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GOOD TECHNOLOGY, BAD MANAGEMENT: A CASE STUDY OF THE SATELLITE PHONE INDUSTRY

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ABSTRACT

Satellite phone services use advanced technology to deliver phone service around the world. Although technologically advanced, satellite phone companies have not captured a substantial share of competitive mobile phone markets nor returned large profits to investors. In this case study, we examine why Iridium, a major satellite phone service provider, fell short of analyst's expectations and failed to achieve profitability. We illustrate how high cost structures, lack of critical mass, "threat of substitute services" and weak market positioning have limited satellite phone companies' ability to compete with conventional mobile phone companies. This case demonstrates that state of art technology may not lead to market success, even with supportive investors, global cooperation and alliances with other firms.

Keyword: satellite phone, LEO, Iridium, five forces, critical mass, network effect, wireless, price war, positive feedback, mobile phone.

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INTRODUCTION

During the Operation Iraqi Freedom in 2003, satellite phone services enabled round-the-clock television coverage of the battlefield. Lacking conventional wireless or cable telecommunication infrastructures, embedded journalists used videophones equipped with small satellite antenna to deliver live reports from the frontline. Through satellite transmissions, viewers watched live broadcasts of troops in combat and missiles striking Baghdad. News coverage of the war illustrated satellite phone services' potential to transform how the news is communicated across national boundaries and from conflict torn regions.

Despite their potential to transform communication, satellite phone companies have struggled to achieve profitability. Many well-known companies such as Motorola, Sprint, and, Kyocera, have provided financial and/or technical support to help develop satellite phone networks. Due to their resource rich environment, satellite phone companies developed mature technologies that allowed customers to transmit voice and data messages from anywhere on the globe. Despite their resources, leading satellite services such as Iridium have filed for bankruptcy protection or restructured their debt.

In this case, we use Iridium [11, http://www.iridium.com/corp/iri_corp-understand.asp], the first satellite phone service, to illustrate why satellite phone services have failed to meet investor expectations and win market share. Iridium experienced serious setbacks due to factors such as weak market positioning, high cost structure, and lack of critical mass. This case illustrates how state of art technology may not lead to firms' acquiring market share or earning profits.

This case unfolds as follows: first, we describe opportunities and challenges presented by the mobile phone marketplace during the 1990s. Then, we provide an overview of how satellite phone systems work. Next, we identify and describe services provided by Iridium's competitors in the phone service industry. The case concludes with a discussion of lessons learned from Iridium's experience.

MOBILE PHONE SERVICE IN THE 1990s

Though cellular and PCS phones eased communication, consumers mobile phone companies as providing unreliable services through the mid-1990s. Due to their rapid expansion, mobile phone companies lacked the infrastructure to support customers' needs. For example, cell phone companies frequently lacked enough cell sites to provide the bandwidth necessary for providing customers with basic services. As a result, mobile phone users were frequently unable to make calls or had their connections were dropped mid-sentence. Also, mobile phone companies used different communication technologies within and across countries. When traveling within a country, cell phone users would frequently find they were either unable to make or had to pay roaming fees for a connection. When traveling abroad, cell phone users had to lease or purchase new equipment to access mobile services.

Due to the limitations of existing mobile phone technologies, satellite phones were perceived as an attractive alternative wireless phone technology. By using satellites to transmit messages, investors believed they could address the signal quality, roaming and infrastructure problems that plagued conventional mobile phone services. When compared to cell phones, satellite phones had access to more bandwidth that could enable stable voice and faster data transmission. Because of their globe spanning infrastructure, satellite phones would not require roaming fees or present compatibility problems across networks. Analysts envisioned a world in which users could use the same handset to communicate data whether they were climbing Mount Kilimanjaro or laying on a beach in the South Pacific.

Seeking a first mover advantage, investors sank billions of dollars into developing and implementing satellite phone systems. Established in 1991, Iridium was the first active satellite phone network [15]. Many well-known companies such as Lockheed, Sprint and Sony, provided financial or technical support to the new firm. During May of 1997, Iridium launched the first satellites of its network [12]. When complete, the Iridium system provided robust voice and data solutions across the globe. Without roaming fees or compatibility problems, Iridium users placed calls from any location including oceans, airways, and mountainous regions.

