Inflight Internet Connectivity Technology and Its Application on E-Commerce

by

Ms. Manasuda Suwanateep

A Final Report of the Six-Credit Course
IC 6998 E-Commerce Practicum

Submitted in Partial Fulfillment
of the Requirements for the Degree of
Master of Science
in Internet and E-Commerce Technology
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Project Title	Inflight Internet Connectivity Technology and Its Application on E-Commerce
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The Graduate School of Assumption University has approved this final report of the six-credit course, IC 6998 E-Commerce Practicum, submitted in partial fulfillment of the requirements for the degree of Master of Science in Internet and E-Commerce Technology.

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ABSTRACT

Today there are millions of air travelers in a year some of who call for the Internet connection on the planes. Thus, effective integration of those related technologies can create the capability of Internet in delivering data services in airline business. In addition, an integration of the Inflight Internet connectivity market such technology ventures, airline businesses cannot only strengthen the possibility of the internet in the sky but they also prove the other possible network rather than one on the ground.

Two Inflight Internet architectures are as the real time broadband and cached narrowband. Their services are slightly different, although based on the same market prospectives. The satellites are developed as communication means of the systems. Some disguises of protocols, which work with satellite, are clarified by the technology providers and supported by the Aviation Authority. This study was accordingly conducted to assess the status of Internet technology and E-Commerce technology in the present and in the future connectivity. As the technology matures, the benefits are enhanced to either micro or macro scopes. The airliners are introduced to mutually integrate into the networks for the sake of the global communication. The passengers can continue their businesses without limitation. In terms of E-Commerce, the online business can spread on wires as the Internet enhanced.

In this project, the onboard Duty Free Sales is proposed as the first attempt to exploit the opportunity to increase their market areas. With the limitations, the online DFS business needs to cooperate with other airlincs and other countries' DFS. The results of this study support the technology performance and henceforth.

ACKNOWLEDGEMENTS

I would like to express profound gratitude to my advisor, Dr. Kitikorn Dowpiset, for his valuable support, encouragement, supervision and useful suggestions throughout this project. His moral support and continuous guidance enabled me to complete my work successfully. I also would like to extend my deepest appreciation to Rear Admiral Prasart Sribhadung, Dean of Faculty of Internet and E-Commerce Technology, Ajarn Pornpong Vatanaromya, for their valuable suggestions throughout this study and all professors whose lessons acknowledge some crosswise during the process.

I am as ever, especially indebted to my parents for their love and support throughout my life. I also wish to thank my IEC friends for their encouragement and understanding during my study.

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I. INTRODUCTION

1.1 Objectives

This paper is the project studies of the Inflight Internet technology and its implementation cases. The project studies illustrate the scenario of the most up-to-date internet technology on mobile platform such an airplane to bring about the global internet-airline community.

The project purposes on the studying of the emergence of the technology. Hence the air travelers are now entering an era of total connectivity.

The project indicates splendid utilization. Thereafter, the studies are implemented onto Thailand's national flag carrier in 2 cases; whether Thai Airways should adopt this technology and what actual benefits are delivered, the illustration of sample business onboard such online Duty Free Sales service that possibly develops by the inflight internet technology.

1.2 Scope of the Studies

The project studies cope with the technology and its services. It will technologically based on the area of American technological market sources where consist of the technology ventures; technology initiators, service providers, hardware developers.

In the prime time, its services can be delivered within the regional market in US. Continents while the European and Asian airlines have the movement to purchase the fully enhanced technology to bring the benefits to their market. In the moment the technology providers offer the temporary system to some of the European and Asian airliners. Meanwhile the source from the technology initiator insists that it be extreme

benefits when the mature inflight Internet technology converges and spread over the globe.

For Thailand 's national flag carrier, according to the studies, the project has an attempt that Thai Airways is put as a sample case, ideally implementing this technology on its aircrafts and its deliverable services of the online onboard Duty Free Sales. Though it would survey the feasibility on Thai airlines market demand on further studies.

II. INFLIGHT INTERNET CONNECTIVITY SYSTEM

2.1 The Pre-Existing Inflight Internet Technology

There was one distinct architecture, the quickest and simplest solution to provide Internet access to airline passengers using the prevailing aircraft telephone system via the Aircraft Communication Addressing and Reporting System (ACARS), already equipped onboard in most aircraft.

With the aircraft communication system, generally ACARS serves as a router to address the Air Traffic Control messages to the appropriate aircraft, airline host computer, or other Air Traffic Control agency and permits direct data exchange between the aircraft and the airline ground-based computer through VHF radio or the aircraft satellite system (SATCOM) if the radio frequency is unavailable. (See Appendix A)

2.1.1 System: Seatback Telephone System

The provider of seat-back telephones such as AT&T, Verizon Airfone, GTE Airfone, adapts the existing phone system to use as a pipeline to bring Internet access with the addition of a single black box in a plane's electronics bay. (Figure 2.1: Internet via Onboard Telephone System) The function's system is similar to an in-office network that means an individual has to dial up the Internet Service Provider from one of those seatback phones. Data ports at seatback deliver a high-speed connection to a host server and via ACARS, the aircraft communication system. Automatic data exchanges unite the laptops with the platform below. The telephone system provides periodic e-mail feeds between the air and ground, along with limited Internet access. For instance, Tenzing Global Communications Inc., is the wireless technology vendor who initiates the e-mail access on most planes regarding the system.

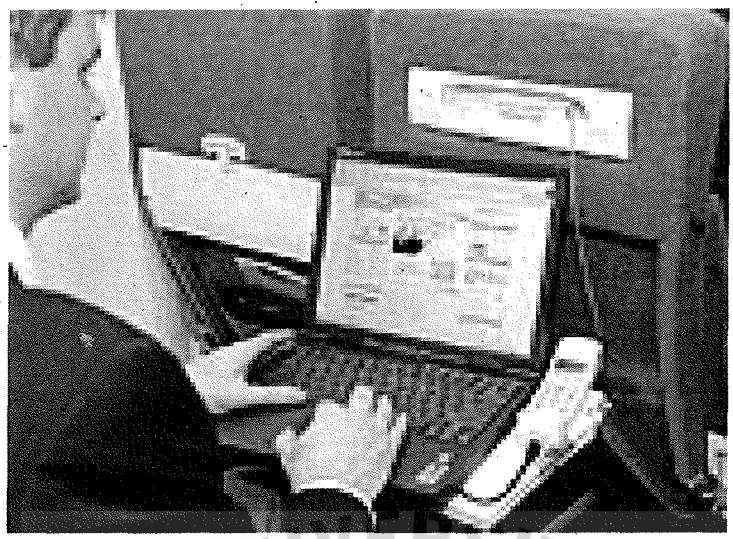

Figure 2.1. Internet via Onboard Telephone System.

