Before the
COPYRIGHT ROYALTY BOARD
LIBRARY OF CONGRESS
Washington, D.C.

In the Matter of	)	
	)	
Adjustment of Rates and Terms for	)	Docket No. 2006-1 CRB DSTRA
Preexisting Subscription and	)	
Satellite Digital Audio Radio Services	)	
	)	

DIRECT TESTIMONY OF ROGER J. RUSCH
(ON BEHALF OF XM SATELLITE RADIO INC. AND SIRIUS SATELLITE RADIO INC.)

Introduction

1. I have been retained by the law firms Constantine Cannon, P.C. and Wiley Rein & Fielding LLP on behalf of XM Satellite Radio Inc. (XM) and Sirius Satellite Radio Inc. (Sirius). I have been asked to give expert opinions and testimony in the Copyright Royalty Board proceeding to determine the royalty payable by Satellite Digital Audio Radio Services. I was retained to provide expert opinions on the following issues:

- The types and levels of risk in starting and operating a satellite-based communications business.
- The types, nature, and amount of investment required to make a satellite enterprise viable.
- The anticipated returns necessary to attract investment required to launch, operate, and maintain a satellite business at various stages.
- How changes in operating cost and revenues would affect the business.

- How these considerations apply to Sirius and XM.

Qualifications

2. I am the President of TelAstra, Inc., a technical and management-consulting firm located in Palos Verdes Estates, California. My firm advises prospective investors in space-based systems. In this capacity I have reviewed many business plans and have monitored the progress of new satellite enterprises. **Exhibit 1** is my detailed resume, documenting the details of my 44 years of experience in the area of satellite communications. It also lists all my publications within the last 10 years and selected relevant publications in earlier years.

3. In summary, I have been active in the management and design of communications and broadcasting satellite systems since 1965 starting with INTELSAT III at TRW (now Northrop Grumman), INTELSAT IV at Hughes Aircraft Company (now Boeing Space Systems), and INTELSAT V at Ford Aerospace (now Space Systems/Loral). I have held responsible positions on a wide variety of communication satellites and have been involved with radio broadcasting satellites since 1983.

4. I served on a panel of the National Academy of Sciences to review early studies concerning the use of direct radio broadcasting satellites for the Voice of America. I wrote an early paper on the use of S-band frequencies for radio broadcasting in 1986[1] that was published in 1990. I was a member of the U.S. delegation to the International Telecommunications Union (ITU) World Administrative

[1] The first paper was incorporated in the 1986 National Academy of Sciences report to the Voice of America and subsequently published: R. J. Rusch et al, "Design and Price of Audio Broadcasting Satellites", Symposium on Digital Audio Broadcasting, Washington, March 1990.

Radiocommunication Conferences in 1992 (WARC'92) and 1995 (WRC-95) that dealt with all aspects of radio frequency spectrum allocation including the assignment of spectrum for radio broadcasting. I supported the U.S. Department of Justice in defending the United States from litigation proposed by the satellite television broadcasters. I have provided expert opinions to the Federal Communications Commission relative to satellite broadcasting policy.

5. Under my supervision TelAstra, Inc. has prepared satellite system appraisals and due diligence reports for mergers and acquisitions, litigation and bankruptcy proceedings. I have lectured extensively in North and South America, Europe, Asia, Australia, and Africa on the business and financial aspects of communication satellites.

Previous Experience as an Expert Witness or Consultant

6. I have been retained as a consultant in legal actions including the following:

- Expert witness for Lockheed Martin in a dispute over prices of Proton launch vehicles in February 1998. Prepared expert report for Epstein, Becker & Green, February 1998.
- Expert witness for the partners of Cellularvision in a dispute over ownership rights to the Visionstar satellite system in July 2000. Retained by Robson, Ferber, Frost, and Chan. Testified in court as an expert for both sides of the dispute.
- Expert witness for the U.S. Department of Justice in defense of the Satellite Home Viewer Improvement Act (SHVIA) starting in April 2001. Prepared expert witness report and a deposition.

- Expert witness for the International Family Channel to retain broadcasting rights on the Echostar system starting in December 2001. Prepared expert witness report.

- Expert witness for Pegasus Satellite Television, Inc. and Golden Sky Systems, Inc., to give expert opinions and testimony in a legal action regarding the DIRECTV satellite broadcasting system. I also testified on behalf of the National Rural Telecommunications Cooperative (NRTC) and the plaintiffs in the related class action. This activity extended from January 2001 to March 2004.