Even though Iridium offered superior services, consumers did not flock to purchase satellite phones. When compared to traditional services, consumers found that Iridium's costs (i.e., expensive proprietary equipment and high service fees) outweighed satellite phones' benefits (i.e., reliability and access). Also, by the late 1990s, consumers perceived existing mobile phone companies as providing adequate access to their networks. For example, companies such as Verizon or AT&T offered phone packages that included unlimited minutes and no roaming fees. Because consumers' weak response, Iridium for Chapter 11 bankruptcy [3] on August 13, 1999.

OVERVIEW OF A SATELLITE PHONE SYSTEM

Operating Basics of Satellite Phone Networks

When the user initiates a call on a satellite capable handset, the nearest satellite picks up the call and authenticates the users through the nearest gateway on the earth. If the destination phone is part of the public switched telephone network (PSTN), the call is routed to the nearest gateway and consecutive PSTN. If the destination phone is another satellite handset, the call routing occurs through satellites only, which increases transmission efficiency and quality.

Satellite Communication Systems

There are three types of satellite communication systems which differ in terms of orbit and signal strength (see Table 1). Low earth orbit (LEO) satellites orbit below about 1,800 miles from the earth's surface. Medium earth orbit (MEO) satellites peak at 9,000 miles and geo-synchronous earth orbit (GEO) satellite at 22,300 miles. The distance of orbit from the earth has an inverse relationship with signal strength and positive one with a satellites lifespan. Because of their proximity to the Earth, LEO satellites provide strong signals; however, they have a relatively short 5 to 7.5 year lifetime. Due to their distance from the Earth, a MEO satellite transmits a weaker signal; however, they may orbit the earth for 10 to15 years. GEO satellites have the greatest lifespan and transmit the weakest signals.

Table 1: Comparison of Satellites

Features	Satellite Type		
	LEO	**MEO**	**GEO**
Orbit	Up to 1800 miles	Up to 9000 miles	Up to 22300 miles
Signal Strength	High	High	Low
Lifetime	5 years	10 years	15 years

LEO and MEO satellites are used most frequently by satellite phone services. Because of signal strength, LEO and MEO enabled systems require phones that use small omni-directional antenna. Despite this advantage, low orbit satellite systems present firms with technical and financial challenges. Technically, firms had to design LEO and MEO systems that could constantly switch users' signals from one satellite to another. This is because LEO and MEO satellites move more rapidly than the Earth's orbit and a handheld device Because of their shorter distance from the earth, LEO and MEO satellites orbits degrade relatively quickly. Financially, this meant that firms had to pay for launching new satellites more frequently than if they had built GEO satellite networks.