2.1.2 Current Problems and Areas for Improvement

There are somewhat constraints in the speed and cost of digital communications of the aircraft. The prime architecture was so slow and costly to the users. The download speed of seat-back phones is at 9.6 Kbps. The aircraft telephone system via ACARS causes the download and roundtrip delay then finally forces the system links to the satellite.

The cost is as high as phone fees, for example, $3 per minute within US continent. The e-mail download delay forces many to use telephone conversations via a satellite communication, which costs a lot to the aircraft. As the technology provider has arrangements with the telephone system provider to sell its data service to corporations or individuals at a monthly or annual fee, the subscribers pay the telephone fee at current rate $1.99 per minute (Dec 2001). The actual price is much higher regardless of the subscription. Only the subscribers can use the services. The system has to install adequate phone lines to support multi-users on the plane.

2.2 Satellite-Based Inflight Internet Technology

The satellite-based architecture is developed by Boeing Company, the biggest aircraft maker and the best in aviation technology, and with joint ventures to make the Internet most compatible while inflight. The system blends proprietary software, satellite and land networking, and onboard LANs. (Figure 2.2: The Satellite-Based Internet on Aircraft) As it is the new case of technology, no single standard currently exists. The existing satellite-based inflight Internet systems fall into two broad groups: those implementing new satellite-based broadband systems and those using existing narrowband air-to-ground telephone links. But thereafter the advanced satellite communications technology, launched in 1993, with multiple antennas enhances the narrow-beam transmissions. Either way these systems use some form of on-board server/caching systems that are kept updated during flight, though slow when using the narrowband phone links. Further to the advance technology of Internet connectivity, the satellite will be supplemented by the future Internet Airborne.

With satellite enhancement, the first technology uses a full-capacity telecommunication infrastructure to offer a real-time, high speed, truly broadband cable-quality Internet service equivalent to what users have on the ground. The system provides Internet and company Intranet access, unlimited connectivity to airborne environment. Meanwhile the latter, the narrowband systems, does not have the capacity to support full company Intranet access. The cost of retrofitting an existing airliner with the service, or to build it into new commercial jets ranges from $20 million to $200 million.

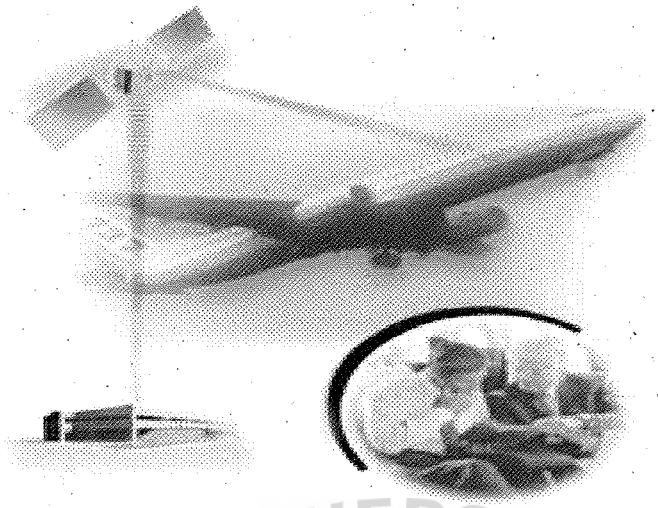

Figure 2.2. The Satellite-Based Internet on Aircraft.

2.2.1 Real Time and Broadband Internet Technology

Broadband is how much more data to send and download including audio files, video files and photos. Broadband is telecommunication that provides multiple channels of data over a single communications medium. It is important to airlines and customers because it provides high-speed connectivity and live entertainment services concurrently to multiple users.

The capability of satellites is to augment the broadband Internet access and the opportunities created by these unique abilities. There is also a new type of service being developed that will take broadband into the air.

Industry leaders will discuss how satellites are helping to meet the demand for Internet and multimedia services and to address the bottlenecks inherent in today's networks. A variety of Internet-based applications include high-speed access, IP multicasting, satellite caching, Ka-band/Ku-band systems, content delivery and distribution, the future broadband systems, satellite-based Intranets, voice-over-IP, and

satellite-terrestrial hybrid networks. Business issues will include industry forecasts and outlook, business models, alliance strategies, and the role of satellites in the future of the Internet Connectivity.

System

Initially, it enhanced two-way broadband data services at 5 Mbps to receive communications and 1.5 Mbps for outbound transmissions. The bandwidth will be expanded to correspond with advancements in new technologies. As the service matures, it extends to a mix of advanced antenna technology and existing satellites. The service leases the Ku-band transponders and proprietary phased array antennas, developed and patented by Boeing, to deliver content at 5 Mbps and support responses at T1 rates (1.544 Mbps).

The service infrastructure has integrated these portions of elements as follows:

(1) Airborne Network System

(2) Ground Network System

(3) Space System

Airborne Network System (ANS) is consisted of the airborne antennas, airborne servers, routers and associated wiring.

In 1986, Boeing has developed a proprietary solid-state phased array, transceiver antenna that is the key enabler for the two-way broadband communications service. The new design will improve system performance and overall capability. Proprietary Boeing technology, in particular a satellite antenna developed originally for military command and control centers, will provide a virtual pipe to the Internet-enabled aircraft.

The flat, two-inch antenna and additional wiring would be attached to each top of aircraft, stretching 55 inches across the top of a plane upper fuselage with which

commercial aircraft already in service would need to be retrofitted. The phased array antenna provides enhanced response to directional changes by steering signals electronically vs. mechanically, permitting instantaneous and continuous connections between satellites and customer aircraft. The device adjusts to keep in touch with the nearest satellite. That helps avoid interruptions. The phased array antenna locks on a satellite by steering its signals electronically. There are no moving parts. The antenna remains in constant contact with the satellite, even when the plane moves at 600 miles per hour while the competing systems use antennas that move mechanically to stay connected with a satellite. Most of the total expenditure of US$100 million was spent to produce an onboard antenna.