- Expert consultant for both the debt and equity holders in the Loral Space and Communications Ltd. bankruptcy proceedings during the period from December 2004 to July 2005.

Summary of Conclusions

7. My conclusions are as follows:

(1) Satellite communications is an inherently risky business because of the nature of space technology.

(2) New satellite ventures embody a great deal of uncertainty during start-up. Investing in a new satellite service is extremely risky.

(3) Because of the high risk, equity investors, venture capitalists and other banking institutions expect high returns.

(4) Founding a new satellite venture requires many things to be done perfectly and almost nothing can go wrong.

(5) After the initial phase of a satellite service company, the risks remain high.

(6) Unanticipated costs and delays can burden the enterprise.

(7) Affordability is a key issue. Many satellite services have failed because the service and equipment prices are set too high.

(8) It takes a long time to earn revenue, become cash flow positive and eventually profitable. The satellite radio broadcasting industry faces significant risks before - and even after - it becomes a viable business.

(9) Customer value including quality of service and customer satisfaction must be balanced against costs.

(10) Driving up the costs of operation could impair profitability, reduce access to financing, and have a disruptive impact on the enterprise.

8. The principal of free enterprise is to balance the investment risk and rewards. Investors must be able to realize a profit on successful businesses. If government policy deprives investors of expected returns it will be difficult to finance future innovation.

9. Satellite radio is an innately risky space-based service. Not only was this industry subject to uncertainty during start-up but also there are ongoing risks since the service became operational. Satellite radio is not yet a profitable business and it faces competitive threats from terrestrial broadcasting services and new technologies. There is pervasive pressure to reduce costs and prices to grow the businesses. Raising royalty rates would clearly place satellite radio at a greater disadvantage.

Risk versus reward assessment for satellite radio broadcasting

An account of the changing perception of risk

10. Practical satellite communications started more than 40 years ago. Some of the basic policy and technical issues have been resolved[2] but many business risks remain. Although satellite communication is a glamorous and exciting industry, developing a new satellite service is still a risky undertaking and must be evaluated as a serious financial proposition.

11. The theoretical roots of satellite communications go back to 1895 when a Russian visionary realized that artificial satellites could be placed in stationary orbits[3]. The earliest tests of satellite communications were sponsored by civil and military organizations. Financial skepticism was widespread at that time because of the high cost of space technology. The risks of a commercial space business were high. Consequently, the U.S. Congress passed the 1962 COMSAT Act to protect this nascent industry. Many of the practical technical issues were resolved in 1963 when NASA launched Syncom II, the first successful synchronous satellite. Nonetheless, as additional protection to offset business uncertainties, an international governmental organization was created for communications satellite services. An international treaty created an international service monopoly. Furthermore, risk was syndicated with several national telecommunications operators investing in the institution that became INTELSAT.

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[2] Von Karman Lecture: "The Rocky Road to Communication Satellites" by Dr. A.D. Wheelon, Hughes Aircraft Company, AIAA 24th Aerospace Sciences Meeting, January 6-8, 1986, Reno, Nevada.

[3] The Russian pioneer, Konstantin Tsiolkovsky observed that a geostationary satellite could be orbited to provide a stationary "star".

12. Several national systems were founded to provide domestic services in the 1970s. A great deal of transmission capacity was leased to distribute television programs to network affiliates and to "cable-heads" for terrestrial distribution. In subsequent decades the commercial viability of Fixed Satellite Service (FSS) communications led to the formation of regional satellite operators and international competitors. The international monopolies were dissolved. Today INTELSAT and some other companies in the FSS industry are profitable.

13. In 1979 another international organization, Inmarsat, was formed for Mobile Satellite Services (MSS). Although the frequency band was new, COMSAT, the European Space Agency and INTELSAT agreed to provide capacity with small satellites and "piggyback" payloads to start the new business. Inmarsat leased capacity from these other operators. Since Inmarsat did not have to make a large up-front capital investment, it became profitable in a relatively short span. For many years Inmarsat subscribers used suitcase or laptop size terminals. Space-based domestic and international cellular *telephone* service was introduced between 1995 and 1999 by competitors to Inmarsat. These included American Mobile Satellite Corporation (now Motient), Telesat Mobile Incorporated, Iridium, ICO Global, and Globalstar. While these companies were struggling to become established the addressable market changed. Terrestrial cellular service expanded and airtime charges dropped. The space-based costs were so high that service charges were prohibitive to most prospective users. These new satellite competitors were business failures and most of them declared bankruptcy. These MSS companies failed because the market did not materialize. It was the first time that satellite business aspirations had outstripped market demand.