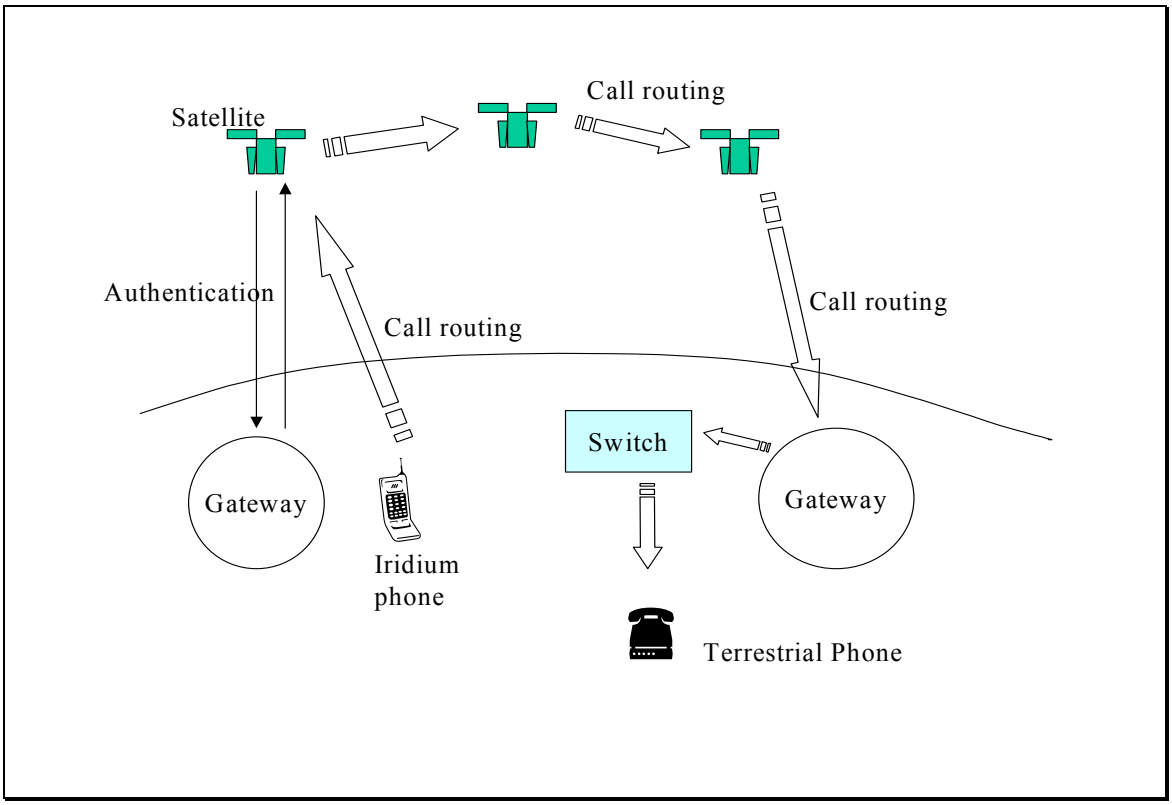

Figure 1: How Iridium works.

Iridium's Network [11]

The Iridium satellite system uses 66 LEO satellites that orbit 780 km (about 485 miles) above the earth's surface, to transmit signals. Each satellite cost $62 million, weighs about 1500 pounds, and revolves around the earth every 100 minutes. The satellites cast 48 beams onto the surface of the earth, covering a circular area with a diameter of 2700 miles.

Iridium transmits data between phones, satellites, and traditional communication networks. Calls are routed from one beam to the next or one satellite to another when the satellite moves out of the range of the user. The service link between phone and satellites operates in L-band frequency at1-2 GHz.

Iridium relies on circuit and packet switching to manage voice and data transmissions between phones and satellites. Circuit switching sets up a dedicated connection for the duration of each voice transmission i.e., a phone call. By using circuit switching for phone calls, Iridium ensures that users will not experience transmission interruptions due to dropped or degraded signals. Packet switching breaks down data into smaller units called packets and sends them over a shared connection. By using packet switching, the Iridium system efficiently uses bandwidth to allow more concurrent users to transmit data.

Iridium uses gateways to manage communication between its satellite network and more conventional telecommunications systems. Gateways are points that a signal may enter or leave a network. Iridium currently maintains 12 gateways, 2 in North America, 7 in Asia, and 1 each in Europe, Africa, and South America. Communication among satellites and gateways uses Ka-band frequency at a rate of 19.4 – 29.3 GHz.

SATELLITE PHONE SERVICE INDUSTRY

Following Iridium, several companies attempted to enter the satellite phone marketplace. However, due to a lack of financial support, Iridium's rivals have not successfully implemented global satellite phone networks. Table 2 summarizes features of each satellite phone company.

Odyssey Worldwide Services [14]

Odyssey Worldwide Services planned on implementing MEO satellite system as a backbone of its service. Because a MEO system required less maintenance, analysts believed Odyssey would yield greater profits than Iridium's LEO satellite system. However, despite the financial backing of TRW and Teleglobe, Odyssey lacked sufficient resources to complete the satellite system and merged with ICO [10, http://www.ico.com/press/releases/199712/971217.htm].

ICO Global Communications [10]

ICO's founders envisioned a system that combines the strengths of satellites and terrestrial network to deliver services. ICO's proposed system would have used MEO satellites to reduce maintenance costs and simplify transmitting signals. MEO satellites operate at higher altitude which leads to a longer lifespan than LEO satellites. Also, because they can cover larger areas, MEO satellites switch signals fewer times to span the globe than a LEO-based satellite network. Due to financial difficulties, ICO filed for bankruptcy in August, 1999. In 2000, Craig McGaw, founder of Nextel, raised 1.2 billion dollars to lead ICO out of bankruptcy. In a step forward, ICO launched its first satellite in 2001. However, despite the infusion of capital and successful satellite launch, ICO has not implemented an operational satellite phone system.