The connection speeds previously provided by satellites were slow, about 2.4 Kbps for international flights and 9.6 Kbps for U.S. flights. The actual bandwidth will be expanded to correspond with advancements in new technologies with its speed at 128 Kbps, twice that of a home PC 56k modem, comparable to a high-speed, ground-based Internet connection. But those numbers are somewhat deceiving because the speed will diminish by sharing among multiple users, effectively slowing it. Actual speeds available to individual passengers will depend on how many people onboard are connected though the promised minimum speed of 56 Kbps, same as a standard dialup modem.

The capabilities provided by satellite design and manufacturing facilities will enhance the overall service infrastructure and help to bring forth this exciting new mobile communications service.

The cabin file server (Figure 2.3) allows the same type of Local Area Network. It is designed for the unique requirements of the aircraft environment. Its small size and

minimum cooling requirements allows it to be mounted in any convenient location in the cabin. The cabin is equipped with onboard server, router and service-analysis equipment and is outfitted for the security enhancement capabilities pursuing for commercial airline customers. Seats are configured for connectivity. Since Internet traffic tends to happen in bursts, the cabin file server not only allows multiple users to share access to a single physical connection, but also allows them to be on-line simultaneously.

When a laptop computer and a network interface card is plugged in to the airplane seat, it will identify what kind of computer and operating system of the laptops and ask for the appropriate software. Passenger laptops interface to the cabin file server through Ethernet cabling installed throughout the cabin. Interfaces include three RS232 serial ports, a parallel printer port, connections for keyboard, mouse, floppy drive and CD-ROM, digital and analog video output and a USB port. There is also the ability to support a variety of interfaces such as Ethernet, modem and others through two Type-II PCMCIA slots. An optional ARINC 429 PCMCIA interface allows the cabin file server to utilize aircraft data such as position reporting and maintenance information. This airborne computer is very versatile due to its extensive interface capabilities and removable hard drive. It also allows the computer to be updated and tested on the ground without removal from the aircraft.

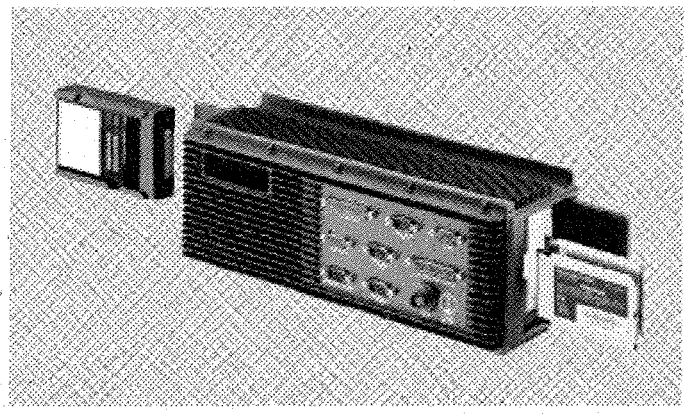

Figure 2.3. Airborne Network Server.

In addition to the antenna, the system requires a server and router -- powerful machines used to operate computer networks. It will also wire the aircraft to carry the service, potentially building a data port into every seat on the plane.

Ground Network System (GNS) is consisted of Network Operations Center (NOC), Associated Satellite Uplink/Downlink Equipment, and Business Operation Center. The NOC extends the capabilities to a satellite orbiting at about 23,000 miles. Information is uplinked from the NOC to a satellite, which then downlinks the information to an aircraft via an antenna. The downlink information goes to an on-board server and the signal is then routed to individual seats on the aircraft. Business Operation Center supports the system such as the database to provide the information to the aircraft.

Space System is consisted of Satellite Transponders. The service uses Ku-band satellite transponders. Once in orbit, the satellite will be parked in an orbital slot located at 63 degrees West longitude and provide air travelers with the first real-time broadband Internet access over the North Atlantic. Leasing transponders on the high-

powered Ku-band satellite provides a low-risk solution and a good blueprint for expanding the broadband communication service to other parts of the world. This also brings the progressive new service to populous markets such as Europe, Asia Pacific and other regions. Using leased, dedicated transponders is an economical approach to providing the necessary system capacity, bandwidth and transoceanic coverage and it will continue to explore similar opportunities with satellite service providers in other regions.

Internet Service

Ultimately, the service will be available everywhere airplanes can fly. The perceived service will initially be available to commercial airline customers in North America and anticipated in 2002 in Europe. Additional global regions will be added as the service matures.

The system has contracted with the third party content provider to provide customized, destination-based, licensed content, including worldwide, national and local news, sports and features - from more than 3,000 publications in its global digital content network, then filter, deliver and instantaneously integrate it into the system. As a result, airline passengers will be able to choose from a multitude of personalized real-time services including Internet and corporate Intranet access, E-Commerce, live entertainment and information. The system offers multilingual programming. Selections will be based on the specific needs of the customers in different regional markets. This content complements full Internet/company Intranet access and infuses the service with the time-sensitive data but will not initially supply voice service.

Channel content will depend on whether the flight is in Europe, Asia or North America. For North America, Boeing has negotiated an agreement with CNN Inflight,

ESPN, EuroSport and CNBS. EuroSport, the leading European sport network supplies sport contents to the airline travelers in North America and European Continent. They will gain inflight Internet access to live sports programming while traveling throughout continental Europe. As part of the Internet service, instant messaging and chat rooms will be available. Revolutionary new computing capabilities are now available to business jet cabins with the airborne network server, similar to those they are accustomed to in their ground-based offices, sharing files and printers and access E-Commerce. Intranet service will be more complicated because company Intranet has protective firewalls. The agreements must be worked out in advance so that an employee can access his or her Intranet by using the service.

In this Internet environment, it eliminates the complexity and expense of maintaining multiple phonelines and user accounts for each individual connection under conventional schemes. Internet usage may be enabled and monitored on an individual basis. Those services are differentiated by airlines that enable this technology. (See Appendix B)

Internet Fee

The price has fluctuated and remains open to change. For the onboard service fee, the service will cost passengers about $20 per hour (likely less than $8 a minute of inflight phone call). The passengers can watch paid television program, access their corporate Intranet and surf. Up to four live television channels will be offered at either free of charge or paid programs. Those charges are likely to be around $17.50 per hour but also may include flat-rate options for each leg of a trip. For the payment, passengers will use credit cards to pay charges. They will type the credit card

information into the system when they sign on and it will remember the card number so passengers don't have to retype the number the next time they fly.