14. Initially, FSS satellites connected to terrestrial networks through ground stations, called a gateways or teleports, that had large antennas. By the early 1980s, a few individual users started to install large (8 to 10 feet diameter) antennas to receive television programs directly from satellites. Satellite technologies continued to improve over time. Satellites became more powerful with larger antennas. Ground antennas could be much smaller. Consequently, strong interest developed in broadcasting television and radio directly to end users rather than passing through a gateway. Satellite television broadcasting started in Europe during the 1980s. The first successful Direct Broadcasting Service (DBS) in the United States, DIRECTV, was introduced in 1994. Echostar followed a year later. Almost 10 years passed before these companies became profitable.

15. Starting in 1995, hundreds of broadband satellite networks were proposed to provide global high-speed Internet access. Several of these concepts were licensed and funded with billions of investment dollars. Collapse of the telecommunications and Internet bubble dried up funding for most of these initiatives. Nearly all of these systems were terminated during the recession. Today only WildBlue and vestiges of Spaceway survive. The long-term prospects for this service remain in doubt.

16. Worldspace pioneered satellite radio broadcasting[4] in Africa and East Asia in 1999 and 2000. Today Worldspace is widely considered to be a business failure. Satellite radio broadcasting started later in the United States. Sirius[5], first called CD

[4] Satellite radio broadcasting received a frequency allocation at World Administrative Radiocommunications Conference 1992 (WARC'92) in Torremolenos, Spain.

[5] "United States Satellite Digital Audio Radio Service"; Robert D. Briskman, Satellite CD Radio, Inc.; Pacific Telecommunications Conference Record; Honolulu, Hawaii; January 1993; Pages 511-518

Radio, Inc. and XM, originally called American Mobile Radio Corp., and developed business plans starting in the 1990s and received FCC construction permits in 1997. XM and Sirius commenced commercial service in late 2001 and early 2002 respectively. These U.S. satellite-radio broadcasters are gaining acceptance but are not yet profitable businesses.

17. I have provided a brief business summary of these companies and a discussion of some of the risks still facing these companies below. The following are several conclusions that I have drawn from my experience.

Conclusion 1: Satellite communications is an inherently risky business because of the nature of space technology.

18. Satellites are highly sophisticated facilities that must be entirely self-contained. Every aspect needed for operation and survival must be incorporated into the space vehicle. Satellites are designed and tested on the ground but experience the unique space environment for the first time after launch. Any design deficiency could lead to degraded performance or failure. High-energy rockets can destroy the precise electronic machinery of a satellite. Even if the launch is benign the rocket trajectory could be misaligned and render the satellite unusable. Once a satellite is placed in orbit it cannot be repaired physically, corrective actions from the ground are extremely limited. It is completely impractical to send a technician into orbit to make repairs. The cost of taking corrective action is greater than building a replacement satellite.

19. Terrestrial systems are not subject to the same deployment and operational risks and can be repaired or replaced readily. Terrestrial communication networks can be

built and rolled-out in small steps without requiring deployment of the entire infrastructure. Service revenue can be used to fund network expansion. The rate of investment can be adjusted to match customer demand more closely.

Conclusion 2: New satellite ventures embody a great deal of uncertainty during start-up. Investing in a new satellite service is extremely risky.

20. Funding a new satellite service is an enormously risky undertaking because space-based services have distinctive characteristics. Satellite signals travel longer distances and are often weaker than signals from terrestrial transmitters. The higher frequencies used by satellites are more easily attenuated by vegetation, buildings, or adverse weather conditions. Customer acceptance of satellite service can only be demonstrated after the entire system is placed into service. It requires the entire capital investment up front and many years before there is any revenue. Terrestrial communication systems can be funded incrementally with phased capital investment and earlier revenue. Recovery of the investment on a successful satellite enterprise requires significantly longer than most business projects. For example, deployment of the satellite radio broadcasting constellations required three to four years from the satellite contract awards to launch of the last satellites. Many aspects of the business can change during business development.

Conclusion 3: Because of the high risk, equity investors, venture capitalists and other banking institutions expect high returns

21. Early equity investors demand[6] 30% to 40% Internal Rate of Return (IRR) and debt for these enterprises carries "junk bond" interest rates of 10% to 14% today. Although these rates seem extremely high, investors require these returns on new satellite investments because of the extraordinary risks involved.

22. From an investment perspective the capital required is large, the payback time is long, and the technical and other risks are significant.

