased flexibility and very favorable revenue requirements. The business decision as to whether to proceed with the low or high capacity system depends upon an entrepreneurial assessment of the risk, market potential, and the business environment.

It should be noted that, as previously stated, the shortwave facilities operations costs do not include allowances for depreciation, cost of money, or profit. Since most of the shortwave facilities are owned and operated by either Government or not-for-profit private entities, this practice is not questioned. For a privately-financed and owned system, operated on commercial basis, these expenditures account for a majority of the annual operating expenses (70% in Table 6-4). Therefore, the real costs for distributing programming over shortwave facilities are much higher than shown in Table 3-1.

It is apparent that costs to international broadcasters such as VOA will be much less over the DBS-R than over the shortwave facilities. It is also noteworthy that as DBS-R matures, the costs are expected to decline.

6.6 Maximum-Minimum Boundary Analysis

We can bound the expected cost range for satellite and shortwave operating costs by comparing the maximum and minimum cost data from each set. The maximum cost data from the satellite set is given by lightsat satellite system as $340 per channel hour. The maximum cost data from the shortwave set is given by BBC's Regional Service -- $198.58 per transmitter hour -- which should be multiplied by 1.2 to account for depreciation and amortization, yielding $238.30. It is clear that the upper bound cost figures for satellite and shortwave are comparable to each other.

The minimum cost data from the satellite set is given by the large satellite at $89.00 per channel hour. The minimum cost data from the shortwave data set is given by the 50 KW religious broadcasters as $44.87 per transmitter hour. This number will be multiplied by 1.2 to account for depreciation and amortization, yielding $53.84 per transmitter hour. This number is comparable to the satellite minimum cost data.

While comparing programming distribution costs of international broadcasters via shortwave and DBS-R facilities, it must be recognized that international broadcasters such as VOA typically broadcast the same material on 3 different frequencies using 3 separate transmitters to safeguard against natural and man-made interference sources. Therefore, the cost to VOA of distributing one hour of programming material via the shortwave facilities is 3 times that of a transmitter hour, i.e., approximately $450 to $500 per hour. The DBS-R because of immunity from natural noise sources, will not require broadcast over multiple channels. Hence, DBS-R offers the prospect of reducing broadcasting costs by a considerable margin.

6.7 Organization Considerations

The establishment and operation of a DBS-R system faces many legal and regulatory challenges. For a national system, the DBS-R operator must receive permission to use a part of the frequency spectrum and must comply with any licensing requirements that might be imposed. For a regional or global system, spectrum allocation must be approved by an international organization such as WARC. The issues of cross-border broadcasting and copyright law enforcement must also be dealt with. It is believed that a private organization operating under the umbrella of an international organization such as INTELSAT or INMARSAT might be the optimal choice for a regional or global system. The legal and regulatory issues underlying the establishment and operation of a national or global DBS-R system are addressed in Section 5. Here, we make a few brief remarks concerning the technical aspects of the organization that eventually has the responsibility for the implementation and operation of a domestic, regional, or global system.

Organizationally, the key consideration is to ensure that management is responsive to customer requirements, while remaining profitable. The organizational question is whether the DBS-R customers are programmers or listeners. Since the programmers' primary customers are the listeners, the DBS-R operators' primary customers must be the programmers. This means that the DBS-R operator should organize its business to identify and satisfy the needs of radio programmers in a profitable manner.