The system above exemplifies the technology of Connexion by Boeing (See Company Profile). In 2000, Connexion (See Company Profile) is the separate business unit to focus this effort, especially developing the broadband inflight Internet technology. Connexion by Boeing is the market-leading initiative to bring commercial broadband data services to commercial and executive aircraft during flight, allowing passengers to have access to Internet, firewall-protected Intranet access, E-Commerce, television, news and entertainment content, and transmit and receipt of data. Aircraft operators also benefit from inflight Internet access to aircraft and crew data. Boeing studies the potential applicability of the Connexion broadband in-flight data services for enhancing aviation security.

The innovative new commercial broadband data service combines the core strengths of the world's largest aircraft manufacturer with the space-based communications units such as of Loral Space and Communications, Tokyo-based Mitsubishi Electric Corporation (MELCO) group and Rome-based Alenia Aerospazio, a Finmeccanica Company to create an inflight communications venture. Loral's Skynet has 10 satellites covering North and South America, Europe and parts of Asia. (See Company Profile) The service leases the Loral Skynet's Ku-band transponders and Boeing's proprietary phased array antennas to deliver content. Loral Skynet do Brazil will add additional transponders to the Estrela do Sul 1 satellite scheduled for launch in mid-2002. Both Alenia and MELCO companies will support the design and manufacturing of the next-generation phased array antenna and the supporting electronics for the Connexion by Boeing service.

Connexion has contracted with ScreamingMedia Inc., to provide customized, destination-based content. ScreamingMedia will provide with its own network content, and also will use its technology solution software to deliver pre-contracted third-party content. ScreamingMedia Content Engine technology will parse, normalize, process, customize and integrate content as part of the delivery process. Connexion by Boeing will then use the acquired destination and news content to supplement the live television and radio content and flight-specific information provided to passengers during flight.

Some 11 corporate customers, who have outfitted their private aircraft with Boeing equipment, are using the Connexion service. The three airlines, American Airlines, United Airlines and Delta Airlines will equip a total of 1,500 aircrafts with the venture's innovative, high-speed broadband Internet connectivity service.

2.2.2 Narrowband and Cached Internet System Technology

System

The narrowband networks is the temporary solution of Internet connectivity with reliable, uninterrupted and affordable access, however, by using the existing airplane communication links. The system caches all the incoming and outgoing messages. Because of limited throughput of the air-to-ground data links, so it is not real-time, with response times around 15 minutes. The cached or prepackaged stored in an on-board server computer would periodically forward content to the ground. It has backed an optional broadband real-time Internet access.

The system provides the communication between the Airborne Network System (ANS) on board and the Ground Control System (GCS) via satellite.

Airborne Network System

ANS is an onboard Local Area Network that connects each seatback telephone bay to an onboard proxy server, based on IEEE 802.11b. The connection on behalf of the individual users is routed through the proxy server, hence the term proxy at speed of 11Mbps. Each laptop wireless LAN card also has a hardware-defined address, which in turn is mapped into the server as the access point. The aircrafts will house both e-mail and Internet servers. The type of LAN varies between airlines. Cathay Pacific has installed USB ports in its seats, while SAS is with an 802.11b wireless network, for instance.

The caching is necessary because although the onboard LAN will carry data at rates up to 11Mbps, the proxy server in turn will communicate with ground-based networks at rate up to 64Kbps. Each user connects to the aircraft's on-board server at 64 Kbps, like a home modem to store web pages and buffer connection breaks, sending data periodically in compressed packages.

As of the connection establishment, the passengers plug into a Local Area Network on the plane; logging onto global ISP provides quick access to onboard web content and email delivery service. Once the dial-up is made from the 56k laptop's modem via the seatback telephone, the requests are intercepted by the onboard server at 11 Kbps rate and then the onboard proxy server sends a signal to the ground ISP server at rate up to 64Kbps to retrieve messages. The email transfers from the onboard server to laptop at the 56Kbps speed supported by the onboard LAN. Total download time may be the same.

Ground Control System

A ground-to-air satellite data link uses Inmarsat's Aero-H service. Once connected, the on-ground server will collect and compress e-mail, filtering out large messages or attachments, before sending it back to the onboard proxy server and on to the user. However, the proxy server does not automatically retrieve long messages and file attachments. The message size is limit, varying among airlines, for example, 75 KB on Air Canada.

Internet Service

The access gains by running an application downloaded ahead of time from software kit on the airplane or alternatively by a standard dial-up networking connection with standard POP3 email program. It is totally compatible with Windows family, web browser and email program for instance, using POP3 email account. No hardware is necessary but laptop. HELP functions as the personalized and outstanding customer support.

The web content is stored in an on-board web server that updates itself periodically -- not connected with the ground in real-time. The software will remember which web sites are preferred by passengers on a particular route, and squeeze the most possible connectivity out of limited satellite connections. Since web content and email is currently stored on a server, the average connection rate of 56Kbps poses no slowdowns or hiccups. The service users will not directly experience the lag associated with such slow speeds.

The service features include inflight email exchanges, web content. The corporate email access can be sent and received via Lotus Notes or GroupWise e-mails through company's secure firewall. Passengers can surf those limited web contents, which are

furnished for free through deals with about 100 content providers such as Yahoo, the Wall Street Journal and other smaller sites. Web content, up-to-date news, weather and travel resources are currently uploaded at the originating airport depending on the timeliness of the subject matter. Time critical data such as News, Sports, Weather and Stock Market Condition are updated on a routine basis while inflight.