Conclusion 4: Founding a new satellite venture requires many things to be done perfectly and almost nothing can go wrong.

23. **The technical approach must be sound.** There cannot be any weak aspect that is ignored. Many projects are adored for technical splendor, but are not practical or feasible or will not satisfy consumer needs. Sometimes a fatal flaw or "show-stopper" is ignored. When momentum has set in, the participants are reluctant to turn back. Denial sets in. Low Earth Orbit (LEO) constellations for satellite cellular service created great excitement, but the phones did not work inside of buildings. Similarly LEO broadband satellite services like Teledesic and Skybridge were not successful because the infrastructure was extremely expensive to build and operate and required an extremely expensive user terminal that tracked the satellites.

24. **The business people are crucial.** The founders must have enormous energy, enthusiasm, and stamina. Preferably, the initiative would be backed by a large

[6] Investors are unwilling to fund high risk investments unless the business plan shows the potential for high returns. In this sense the investor return-threshold is a requirement or "demand."

institution with large reserves of wealth, technical talent, and management resources. This is an endeavor that demands high levels of drive and commitment. Many great ideas have failed for lack of support. Highly experienced managers are required to ensure success. These executives command and deserve high levels of compensation.

25. **Investment must provide a secure foundation for launching the business.** Capital must be provided through private equity, debt, and public stock sales. The funding must be firm and long term so that the company can survive delays and economic issues that might reduce income.

26. **The business plan must be realistic.** Since investors expect large returns, the plans frequently minimize capital costs and have an optimistic view of the ramp up in revenues. Investors expect a certain amount of optimism in these plans, but they have to pass a "reality screen." Fundraising is typically started early in the business development process. There is a risk that an overly optimistic plan may not be realized and that investors will be reluctant to sustain an enterprise that does not meet expectations. Seven years ago the satellite radio companies anticipated that they would become profitable sooner. There have been substantial shortfalls of revenues and the cash flows turned out to be less than expected.

27. **The first major milestone is obtaining market access through regulatory approvals.** The company must be authorized by a sovereign government to launch a satellite and to provide communications services. If the service is new and requires changes to radio frequency spectrum allocations, it may be necessary to obtain international approval through the ITU, which only meets at multiple-year intervals. After there is international agreement, the FCC or other national agency must adopt the

new radio regulations and issue a license to the applicant. This process requires a minimum of two to five years. It is important to remember that all radio spectrum is being used and that a new license requires reassignment.

28. **The product must be introduced when the market and technology are ready, not too early and not too late.** There are examples of services that were introduced before the technology was mature and failed because of inadequacies. For example, the earliest DBS companies, called USSI and Satellite Television Corporation (STC), failed in the early 1980s partly because the number of video programs was limited and the installation time was long. In other cases new services have been late to market and other terrestrial alternatives have grabbed the market. Space-based services have a disadvantage relative to terrestrial services in this regard. Since the implementation spans of satellite projects are long, there could be changes in technology or consumer tastes that would affect service acceptance.

29. **A satellite operator must have strong patents.** Competitors or "patent trolls" could assert patent rights to the selected technical approach. Therefore, the company must have a solid position to preclude or defend against challengers. In the early days of satellite radio there were patent issues between Sirius and XM that have been resolved.

30. **Reliable satellites must be designed, built, and launched.** Many companies focus primary attention on this aspect of the business because the space segment is sophisticated and highly risky. Placing a satellite into service carries a huge risk because a defective launch can destroy the satellite. The substantive test of a satellite is operation in the space environment. Insurance premiums for the launch phase of 15%

to 25% reflect the degree of risk. If a satellite is lost at launch it can take two or three years to replace.

31. **Satellites must function properly in orbit.** Perfect operation is essential since there is no practical or cost-effective way to repair a high-altitude satellite in orbit. Performance anomalies and wear-out mechanisms can degrade the quality of service or require early replacement of the satellites. Usually satellite defects are revealed within a few weeks or months, but sometimes, satellite problems have remained hidden for six to eight years before becoming apparent. In recent years there have been several examples of solar array problems that have lowered the available electrical power, reduced the capability of satellites, and lead to early replacement. The impact of the defective Hubble Space Telescope mirror is well known. Several years, two missions, and enormous cost were required to repair the manufacturing defect. In the case of geostationary or highly elliptical orbits that are used for satellite-radio broadcasting, the cost of similar repairs is prohibitive.

Conclusion 5: After the initial phase of a satellite service company, the risks remain high.

32. In addition to the continuous technical risks of satellite failures or equipment problems there can be other business or commercial risks.