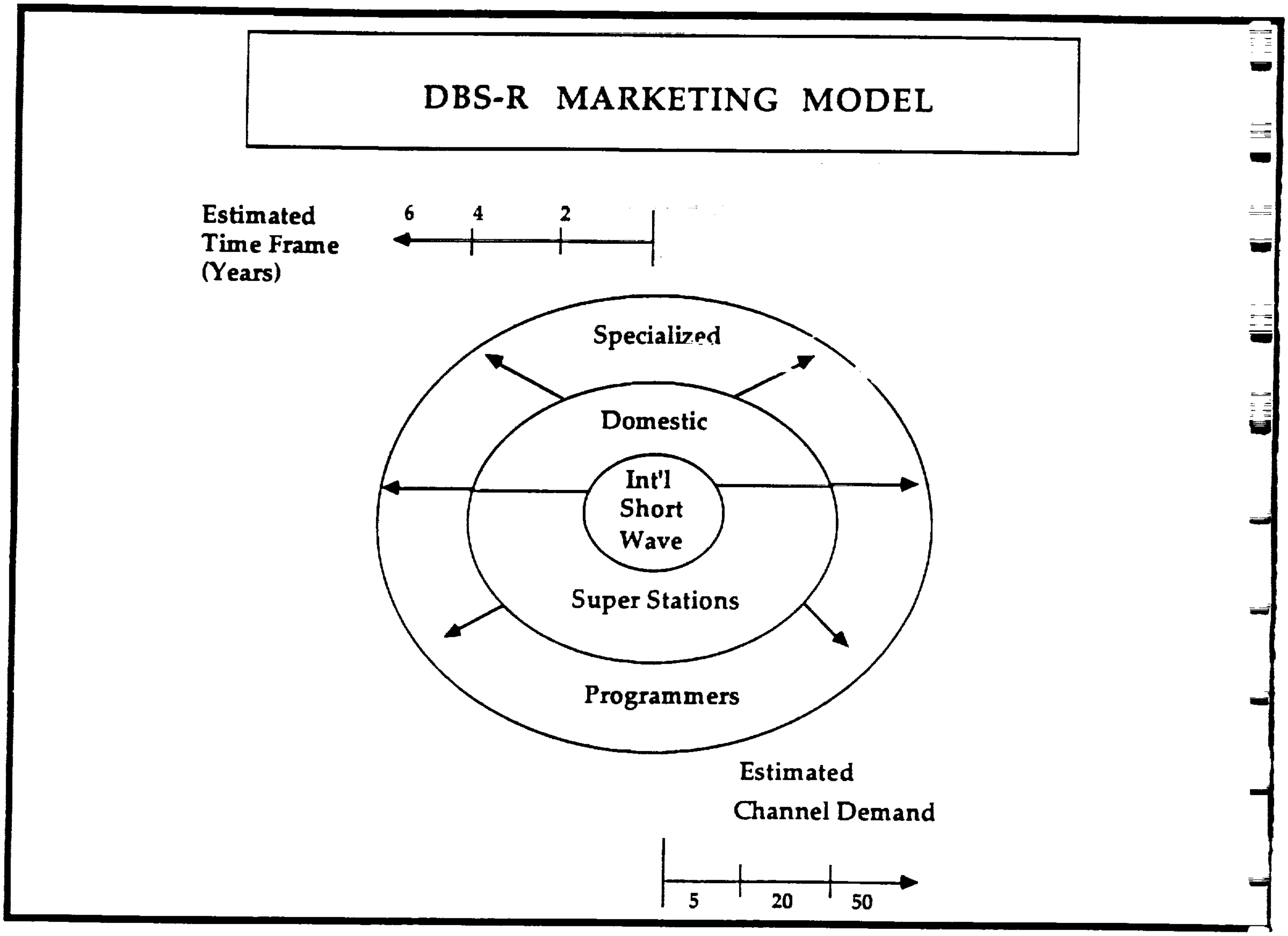
6.7.1 Organizational Considerations for Market Penetration

The first step for the DBS-R operation from an organizational standpoint is to identify its customers, both near-term and long-term. All subsequent organizational steps should be based upon understanding and satisfying the identified customer requirements. Figure 6-3 shows a DBS-R marketing model based on the concept of incremental growth from a core business base. Examining the model, it will be seen that the core customers are international shortwave broadcasters, followed by domestic superstations (local urban radio stations that want to go national via satellite), and finally specialized programmers that are looking for broader audiences. Based on focus group research with African broadcast specialists, examples of specific potential customer identities in each of the three aforementioned customer categories are shown for the African continent in Figure 6-4. It follows that the DBS-R operator should structure its marketing and management effort to provide maximum focus on international shortwave broadcasters, with some resources devoted to leading urban radio broadcasters, and an outreach effort to specialized programmers.