However, it offers only limited, preloaded web browsing, and disables for corporate, America Online AOL, or web-based e-mail such as Hotmail or Yahoo. E-mail responses and web pages that contain time-sensitive content might cause some delays though. The current system operates at 11 Kbps (compare with ground-based connection 56.6k modems), while the high-speed connection system will run at 5Mbps, about 500 times faster. The web content is accessible only for the paying email customers. In the future, passengers may be able to call ahead for certain popular sites to be cached before they board particular flights so they can see them in the air. For airlines that enable this technology. (See Appendix B)

Internet Fee

The service fees are based on bandwidth usage. The price structure hadn't been finalized. The pricing is variable according to the airlines. It is hard to distinguish because the technology and its service are different, though based on the same technology. It is hard to say whether the price is reasonable or not. The service will cost $4.95 an hour over North America and $9.95 an hour on international flights; reading or sending email would cost an extra 50 cents a page. The flight from Hong Kong to Vancouver, the Cathay Pacific system charges US$ 5.99 a minute for Internet access from aircraft vendor terminal. It costs at US$10 to 20 to upload and download up to 500KB of mail during a day's travel including all connecting flights that offer the

service for instance. Passengers, who want to send or receive long e-mails, like video clips or lengthy attachment, would be charged more. Most of the systems are being designed to scan their e-mail headers before they receive them in order that passengers can decide which messages to accept now or later.

Business users will be billed through pre-established corporate accounts while leisure travelers will be billed through their credit cards. Company Intranet services will cost a fee. While inflight phone/fax are charged at a flat rate per minute or part thereof at US$8.80, the customers with subscription pay an extra $4.95 to access their email for a 24-hour period. An option allows them to read only the address of the sender and the subject line. Users then pay about 50 cents per page if they choose to read or send e-mail. The itemized monthly billing is allowed to control the account and easily manage through the Web. It is predictable costs and the users do not have to pay for inflight phone connections. The users can pay for email access on the next flight, or purchase a subscription to fit their regular travel needs.

The technology above exemplifies the Tenzing Technology. Tenzing, the Seattle-based communication technology provider, partners with the world's leading air carriers to make the total connectivity a reality and speed up this technology.

Tenzing teams with industry leaders in communication, telephony, networking technologies, airborne platforms, Internet content, and E-Commerce. It aims at strategic relationships for the long-term -- preparing the company to innovate new solutions for a changing marketplace and evolving digital platforms. Tenzing teams with iPass, a premier provider of enterprise-grade remote access services in over 150 countries over 14,000 points of presence (POPs) and toll-free dial-up numbers, to deliver a high quality global roaming solution. The iPass network provider includes

Equant, Level3, CompuServe, France Telecom, Pacific, Deutsche Telekom, and many other leading network operators. Web Content Partners are AcrossFrontiers, Actijob, BizTraveler, Canada Film Board, DoAsia, e-street.com, Execubooks, FT.com, GetAsia, Grand Prix Canada, Intowine , Knowledge Anywhere, Lonely Planet, MSNBC, Points.com, Restaurant Row, Time, Time Canada, Travlang, Wall Street Journal, Wines, World Travel, Worldroom, Yahoo, Amazon.com. They deliver an outstanding choice of content that enhances the productivity and enjoyment of the connected traveler and also deliver quality goods and services selected especially for the frequent business traveler. Tenzing offers targeted Web content and e-commerce outlets perfectly matched to the savvy business professional. Technology Partner includes air-to-ground communications, high-speed LANs, and wireless networks. Those partners are iPass, Telia Homerun, Skynet global, SITA, Nokia, Hughes Global Services (HGS), Inmarsat, COMSAT, ARINC, Skytel, VerizonAirfone (GTE), Miltope Corporation, General Dynamics, Matsushita Avionics Systems (MAS) and AIRIA the live inflight television innovator.

Tenzing maintains a less costly narrowband or cached system for Internet and e-mail solution, though its solution does not offer as the broadband, real-time capabilities. It remains competitive due to price issues. Tenzing later began to extend the Internet capabilities by include both broadband and optional narrowband. The user experience is similar to that of a remote connection on the ground. Passengers and airlines can choose from live Internet access at a speed of 8 Mbps to 25 Mbps or free access to the selected best of the web content stored on the onboard server. Airlines may upgrade to emerging broadband technology for superior coverage and speed as their connection needs evolved at lower cost. It takes a few hours per aircraft to leverage the existing

onboard infrastructure. The supplier of satellite services is currently developing a high-speed data solution that utilizes Inmarsat 's new 64Kbps satellite services. This technology will provide up to 128 Kbps data rates (using 2 channels) on and off the aircraft, nearly 20 times faster than previously available.

Services include inflight email, terrestrial global roaming capabilities, extensive web content, a business-focused web portal, targeted E-Commerce services and frequent content updates.

Tenzing, partnered with aircraft equipment maker Honeywell, offers the broadband Internet by using end-to-end satellite communication service which enables passengers to choose their connectivity speeds and surf the web in real time, as well as send and receive email from behind corporate firewalls via an onboard virtual private network. Tenzing broadband upgrade path offers airlines a low-risk entry to passenger connectivity. Tenzing has formed a strategic partnership with AIRIA to offer airlines this integrated entertainment and communications solution, an integrated suite of live television, email and web cache services. They integrates satellite communications, terrestrial networks, and global roaming services to deliver seamless, customer-centric connectivity designed specifically for the business traveler across all physical, technical, and conceptual boundaries -- worldwide.

Tenzing has the large network of committed aircraft with fleet deployment arrangements with Air Canada, British Airways, Cathay Pacific, FinnAir, Singapore Airlines, VARIG, and Virgin Atlantic. Tenzing concludes the trials and negotiations with another dozen leading airlines.

2.2.3 Current Problems and Areas for Improvement

The technology hurdle issues include some complications to be considered.

(1) Discussion of how Transmission Control Protocol reacts to satellite conditions

Even though the utilization of the satellite plays role instead of the existing aircraft telephone system, the connection speeds provided by satellites are still unbearably slow. It needs to review a survey of proposed solutions and how protocol gateway offers the best solution of the high performance access via satellite. According to NASA scientists (October 1996), the TCP standard for communications over the Internet and corporate networks does not work well in space. Distances cause delay in transmission, where TCP acts as if the network is backed up, and thus, the acknowledgements from the receiver are delayed. The poor performance of the TCP protocol under the long latency, high bit error rates, and asymmetric bandwidth associated with satellite networks are the primary limitations to efficient, high speed Internet access using satellites.

TCP/IP protocols used to transfer data over the Internet were never designed for conditions typical of satellite communications. If without TCP compatibility, satellites cannot provide Internet services. It was an issue for companies wanting to use geostationary satellites to transmit data that needs heavy investment in terrestrial transmission systems. The system has to be developed to the remove the TCP incompatibility.