33. When established terrestrial operators oppose satellite service the situation can be difficult for satellite service. Both satellite and terrestrial competitors can introduce regulatory and legal obstacles. In some cases legislators have targeted satellite service providers to obtain tax revenues or preferential treatment for terrestrial competitors.

34. User equipment must be well designed, meet production rates, and perform reliability. There have been cases where the hardware or software does not function as expected when introduced. Ground hardware or software problems have contributed delays of a year or more before a service could be introduced. Sometimes the manufacturer has not been able to produce satisfactory hardware as fast as needed thereby limiting the number of subscribers. User terminal problems with receivers or transceivers can also create a bad impression of the service. The equipment must be easy-to-use and simple to operate.

35. The business must have effective distribution channels. Retail outlets provide access to the end user. The distributor provides installation, servicing, and initial registration for the product. Typically the operator negotiates a fee or cost sharing arrangement with the distributor. In some cases the distributor may be a major company like an automobile manufacturer. If the distributor is not motivated and enthusiastic the service will not be promoted to the prospective subscriber.

36. There are overriding market risks related to consumer acceptance. User decisions are based on the perceived value, quality, and cost of the service. Customer decisions are also affected by economic conditions. If income is low or job security is tenuous prospective subscribers are reluctant to make long term commitments. When the automobile industry goes through periodic production slumps fewer new cars are built and, therefore, fewer new satellite radio receivers are installed. Automobile cycles may not be correlated to economic level in a simple way.

Conclusion 6: Unanticipated costs and delays can burden the enterprise.

37. The satellite communications business is replete with examples of unexpected costs. Insurance rates can soar due to satellite failures on other programs. Launch prices can increase due to economic conditions in another country. Users may expect additional service features or programming. In the case of satellite radio broadcasting, listeners were found to be interested in non-music content including talk shows and sports coverage that was not originally anticipated. Sirius and XM found it necessary to pay for branded proprietary content. DBS companies discovered that prospective subscribers wanted to receive local television broadcasting stations. Set-top box designs required revisions to reduce widespread signal pirating.

Conclusion 7: Affordability is a key issue. Many satellite services have failed because the service and equipment prices are set too high.

38. Satellite systems are inherently expensive because of the sophisticated nature of the transmission system. Satellites and launch vehicles are extremely expensive. Every possible measure must be considered to reduce costs and extract maximum value from the service. In the last decade satellite manufacturers became enamored with LEO satellite constellations that were extremely expensive to build and operate. The ultimate cost of these systems was not revealed until major financial commitments were made. Consequently, the necessary airtime fees established for the service (up to $6 per minute) were considered to be unaffordable by most prospective users.

39. **Worldspace failed as a radio broadcaster because its service was not affordable.** Worldspace was described at the World Summit for Satellite Financing (held in Paris, September, 2006) as a business failure because it has not attracted a significant

number of listeners. It has not developed an income stream to repay its operating costs let alone its initial capital investment after seven years of operation. Worldspace satellites were stationed in orbit positions to serve Africa and Central/Eastern Asia. These regions desperately need good communications services but are inhabited by populations with extremely low-income levels. Most of the prospective audience cannot afford a satellite radio receiver and cannot pay a modest subscription fee. Nevertheless, Worldspace was able to raise $250 million though an IPO in 2005[7]. The shares were priced at $21 and crested at $24 on the first day. Subsequently, the stock price fell to 10% of its original value ($2 per share) and it now resides at $3 per share.

40. **Iridium and Globalstar failed because their services were too costly for a large market.** Inmarsat started service in 1980 for ships at sea, but only had 12,000 subscribers by 1991. The cost of MSS was between $6 to $10 per minute at the time. Satellite cellular telephone service created a sensation in the early 1990s when the cost of cellular service was much higher than today and when the coverage areas were limited. Iridium and Globalstar designed extravagant satellite networks for personal telephone service. The capital cost for each of these systems was over $5 billion each. The cost of service was several dollars per minute. Satellite telephones cost $1500. Many people wanted to have service anytime, anyplace but were unwilling to pay these prices for satellite service.

41. **Connexion-by-Boeing was too expensive.** Boeing developed a high-speed Internet service for commercial aviation called Connexion. In a fashion similar to

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[7] WORLDSPACE, INC. AMENDMENT NO. 7 TO SEC FORM S-1 REGISTRATION STATEMENT July 20, 2005.

satellite phones many people liked the idea of the service but were not willing to pay the price. Few passengers used it and Boeing plans to terminate the Connexion service. Once again the financial community regards this as a failed service because it was too expensive.