6.7.2 Organizational Considerations for Profitability

While identifying and satisfying market requirements, as described above, it is also essential to accomplish this objective profitably in order to attract capital for growth and business expansion. It was previously stated in paragraph 6.4 that operating costs for a DBS-R system can be quantified as a certain fraction of space segment costs. Hence, the key to profitability, after market penetration, is to optimize capital spending on satellites, i.e., closely matching the satellite capacity to near-term business projections.

Figure 6-3



DBS-R MARKETING MODEL
Estimated
Time Frame
(Years)
6
4
2
Specialized
Domestic
Int'l
Short
Wave
Super Stations
Programmers
Estimated
Channel Demand
5
20
50

Figure 6-4

DBS-R CHANNEL REQUIREMENTS FOR AFRICA

	CHANNEL NAME	N-W BEAM	S0-CENTRAL BEAM	EAST-ARABIA BEAM
INT'L S/W	VOA	X	X	X
	DEUTCHE		X	X
	NEDERLAND		X	X
	FRANCE	X	X	X
	BBC	X	X	X
SUPER	LAGOS	X		
	ACCRA	X		
	NAIROBI		X	X
	JOHANNESBURG		X	
	CAPETOWN		X	
	DARES SALAAM			X
	ADDIS			X
	CAIRO			
SPECIALIZED	ISLAMIC CULTURE	X		X
	BANTU CULTURE		X	X
	SWAHILI CULTURE		X	X
	FARM	X	X	X
	WOMANS	X	X	
	STORYTELLING		X	X
	HEADLINE NEWS	X	X	X
	WHO	X	X	X
	UNIVERSITY	X	X	X
	HIGH SCHOOL	X	X	X

Figure 6-5 provides a generic framework for DBS-R capital spending. The key is to be able to flexibly deploy spacecraft to meet market demand, and to adapt rapidly to changes in customer requirements. Not until a DBS-R business is well underway, will it be possible to know whether a series of Lightsats, or a single large satellite, is the right space segment development option. Hence, the DBS-R organization must be structured with strong technical management capabilities, and a tight feedback loop between technology and marketing.

6.8 Business Projections

Business projections for DBS-R revolve around the following key numbers, developed in this report, and a strategy for "seeding" the DBS-R market with a sufficient number of satellite radio receivers to enable "self-propelled growth." The key numbers are:

- Radio receiver set growth of 5, 10 or 20 million per year after self-propelled growth commences;

- Capital outlay of $30-40 million per continent for initial service capability;

- Operating costs of $6-8 million per year per continent.