Teledisc [17]

Funded by Bill Gates, founder of Microsoft, and Craig McGaw, Teledisc announced it would build a network of 840 LEO satellites to offer consumers telephone and Internet services. Perhaps due to its high profile supporters, Teledisc successfully persuaded the United Nations and United States to dedicate a portion of the electromagnetic spectrum for their service. After Iridium and ICO filed for bankruptcy in 1999, was unable to raise sufficient capital to fund the network. As a result, Teledisc failed to launch a single satellite. In 2002, Teledisc laid off its last ten employees and went out of business.

Globalstar [8]

Globalstar was formed in 1991 by Loral Space & Communications and Qualcomm. With support from the United States and Russian space programs, Globalstar quickly built a limited LEO satellite network. In 1999, Globalstar began delivering services in more than 100 countries. By November 2000, Globalstar had sold only 21,300 out of its stockpile of 143000 phones [13]. When examining Globastar's failure to win subscribers, analysts suggest that consumers didn't like limited service, bulky phones, and high per-minute charges. Globalstar filing for Chapter 11 US bankruptcy protection during February 2002.

Table 2: Comparison of Satellite Services

Service	Satellite Phone Company				
	Iridium	**Odyssey**	**Globalstar**	**ICO**	**Teledisc**
Voice	X	X	X	X	X
Data	X	X	X	X	X
Fax	X	X	X	X	X
Paging		X	X		X
Global Positioning System	X	X	Partial		
Implemented In Business	X		X	X	

LESSONS FROM IRIDIUM'S FAILURE

Despite multi-billion dollar investments and high profile support, Iridium and its rivals' failures illustrate how offering technologically advanced services does not lead to success in the marketplace. We can draw several lessons about how management and markets influenced Iridium's failure.

First, many consumers may not value quality as much as cost when purchasing communication services. In order to win market share, Iridium focused advertising on differentiating satellite and conventional mobile phone services. Advertisements suggested that satellite phone services quality and reach distinguished Iridium's service from less sophisticated mobile phone services. Even though Iridium effectively differentiated its services, consumers were not willing to incur the high start-up and ongoing costs of satellite phone service. Original US

retail prices were $3295 for a satellite phone, $695 for a pager, and airtime fees of up to $7 per minute. Given the high price for Iridium's service, consumers could not justify the additional expense over using other phone services. To address the service versus price dichotomy, Iridium could have considered using a price discrimination strategy that varied prices with level of service and type of customer. However, due to its billions of dollars in debt, Iridium could not offer consumers lower rates for voice and data communication services.

Second, network effects of existing technologies placed Iridium at a disadvantage when compared to existing mobile phone services. Network effects refers to a service or technology becoming more valuable as more people use it, which may allow firms to lower costs and eventually acquire more customers. By the mid-1990s, mobile phone companies had acquired a substantial customer base in many countries. In countries such as Hong Kong or the United States, mobile phones had become part of daily life for many citizens. Because adding additional customers required relatively little additional investment, mobile phone companies had resources to invest in developing more reliable technologies and expanding their infrastructure. During the 1990s, mobile phone service expanded the size of their calling areas through strategic alliances. By the time Iridium initiated services, mobile cell phone companies had achieved a critical mass of customers necessary to dominate the marketplace.

Third, Iridium underestimated "the threat of substitute services" By the time Iridium initiated services, cell phone companies had addressed many of consumers' complaints linked to signal quality and roaming fees as well as lowered the costs of services. Consumers felt that mobile phone services' low airtime fees and start-up costs compensated for satellite phone services worldwide coverage and higher reliability. In essence, consumers substituted technically inferior services for Iridium's satellite phone service.