Conclusion 8: It takes a long time to earn revenue, become cash flow positive and eventually profitable. The satellite radio broadcasting industry faces significant risks before - and even after - it becomes a viable business.

42. Up-front capital costs are extremely high. No revenues can be obtained until the entire space and supporting infrastructure are prepared. Broadcast facilities and program operations for hundreds of channels must be planned and operational before service can begin. After the facilities are in place and service is introduced subscribers must be enrolled. Customer acquisition requires advertising and promotion. Receivers are costly so the satellite operator often must finance user equipment. A distribution network, including automotive original equipment manufacturers (OEM) and after-market retail outlets, must recruit individual users and provide an income stream. Dealers are paid for customer acquisition. Customer servicing, information call centers, billing, and collection are additional functions that add to operating costs. Securing a sufficient number of subscribers to pay the operating costs often requires several years. Paying back the capital investment requires several more years.

Conclusion 9: Customer value including quality of service and customer satisfaction must be balanced against costs.

43. Constructing a business that offers desirable customer benefits is an art that requires considerable skill. There have been a number of services that market surveys showed would have great promise. For example, prospective subscribers were asked: "Would you like to have telephone service on an airplane?" The overwhelming response was "yes" before the service was introduced in 1982. 18-years later Boeing received similar positive feedback when Connexion-by-Boeing was being planned. In both cases the actual use was far less than had been expected. Consumers were interested in these services, but not at the prices that permitted the operators to make a profit. In these cases the quality of service was probably not the major issue.

44. The business case for satellite radio is much more sophisticated. This is a new subscription service that must compete with free over-the-air services as well as emerging technologies. Furthermore, satellite radio planners know that listeners to "pay-radio" prefer to avoid commercials. Both infrastructure and content are cost elements that affect business performance and profitability.

Conclusion 10: Driving up the costs of operation could impair profitability, reduce access to financing, and have a disruptive impact on the enterprise.

45. When a satellite operator encounters higher costs the company comes under profit pressure. Ideally, any added-cost element would provide tangible customer benefits. In turn an improvement would attract more customers who are willing to pay higher prices or accept smaller discounts. Subscription costs could be raised, but this might choke off subscriptions. Net revenues could drop if prices are raised.

46. Alternatively, the operator could absorb higher costs and defer the date when the service become profitable. Investors and bankers might not have patience for this approach. The stock price would be under pressure and bond-rating services might lower credit ratings. Under these circumstances it would be more difficult to secure additional funding.

47. Another risk is higher payments for programming content. Royalties have a significant effect on operating costs. Higher costs may lead to higher usage fees. The consequence of higher prices is lower public acceptance, reduced profitability and weaker investor sentiment. In setting royalty policy, decision-makers need to take into consideration the impact that rates have on the overall business including financial returns and the need for future investment.

Sirius and XM Business Summaries

48. Satellite television broadcasting directly into homes started in 1994 and attracted millions of subscribers within a few years. Consequently, satellite radio broadcasting also seemed to be a "natural" application of space technology. Market studies[8] indicated that commuters would be willing to pay for clear, dependable radio services, but much less than they would pay for television. Analysis and tests showed that satellites could transmit more than 100 digital radio programs simultaneously. The service could be priced at affordable rates to the end user.

[8] Study by **Strategic Marketing and Research Techniques**, XM SEC 1999 annual Form 10K, p. 3.