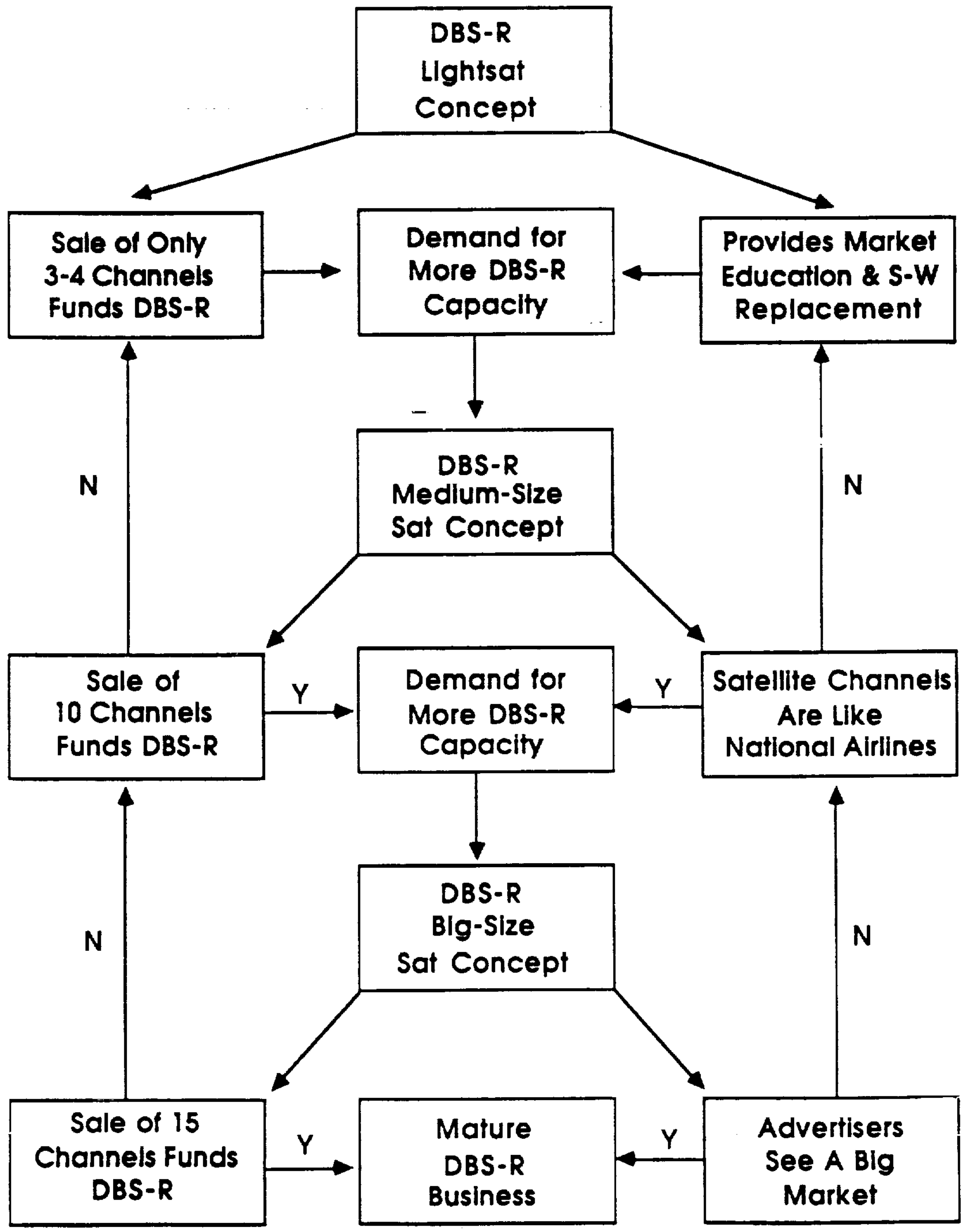
6.8.1 Seeding the Market to Achieve Self-Propelled Market Growth

After substantial discussion and research, the following steps are recommended as the optimal approach to market seeding and self-propelled market growth:

- Target 1 million radio sets globally as the take-off point for self-propelled market growth;

Figure 6-5

Framework for DBS-R Capital Spending



- Take affirmative steps to place about 100,000 radio sets in the hands of "opinion leaders" -- community organizations or individuals to whom others look for behavioral guidance;

- Require the DBS-R operator to be responsible for ensuring the production and distribution to opinion leaders of the first 100,000 radio sets per continent;

- Develop a funding algorithm which weans the DBS-R operator from any kind of explicit or implicit radio receiver set subsidy.

The most straight forward means to ensure that the market is seeded with DBS-R receiver sets is to make the production and distribution of such sets a requirement of receiving international broadcaster orders for DBS-R channel capacity. Since the international broadcasters are projected to be the primary customers of DBS-R operators, they are likely to be responsive to this requirement.

To make DBS-R radios available, without creating a subsidy-based distortion of the market, the production and distribution requirement should follow these guidelines:

- First third of radios are made available to qualified non-profit organizations at no-cost;

- Second third of radios are made available to qualified non-profit or opinion-leader organizations at 50% of cost;

- Last third of seed quantity radios are made available generally at cost.

Assuming the cost of each radio in a 100,000 quantity buy to be approximately $100, the cost of this program to the DBS-R operator would be in the neighborhood of $5 million. Hence, an international broadcaster request for proposal (RFP) for satellite capacity should include a requirement for providing a seed quantity of radios, and should expect bids from this item in the range of $5 million, in addition to hourly channel charges of around $200.