To overcome these limitations, a variety of solutions have been proposed, including modifications to the TCP protocol, data caching, spoofing, and the use of alternative protocols.

The integration and interoperability issues suggests that the global networks are increasingly being designed with multiple transmission technologies incorporating with satellite links in high-speed hybrid networks standards for interoperability, utilizing Asynchronous Transfer Mode over satellite to extend the network and the keys to seamless integration. It enhances the performance and efficiency of satellite on Internet access that helps maximizing the efficiency and performance of satellite IP links, including the advanced error-handling algorithms, data acknowledgement mechanisms utilized flexible rate control to optimize performance based on link and traffic characteristics, data stream combination or "piggy-backing" to allow multiple transmissions to be sent as one.

The voice over the Internet is experiencing a similar delay problem, but in this case, due to digital compression and bandwidth limitations rather than distance. As a result, the communications satellites play the essential role as a radio station relaying in space. Any connection at the T1 line (1.544 Mbps) speed, in fact, via a geostationary satellite is constrained to only 64 kilobits per second, which is 4 percent of the purchased capacity. Those developed satellites get more powerful transmitters with focused radio footprints and gain-type antennas though numerous satellite dishes get smaller.

The issue of latency arises with almost all implementations of the only data protocol with which most people are familiar, TCP/IP, which connects the global Internet and is the standard for corporate networking. The latency causes the annoying delay, impeding understanding and distorting the personal nuances of speech. Excessive latency causes otherwise high-bandwidth connections to communicate at a fraction of their capacity. Applications will be developed for terrestrial networks, not for special networks with non-standard characteristics. Those satellite companies that build networks that are not compatible with the predominant data protocols and applications are taking a big business risk that their systems will be usable only for specialized, proprietary applications.

For all lossless TCP protocols that guarantee the integrity of the data transmission, latency is a constraining factor on the usable bandwidth. Since a data packet may be lost in transmission, a copy of it must be kept in a buffer on the sending computer until receipt of an acknowledgment from the computer at the other end that the packet arrived successfully. Most common data protocols operate on this principle. The data packet's trip over the geostationary connection takes 250 milliseconds at best, and the acknowledgment packet takes another 250 milliseconds to get back, so the copy of the data packet cannot be removed from the buffer for at least 500 milliseconds. Since packets cannot be transmitted unless they are stored in the buffer, and the buffer can only hold a limited number of packets, no new packets can be transmitted until old ones are removed when their acknowledgments are received. Specifically, the default buffer size in the

reference implementation of TCP/IP is 4 kilobytes, which is 32 kilobits. This means that at any given moment, only 32 kilobits can be in transit and awaiting acknowledgment. No matter how many bits the channel theoretically can transmit, it still takes at least half a second for any 32 bits to be acknowledged. So, the maximum data throughput rate is 32 kilobits per half second, or 64 kilobits per second. The interplay of latency and buffer sizes does not affect all data transmissions, only lossless ones.

Changing protocols is not a feasible solution to this situation. The trend in data networking is toward a single "pipe" carrying many types of data (including voice and other real-time data). It is therefore likely to be neither useful nor economical to transmit specific kinds of data using custom, proprietary protocols. In theory, the implementations of standard protocols, such as TCP/IP, can be modified to support higher buffer sizes. But these modifications are rarely simple or convenient, as computers on both sides of any connection need to be upgraded. Moreover, the maximum buffer size possible in TCP/IP is 64 kilobytes, which still only provides 1.024 megabits per second, or 67 percent of a T1 line over a geo-stationary link.

For real-time data, such as voice and video, where it is not essential that all data be transmitted, "lossy" protocols can transmit higher data rates with fewer overheads. Unfortunately, real-time applications, such as voice telephony and videoconferencing, are precisely the applications most susceptible to unacceptable quality degradation as a result of high latency. No one single technology or satellite system type is going to be appropriate

for all communications needs in all settings. The capabilities of fiber cannot be matched for very dense traffic.

(2) System Security Issues and Approval Issues

System Security Issues

These new wireless networks standard known as Wi-Fi have no encryption protections, making them vulnerable to even unsophisticated hackers. The company should not be responsible for security on its networks because the Internet carries security risks. For Internet security, users should install personal firewall.

Wireless LAN manufacturers readily acknowledge the security problems with the IEEE 802.11B standard and have recently taken steps to strengthen their security. The IEEE802.11B standardization was reinforced in August 2000 with the formation of the San Jose-based Wireless Ethernet Compatibility Alliance whose members range from vendors like Dell Computer, Compaq Computer Corp., 3Com Corp. and Cisco Systems Inc. The wireless LAN users must ensure that the built-in Wireless Equivalent Privacy (WEP) 40-bit encryption protocol is turned on after the installation. Without it, the users are vulnerable by whom are motivated to overhear the traffic. This also offers optional 128-bit encryption - a requirement of the a new wireless LAN security and per-session encryption based on public key infrastructure, as well as Wireless Ethernet Compatibility Alliance feature based on the Remote Authentication Dial-Infuser Service protocol used to secure virtual private networks.

System Approval Issues

All services depending on satellites concerns many of the international aviation regulations and requirements to enhance the safe communication throughout the global area network. Regulatory authorities such as Federal Aviation Administration **(FAA)** have strict requirements regarding the inclusion of commercial systems, such as wireless LANs, on aircraft. Every element of Inflight Internet connectivity has to meet up standard. The inflight Internet technology and its system hardware have been tested before the deployment to be certified by FAA.

The international Bureau of Federal Communications Commission (FCC) action is a critical step toward the development and implementation of the satellite-based element of overall Air Traffic Management architecture. FCC considers an important stakeholder in which supports the importance and urgency of a satellite-based Air Traffic Management system.