49. The following table shows some key events identified in SEC filings.

Date	Sirius Satellite Radio	XM Satellite Radio
18-May-90	Initial FCC filing	
3-Mar-97	FCC rules for radio broadcasting	FCC rules for radio broadcasting
2-Apr-97	Won FCC spectrum auction $83million	Won FCC spectrum auction $89 million
15-Jun-97	SS/L signs contract for 3 satellites	
10-Oct-97	FCC license to build satellites	
16-Oct-97		FCC license to build satellites
15-Mar-98		Hughes contract for 2 satellites
20-Nov-98		Distribution deal - General Motors
11-Dec-98	Modified FCC application - elliptical orbits	
15-May-99	SS/L contract for Sirius 4 satellite	
28-Jun-99	Ford Deal To Install Receivers in Cars	
27-Sep-99		IPO 10 million shares
15-Nov-99	Completed Construction of National Broadcast Studio	
28-Jan-00	Agreement with Daimler Chrysler	
16-Feb-00	Agreement to develop a unified standard for satellite radios	Agreement to develop a unified standard for satellite radios
16-Jun-00	Agreement with BMW	
		Distribution deals - Freightliner, Peterbilt, Winnebago
30-Jun-00	Sirius SR1 Satellite launched	
5-Sep-00	Sirius SR2 Satellite launched	
30-Nov-00	Sirius SR3 Satellite launched	
	Increased fee from $10 to $13 Monthly	
15-Feb-01	Planned service start date	
18-Mar-01		XM Radio 2 "Rock" launched
8-May-01		XM Radio 1 "Roll" launched
15-May-01		Planned service start date
15-Sep-01		Commenced commercial service
14-Feb-02	Commenced service selected markets	
1-Jul-02	Commenced service nationwide	
5-Mar-03	Creditors approve plan to pull company out of debt (financial restructuring)	
1-Mar-05		XM Radio 3 "Rhythm" launched
4-Apr-05		Increased fee from $10 to $13 Monthly
15-Jun-05		SS/L contact for XM 5 satellite
15-Jun-06	SS/L contract for Sirius 5 satellite	
30-Oct-06		XM Radio 4 “Blues” planned launch date
4Q-08	Sirius SR5 Satellite Launch date	

Regulatory Delays

50. Although CD Radio, the predecessor to Sirius, submitted its initial filing in 1990, the FCC did not process licenses until 1997. During this long delay founding investors waited for authority to proceed. They were subject to the continuing risk of changing market conditions that could have significantly undermined the business proposition. In the music industry recordings transitioned from LP vinyl records, to CDs to MP3 files within few years. Video content quickly moved from tape recordings to DVD to video-on-demand and HD-DVD/Blue Ray. The cellular industry rapidly grew from a luxury item to a business tool to an almost universal gadget. The Internet exploded in size and transitioned from a government network to dial-up telephone service to broadband to wireless service. Overall there has been a consolidation within the media industries including music, television, broadcasting, and cable services. Sometimes being late to market means that alternative solutions will capture a consumer market. Recovery from this situation means that consumers must alter their behavior patterns. The migration of a consumer from one solution to another is a time-consuming and costly process.

Technology Issues

51. XM and Sirius each use distinct radio spectrum and cannot lease incremental capacity from established operators. Satellites for radio broadcasting have large antennas and have high electrical power requirements. Therefore, a "piggyback" payload is not practical and a dedicated satellite is needed.

52. Most of the satellite television subscribers use a fixed or rigid ground antenna that receives satellite signals along an unobstructed path. Automobile commuters are a major and distinctive market for satellite radio. Since this is a mobile application there are significant transmission challenges. Cars move so there will not always be a clear path from the satellite to the user antenna. Special techniques are required to avoid the loss of signals.

53. XM uses high power geostationary satellites with a larger number of terrestrial repeaters. Sirius redesigned its space segment from a geostationary orbit to a constellation in elliptical orbits. The Sirius approach provides higher viewing angles that are less susceptible to obstructions. This space segment revision required the construction of a third operational satellite, which was an unplanned expense. Although the Sirius orbital architecture was changed to accommodate lower power satellites with fewer ground repeaters, there have been no fundamental design flaws. Both the Sirius and XM space architectures are technically adequate.

54. Both systems use terrestrial repeaters to augment service in urban areas and overcome the blockage of tall buildings. There was a significant risk that the system would not produce a satisfactory quality of service for the prospective subscriber. Processing of the satellite and terrestrial signals requires sophisticated receivers in the user terminals. Sirius contracted with Lucent Technologies to build the chip set, but there were significant design problems that delayed the introduction of service for more than one year.

Launch Success but in-orbit difficulties

55. Six satellite radio broadcasting satellites were launched without failure. There have been a few in-orbit problems, however. High power satellite transmitters are needed to ensure that there will be a strong signal that will not fade due to reflections and ground scatter. Both Sirius and XM selected satellites with large solar arrays to power the satellite transmitters. Both companies encountered difficulties with the satellite solar panels. The XM solar arrays degraded so severely that two satellites had to be replaced early. Insurance did not fully cover the replacement cost of these satellites.