Although these figures do not take into account the cost of capital to the DBS-R operator, they also ignore the countervailing benefit to the DBS-R operator of a built-in market for all the other channels on the satellite system.

6.8.2 DBS-R Rate of Return

Capital investments are based on a comparison of perceived risk with expected rate of return, in light of alternative opportunities and various qualitative investment principles (e.g., pro- or anti-high-tech). In the financial markets of the early 1990's, there are numerous investment opportunities available in operating companies (i.e., with current revenues) with expected returns on investment ranging from 20-35%. Many of these operating companies are not currently profitable, but investors normally consider a non-profitable operating company much less risky than a non-operating company (i.e., with no revenues at all).

In light of less risky alternatives offering a return on investment as high as 20%, a DBS-R project will likely need to project measurably higher returns to investors. The figure of up to 25% is suggested because investors believe satellite-based projects are especially risky, due to much publicized launch delays and rocket explosions. On the other hand, returns much above 50% are rarely credible -- not because they are impossible, but because they require almost everything in a business plan to "go right." In reality, most business plans are continually revised and iterated to account for events that are not in accordance with projections.

6.8.3 Quantitative Business Projections

Provided in Table 6-5 are quantitative business projections assuming (a) the market ramp-up model described earlier, (b) the operating cost data for staged system, and (c) the market seeding requirements identified above.

6.9 DBS-R System Startup Considerations

In order to commence construction of a DBS-R system, it will be necessary for the primary customers for such a system -- broadcasters -- to purchase

TABLE 6-5
DBS-R SYSTEM BUSINESS PROJECTION

Year	1995	2000	2005	2010
Channels Launched (1)	30	180	300	600
Radio Sets in Use (2)	1 Mil.	10 Mil.	30 Mil.	70 Mil.
Channel Revenues (3)	$30 Mil.	$180 Mil.	$300 Mil.	$600 Mil.
Radio Set Sales (4)	$50 Mil.	$1 Bil.	$3 Bil.	$5Bil.
Operating Expenses (5)	$24 Mil.	$112 Mil.	$202 Mil.	$480 Mil.

Notes:

1. Three lightsats during 1993-95, a fourth lightsat and a large capacity satellite prior to 2000, three continent medium sats by 2005 and a global, high capacity redundant system by 2010. All channel data cumulative.

2. Based on historical radio set growth rates. See Tables 6-1 and 6-2. All radio sets data cumulative.

3. Assumes average selling price of $114 per channel hour, 100% duty cycle, or $228 per channel hour, 50% of capacity idle.

4. Assume $5 million per 100,000 radios seeding policy initially, average retail price of $100 per radio through 2005, $75 per radio thereafter, all figures in constant 1990 dollars.

5. Data derived from accompanying text.

channels on the system. Absent such purchase commitments, construction of a DBS-R system by a private organization is unlikely. Nevertheless, as shown in this report, DBS-R systems represent the best strategy for the international broadcasters for the following reasons:

- The inherent advantages of DBS-R technology over terrestrial radio technology will prevent loss of listening audience due to dissatisfaction with audio quality. Figure 6-6 shows a critical audience at risk because of poor quality of SW broadcast.