Connexion meets Federal Aviation Administration (FAA) requirements and been granted certification of the airborne communication network allows the transmission of satellite-based data onto mobile aeronautical platforms using the 12 GHz Ku bandwidth. The Boeing team completed extensive testing of the aviation security and data analysis of critical on-board hardware, software, systems and procedures allowing real-time, high-speed Internet and Intranet access, television, entertainment and e-mail. Connexion One provides a dedicated environment for demonstrating the robustness and inflight operability of the Connexion

service. The cabin is equipped with onboard server, router and service-analysis equipment and, also, is outfitted to demonstrate security enhancement capabilities the venture is pursuing for commercial airline customers. Seats are configured for demonstrating connectivity to the Connexion service. On the exterior, the top of the aircraft fuselage is outfitted with phased array antennas to enable real-time, Ku satellite-based data transmission and reception. The aircraft permits the airline evaluators assessing the enhanced consumer 39,000 feet and operational benefits of real-time broadband services to personally test the service by having it perform multiple, simultaneous high-bandwidth tasks ranging from data transfer and full-featured e-mail to streaming video and global web site access. Airline technical teams have found the service to be as robust or superior to the high-speed connections they enjoy at home or in the office. The robustness of the Connexion was initially demonstrated during a 2.5-hour test flight, when e-mail with digital photo attachment was transmitted from 33,000 feet. The e-mail was received moments later on the ground, where a return reply was composed, sent and promptly received by the airborne team. That's a capability that helps to reduce future risk by thoroughly testing all aspects of the service before it's installed on commercial airliners. The final test summary paperwork necessary for certification was e-mailed to FAA officials in Los Angeles via the satellite communication link from the Connexion One airplane while flying 35,000 feet above New Mexico. The document and supporting material, totaling 800 kilobytes, were transmitted to FAA officials in real-time in less than 30

seconds, representing a quantum leap over what passengers currently can accomplish using communication links currently offered by other service providers.

Boeing has cleared a major hurdle in the development of its Air Traffic Management system with the licensing of a new mobile satellite service enables Boeing to build a medium earth orbit constellation of non-geosynchronous orbit satellites NGOS operating in the 2 GHz band. According to Connexion One, data gathered during Connexion One flight tests also is used to demonstrate that the Connexion by Boeing service can operate without causing harmful interference to other spectrum users, in support of domestic and international two-way license applications and other ongoing international regulatory activities and study groups. The system validation testing continues under experimental licenses granted by the Federal Communications Commission (FCC) that allow the Connexion by Boeing service to operate above U.S. territory and waters.

As the airline regulations are likely to continue to prohibit the use of cell phone inflight because of the risk that they will interfere with vital navigation equipment, the wireless LANs are more safe and the output power of IEEE802.11b is much lower than that of a cell phone. Some newer aircrafts are probably less vulnerable because the rules for construction have been tightened.

(3) Availability

The coverage could take years to build a network. It is necessary to make sure that the systems work on all air routes throughout the world.

There are currently hundreds of airlines in the world. Not all are able to afford to integrate this system although Boeing tries to sell its technology-equipped airplanes to their customers. In the moment, airliners are mostly prompt to integrate the technology consequently. Connexion technology has dominated in US while Tenzing technology in Europe and Asia.

(4) Pricing and Volume of Service

The systems and their technology expenses vary the price of the inflight Internet services. No price structure has been set up uniquely for all until the inflight Internet connectivity market matures. For example, InFlightOnline, the system and software provider believes airlines could provide e-mail service as little as $4.95 a flight while Boeing suggests the airlines about pricing its high-speed service to passengers at as much as $25 an hour. And InFlight Network is pondering a flat monthly fee for unlimited use of about $20 to $25 and additional length of email, video clips or lengthy attachment would be charged more.

According to the current long-term forecasts show the worldwide commercial airplane fleet of about 14,500 jetliners growing at a rate of 4.8 percent a year. In the next 24 hours alone, 4.7 million people will board 41,500 flights around the world. The scope of the installations will allow the venture's system and service to be redesigned and developed so that the costs decline reasonably. Practically, the three-company venture intends to offer low-cost broadband Internet and e-mail services to commercial airline fleets by 2002.

2.3 Satellite

Not so long ago, satellites were exotic, top-secret devices. They were used primarily in a military capacity, for activities such as navigation and espionage. They are an essential part of daily lives as seen and recognized their use in weather reports, television transmission, global positioning system, truck tracking and telephone system. Emergency radio beacons from downed aircraft and distressed ships may reach rescue teams when satellites relay the signal.

In the present, satellite becomes feasible means of broadband technologies to rural states, moving terminals that quickly transmit large amounts of data, including superior Internet service and transmission of voice and video over the Internet. (Figure 2.4: Satellite Enabled Internet Services) It enables the Internet connectivity to the moving terminal regardless of the altitude and speed. The inflight broadband Internet services typically offer a broadband satellite link in only one direction—from the satellite to the aircraft. Achieving a true broadband return link—from the aircraft to the satellite—has been a major engineering challenge.

In the inflight Internet access technology, the satellite is the significant element, relaying the digital or analog signal as the router on the ground system. (Figure 2.5: Satellite as the Router)

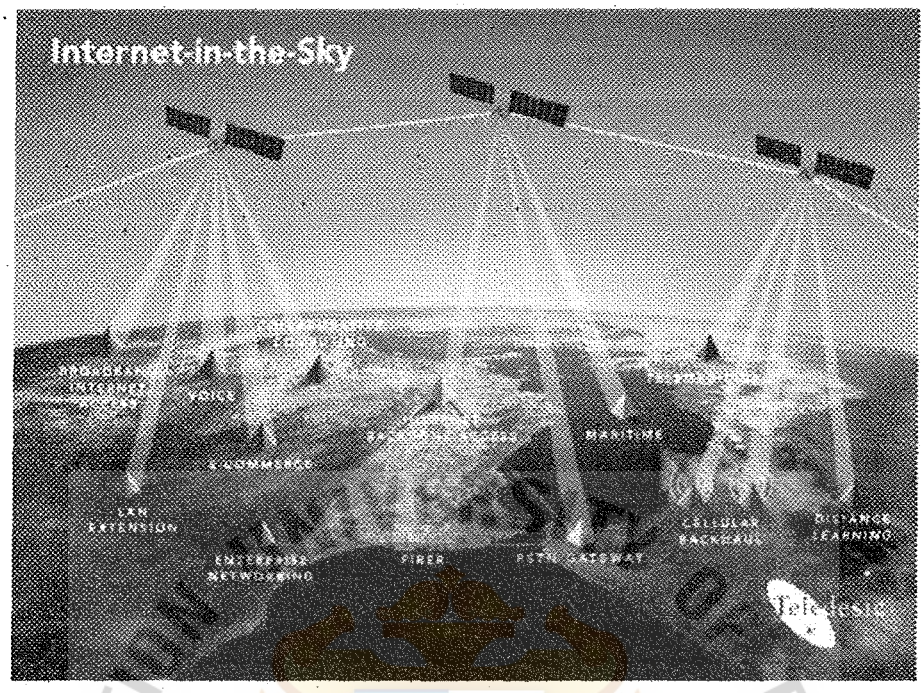

Figure 2.4. Satellite Enabled Services.