Fourth, Iridium's management failed to target many potential market niches. Iridium's advertising strategy focused on large, corporate customers such as oil or aviation companies, however, it did not focus attention on other niche markets such as small businesses or residents of remote regions. A more effective marketing strategy might have targeted small businesses such as importers that require ubiquitous or high quality access to maintain relationships with their global network of suppliers and clients. Iridium also failed to market services to residents of lightly populated, inaccessible areas that lack terrestrial phone service. If Iridium had engaged in a size or geographically based marketing strategy, it might have won customers as well as generated good "word of mouth" advertising.

Fifth, Iridium failed to acquire the critical mass needed to surpass entry barriers presented by existing services. The expected break-even point for Iridium was estimated to be 600,000 customers around the world. By the time it filed for bankruptcy, Iridium had acquired 55,000 customers. Due to its pricing, changes in the mobile phone market, and focused marketing strategy, Iridium never gathered the critical mass to support basic operating costs or to lower prices as a means to attract customers.

CONCLUSION

Despite a history of bankruptcy and failures, satellite telephone companies continue to operate. To survive, companies have been reorganized or bought out by investors. For example, although Iridium's satellite system $5 billion to develop, Dan Colussy acquired Iridium assets for about $25 million at a liquidation sale. Freed of massive debt, satellite phone companies have been able to lower costs. Rather than $7 dollars a minute, Iridium has slashed charges $1.50 per minute of airtime. Despite lower costs, satellite phones may not appeal to broader consumer markets. Satellite telephones cost from $1995 to $9295. When compared to modern cell phones, satellite telephones are bulky and posses fewer auxiliary functions. In lieu of broader consumer markets, satellite phone companies continue to market their services to the industries such as oil exploration and have directed their attention to government agencies such as the U.S. Department of Defense. Iridium recently renewed a contract with the Pentagon to serve 20,000 U.S. Defense Department workers. The usefulness and ubiquitous access of satellite phone services was demonstrated to TV viewers all over the world in the Iraqi war. Despite new contract and increased public awareness of its services, Iridium has a long way to go to meet investors' expectations. Will the future of Iridium Satellite be bright as analysts predicted?

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APPENDICES

A. CASE STUDY QUESTIONS

1. What were some of the problems of mobile phone services during the 1990s?
2. What are the advantages of the satellite phone service over the cell or PCS mobile phone services?
3. What are the advantages and disadvantages of LEO compared with GEO?
4. What did the terrestrial mobile phone companies do to cope with their narrow service region?
5. What market did Iridium try to target?
6. How did mobile phone companies develop "substitute services" for Iridium?

B. USEFUL TERMS

Airtime – The amount of time used by a transmission over a wireless network. Airtime is typically calculated in minutes.
Backbone – A large transmission medium that carries data collected for multiple smaller sources.
Bandwidth – The amount of information that can be transferred in a given time period over a wired or wireless communications link.
Cell sites – The transmission and reception equipment, including the base station antenna or tower, that connects a cell phone to a mobile phone service provider.
Circuit Switching – A dedicated connection that lasts the duration of a transmission.
Critical Mass – The number of users required to achieve profitability or sustain the use of an innovation.
First Mover Advantage – Advantage gained by a company for being the first entry in a new market.
Gateway – Points that a signal may enter or leave a network.
GEO (Geosynchronous Earth Orbiting Satellite) – Satellites that orbit about 22000 miles above the Earth's surface. Typically, a MEO orbits over one spot on the Earth's surface.
LEO (Low Earth Orbiting Satellite) – Satellites that orbit about 1800 miles above the Earth's surface.
Market Niche – a focused, targetable portion of a market.
Market Share – the percentage of total sales of a service or product attributable to one company.
MEO (Medium Earth Orbiting Satellite) – Satellites that are in orbit about 9000 miles above the Earth's surface.
Network Effects – Where the value of a service or product to one consumer depends on other consumers using it.
Packet Switching – Breaking down messages into smaller units and sending them over a shared connection.
PCS (Personal Communications Services) – A wireless phone service that emphasizes personal services and mobility. PCS may also be referred to as digital cellular.
PSTN (public switched telephone network) – A formal name for traditional, wire based telephone networks.
Roaming Fees – Charges to use a cell phone out of a subscriber's home coverage area.
Substitute Services – Where a product or service may be used in place of another product or service.
Switch – A device that channels incoming data to a specific destination.