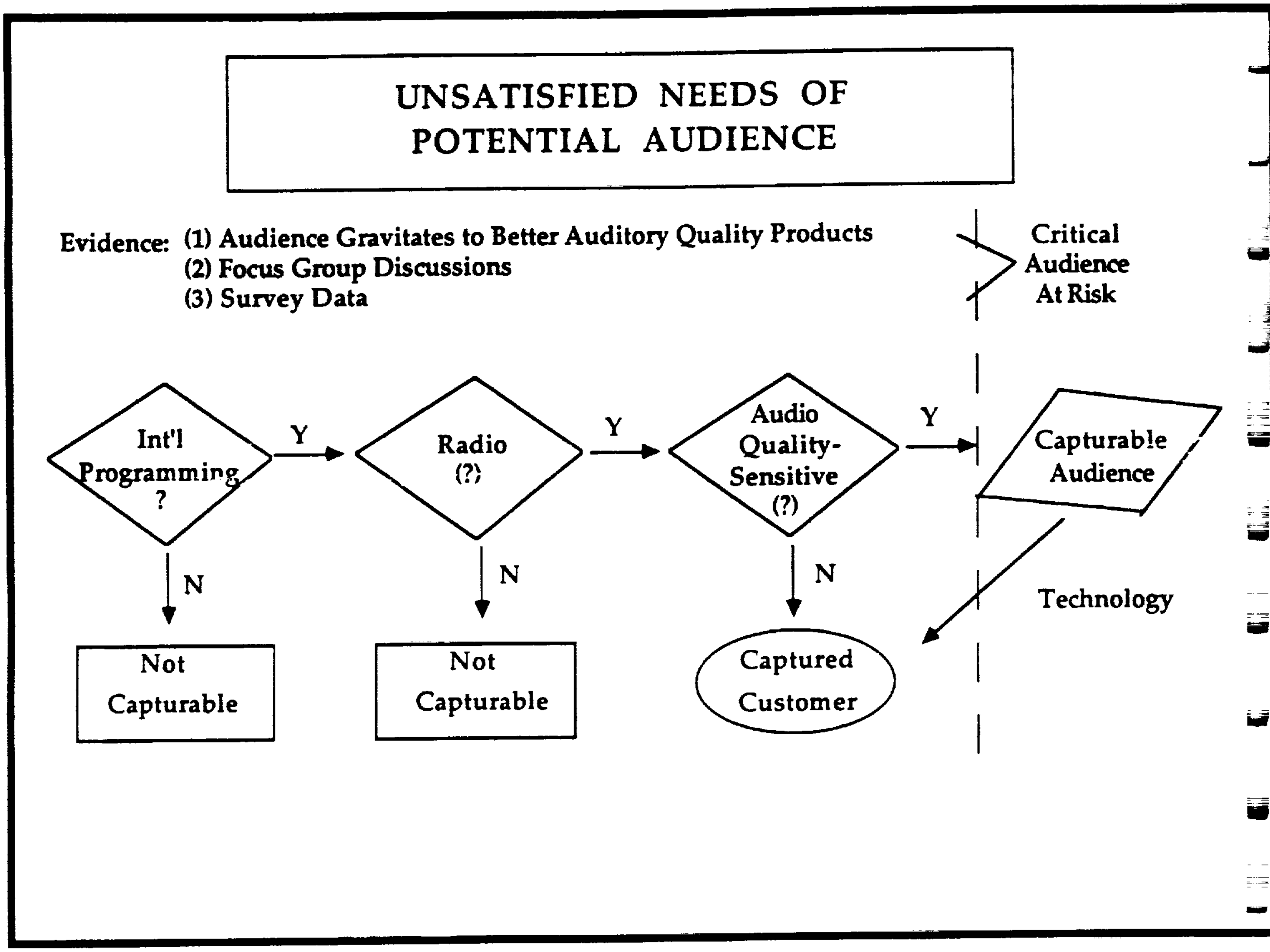
- The inherent costs of DBS-R technology are no greater, and in fact, are less for international broadcasters than those of terrestrial radio technology. The DBS-R costs progressively decrease as economies of scale are brought to bear on systems to meet increasing global demands.

- The "chicken and egg" dilemma of lack of satellite radio receiver sets can be solved with a rational "seeding" policy, costing no more than $5 million per 100,000 radios.

In order to financially move forward, international broadcasters will need to develop and issue one or more RFPs for DBS-R channel capacity, delivered working in orbit, and delivered in tandem with approximately 100,000 satellite radio receiver sets. Budgetary support for this approach will need to be at least $35 million, which represents minimum DBS operator break even point for the satellite plus funding for 100,000 satellite radio receiver sets. It is likely that competitive responses to the RFP will be delivered within the budget range. However, it may be prudent to seek budgetary support in the neighborhood of approximately $100 million to fund proposals for coverage of broader portions of the earth, and to provide a contingency in the event that responses to the RFP are higher than this business plan anticipates.