Slower Subscriber Growth

56. The number of satellite radio subscribers has been growing, but the growth rate has been dropping. The following assessment is based on public data provided by the satellite radio broadcasting companies. In each case I have provided linear and logarithmic displays of the data. Linear graphs are suitable when there are relatively small changes, but logarithmic plots provide more useful information when there are changes of more than a factor of 10. A logarithmic graph has the distinctive property that a straight line represents a constant rate of growth or decay. **Figure 1** (Exhibit 2) shows that growth rate is falling off. The logarithmic scale (Version 1B) indicates that the rate of decay in growth rate is almost constant. Version 1B can be used to estimate the growth rate in one or two years. **Figure 2** (Exhibit 3) shows the number of U.S. satellite radio subscribers. It also shows that market analysts expected a much larger number of subscribers[9]. Here again the logarithmic graph shows that the growth rate is slowing. If the growth rate were constant the number of subscribers would increase along a straight

[9] These forecasts were published prior to service launch.

line. Since the growth curve is bending the growth rate is declining. Satellite radio companies have concluded that music offerings are not sufficient to attract subscribers for satellite radio. There is interest in new forms of content. Sirius and XM have added local reports of weather and traffic conditions, sports programming and talk shows.

Investment Challenges

57. The middle to late 1990s was an era when investors were receptive to new technologies. Fortunately, Sirius and XM were able to raise initial funds during this period. Before the satellites were launched the telecommunications bubble had burst. Sirius signed a satellite construction contract in June 1997 and XM ordered satellites in March 1998. Before the systems were built and placed in commercial service the financial environment had changed dramatically and they faced tough times to keep the enterprises alive. Investors were willing to fund established and proven companies during the period from 2001 to 2003, but new companies struggled.

58. The initial business plans were based on a success scenario. The budgets did not include funds for additional satellites. There were implementation delays as mentioned above. Customer acquisition costs are higher than originally expected. In 2000 (for Sirius) and 2005 (for XM) it became necessary for the satellite radio companies to increase basic subscription rates from $9.95 to $12.95 per month. Raising the price was a risky decision because higher prices tend to depress subscriber growth. Some observers think that there will be pressure to decrease satellite radio prices because of competition from alternative sources like recorded music or WiFi / WiMax coupled to Internet Radio.

59. This is a relatively early time in the life of these businesses. There could be needs for additional funding to grow the businesses until satellite radio becomes

profitable. Financial uncertainties affect the perceived investment risk. Both bankers and equity investors expect higher returns for higher risk investments. Consequently the prices of stocks and bonds drop when unexpected problems arise. Higher interest rates are an additional financial burden. Over the past two years the stock prices for Sirius and XM have been depressed and have fallen to 30% to 50% of earlier values.

Prevailing Risks facing Satellite Radio

60. All satellite services must live with technology risks including premature satellite mortality or launch failures. Other risks are derived from regulatory processes. Competitors try to use governmental policy as a weapon to weaken or defeat a challenger. Incumbent service providers, like terrestrial radio broadcasting stations, prefer to eliminate space-based solutions.

61. We live in a dynamic world where new alternatives are presented every day. Satellite radio is one of the choices that have been presented to consumers over the past five years. New technologies and services including iPODs and wireless Internet radio are alternatives that are sweeping the country. The ultimate growth of satellite radio requires nurturing in this highly competitive environment.

62. Neither Sirius nor XM has achieved a financial "break-even" situation. This means that revenue is less than the cost to operate the service. If costs increase additional funding may be needed to sustain these novel services.

Conclusions

63. The principal of free enterprise is to balance the investment risk and rewards. Investors must be able to realize a profit on successful businesses. Founding investors should be compensated for high risks early in the process. Subsequent investors

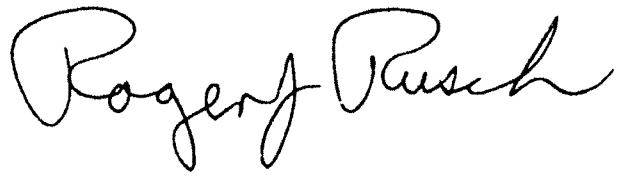
should also receive a reasonable return. If government policy deprives investors of expected returns it will be difficult to finance future innovation. Higher royalties, for example, would discourage investors and drive up the cost to obtain financing. Satellite radio offers a wider variety of programming and provides more universal public access to creative works than is possible in most regions of the country. Few urban regions, let alone rural areas, are able to provide the full range of styles and textures that satellite radio provides. It is in the public interest to preserve and continue these innovative services that are presently delivering service to more than 12 million subscribers.

64. Satellite radio is an innately risky space-based service. Not only was this industry subject to uncertainty during start-up but also there are ongoing risks since the service became operational. Satellite radio is not yet a profitable business and it faces competitive threats from terrestrial broadcasting services and new technologies. There is pervasive pressure to reduce costs and prices to grow the businesses.

Certification

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge, information and belief.

Dated: Palos Verdes, CA
October 30, 2006



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