The financial structure of the negotiated contract will need to be prepaid channel ownership with milestone payments tied to satellite and radio receiver set construction. Otherwise, the DBS-R operation will not be able to fund the satellite construction. A fixed price plus incentive structure, with milestone payments, will probably work best, with the international

Figure 6-6



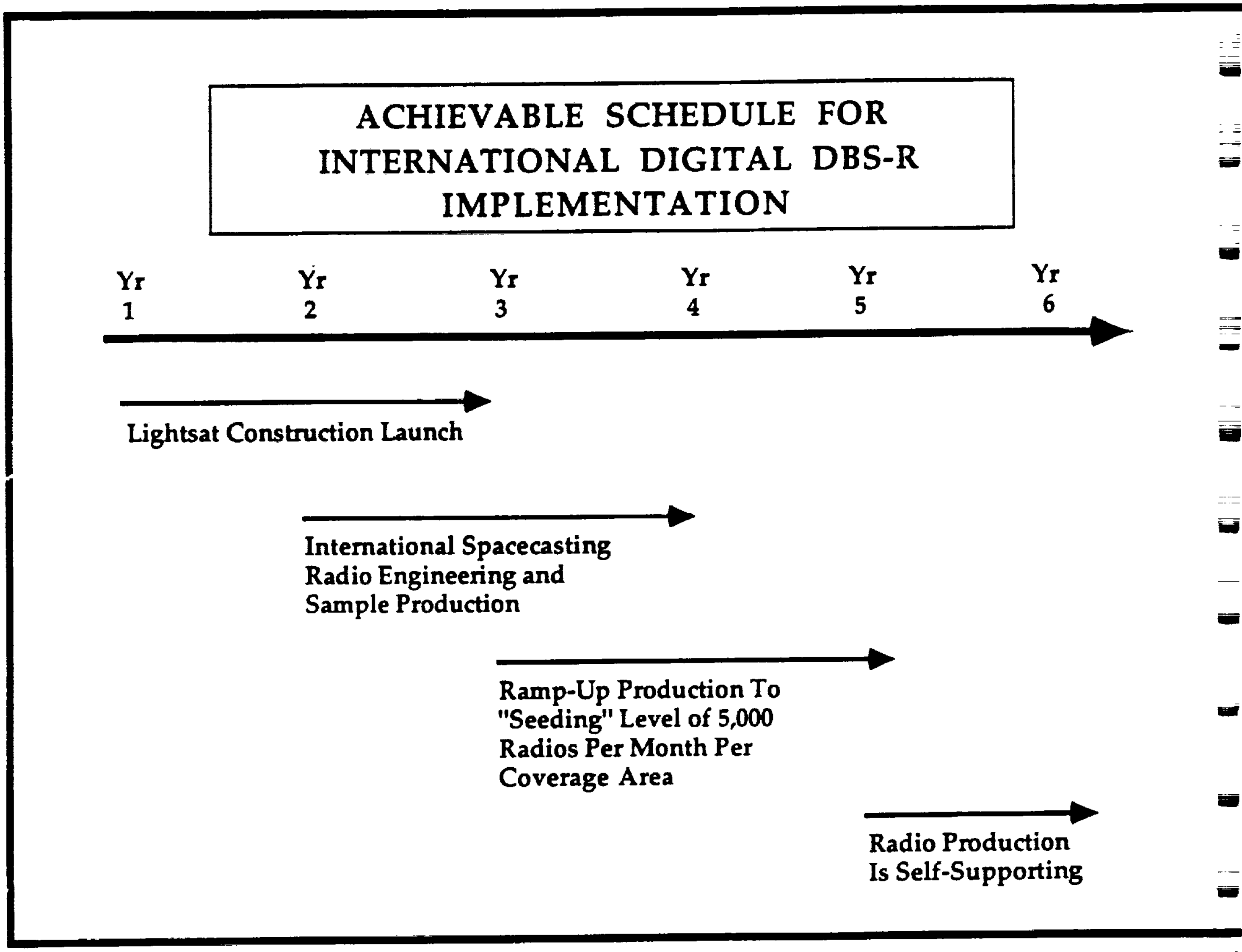
UNSATISFIED NEEDS OF POTENTIAL AUDIENCE
Evidence: (1) Audience Gravitates to Better Auditory Quality Products
(2) Focus Group Discussions
(3) Survey Data
Critical Audience At Risk
Int'l Programming ?
Y
Radio (?)
Y
Audio Quality-Sensitive (?)
Y
Capturable Audience
N
N
N
Not Capturable
Not Capturable
Captured Customer
Technology

broadcaster owning outright its channel(s), and the DBS-R operator free to sell and/or lease its remaining channels.

Figure 6-7 shows an implementation schedule for an international DBS-R system.

The case for DBS-R system implementation could be made on the basis of higher quality and broader coverage alone. However, it appears that the DBS-R system has also the prospect of reducing broadcasting costs of international broadcasters such as VOA. Higher quality coupled with lower costs makes a strong case for NASA and VOA to actively foster and encourage the implementation of private national, regional, and global DBS-R systems.

Figure 6-7


ACHIEVABLE SCHEDULE FOR
INTERNATIONAL DIGITAL DBS-R
IMPLEMENTATION
Yr 1
Yr 2
Yr 3
Yr 4
Yr 5
Yr 6
Lightsat Construction Launch
International Spacecasting
Radio Engineering and
Sample Production
Ramp-Up Production To
"Seeding" Level of 5,000
Radios Per Month Per
Coverage Area
Radio Production
Is Self-Supporting

APPENDIX A

Acronyms and Abbreviations

Acronyms and Abbreviations

AC	Adult Contemporary
AM	Amplitude Modulation
ARABSAT	Arab Satellite Consortium
ASIC	Application Specific Integrated Circuit
AUS	Australia
BBC	British Broadcasting Corporation
CCIT	Comite Consultaif Internationale de Telegraphique et Telephonique (International Telephone and Telegraph Consultative Committee)
CD	Compact Disc
CHR	Contemporary Hit Radio
DAT	Digital Audio Tape
DAB	Direct Audio Broadcast
dB	Decibel
DBS-R	Direct Broadcast Satellite - Radio
EIRP	Effective Isotropic Radiated Power
EUTELSAT	European Telecommunications Satellite Organization
FCC	Federal Communications Commission
FM	Frequency Modulation
GHz	Giga Hertz
HI-FI	High Fidelity
HR	Hour
INMARSAT	International Maritime Satellite Organization
INTELSAT	International Telecommunications Satellite Organization
ITU	International Telecommunications Union
Kbps	Kilobits per second
LeRC	Lewis Research Center (NASA)
LP	Long Playing
M	Meter, Million
MSS	Mobile Satellite Service
MW	Medium Wave
NASA	National Aeronautics & Space Administration
O&M	Operation and Maintenance
RCI	Radio Canada International

RFI	Radio France International
SW	Short Wave
TV	Television
UK	United Kingdom
USA	United States of America
VHF	Very High Frequency
VOA	Voice of America
WARC	World Administrative Radio Conference

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NASA PROJECT MANAGERS
MR. JAMES E. HOLLENSWORTH
MS. ANN O. HEYWARD
COMMUNICATIONS SYSTEMS BRANCH
LEWIS RESEARCH CENTER
CLEVELAND, OHIO 44135-3191

16. Abstract

A Direct Broadcast Satellite - Radio (DBS-R) system offers the prospect of reaching wider audiences with the audio quality tailored to meet the programming material needs. This report examines the regulatory and business considerations underlying the operation of a DBS-R system. The operation and maintenance costs of a proposed DBS-R system are computed, and compared with those of shortwave facilities operated by international and domestic broadcasters. The cost comparison shows that DBS-R can meet international broadcasters' requirements very cost-effectively. The revenue requirements for operating a privately-funded DBS-R system are estimated, and suggestions are offered to facilitate introduction of the DBS-R service by private industry.

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