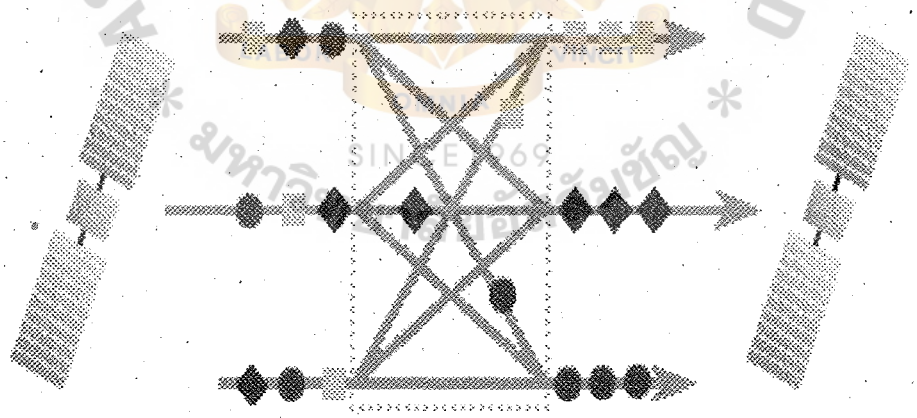

Figure 2.5. Satellite Serves as a Router.

2.4 Inflight Content and Access Technology

2.4.1 InflightOnline Technology

InFlightOnLine claims a hardware platform independent implementation, meaning that the company can deliver Internet services with existing narrowband infrastructure as well as future broadband capabilities like Connexion. IFOL provides software and on-board servers to implement its services, with lots of content. It uses existing narrowband ground-to-air links now or migrates to wider band systems like Connexion.

As the technology evolves, IFOL is able to manage its content through any of the hardware systems in the market. This is important because the aircraft operator may adopt new technologies over time, or equip the aircraft with a wide band satellite technology of off-aircraft communications. The services are designed to work seamlessly on any mix of platforms providing continuity of service and versatility as the underlying hardware technologies are enhanced. The service can be implemented quickly and economically. An aircraft can be quickly outfitted for customized real-time access to their favorite web sites, corporate email and Intranet services, and also offers a customized and flexible service set for each aircraft, and can personalize, design and manage multiple profiles for fractional ownership programs.

In addition, IFOL gives business travelers secure access to their own corporate e-mail account. IFOL offers secure corporate 'firewall' which are of concern to many businesses. IFOL software and data management system is designed to integrate with existing hardware like inflight entertainment and communications systems on aircraft. It accelerates content delivery and enhances narrowband and broadband connectivity and maximizes the effectiveness of these systems. The airline users can access their

existing e-mail accounts in a cost effective and intuitive manner. For airline operating a mixed fleet of systems, it integrates seamlessly on any platform. This allows for rapid deployment of services fleet wide and continuity of service as they adopt new hardware systems or equips the aircraft with wide band satellite technology for off-aircraft communications. This software develops a customized inflight portal with the airline's brand. The inflight portal can also serve as an airline's customer service access point, extending the many information and assistance services such as the airline information. The high-performance software is a building-block technology that powers e-mail and accelerates content delivery on any on-board server – managing and adjusting to the available communications bandwidth.

IFOL has an agreement with AT&T seatback telephone system to store their 20-pound airborne data servers on board. The airborne servers will be linked to the seatback telephone handsets that are offered on virtually every domestic U.S. carrier now. The initial connection will be at 56K, but intends to speed that up in future. Simultaneously, IFOL will use existing satellite systems and ground technologies to update content, depending on timeliness of information.

Methods used to update servers include:

Inflight Updates -- via the off-aircraft communications systems, namely North American Terrestrial System services, and Inmarsat services, on-demand requests are always addressed in real-time assuming off aircraft bandwidth availability.

Direct Broadcast Satellite Updates -- If the aircraft is equipped with this capability, IFOL can support both inflight and ground based updates using this technology.

802.11B Wireless LAN (Gate link) -- Enables high-speed updates of less timely information and content prior to the aircraft departure.

Physical Media Exchange -- May be required for updates and feature changes that require significant amounts of bandwidth and are less time sensitive. Video and audio programming are in this category of service.

The IFOL ground operations center detects changes on the ground sites that need to be synchronized with the aircraft to provide the most up-to-date information. In addition to determining the best method to update the airborne server, the ground center performs the following functions:

(1) Supports routing, tracking and management of traffic and transactions from airborne users.

(2) Supplies billing functionality, including real time credit card processing for inflight transactions.

(3) Manages and stores user profiles, enabling metrics, personalized web experiences and redundancy.

(4) Stores data for all applications and ensures regular synchronization with partner content sites to provide the most up-to-date information.

(5) Provides security to verify that only those persons with appropriate rights can see the data.

Re-host Technology Approach of IFOL

Re-hosting technology supports dynamic updates, enabling real time news, financial transaction and sports information, and enables real time e-commerce from the remote location, while managing expensive off-aircraft bandwidth. The IFOL service masks the connection to the ground by accelerating server response onboard the aircraft, and providing state-of-the-art compression, message handling, and proprietary data management requiring very few bytes to be transmitted to complete a transaction. Users

can typically enjoy a reliable 56 Kbps to 2 Mbps connection to the onboard server, depending on servers and inflight entertainment systems available on the aircraft.

Re-hosting technology supports personalized services while caching systems do not. The caching multiple pages of a web site provides the passenger with the last view of a subset of a site. It enables full web site, no broken links and dynamic updates during flight but tends to lose dynamic properties such as searching and e-commerce capabilities as well as server-side applications that must interact with a web sites database. Caching also requires significantly more storage memory, reducing the number of interactive sites presented to a user and not meeting the user expectations for the Internet due to its low quality, static nature and inflexible content.

Re-Hosting enhances broadband. While direct access to the Internet may provide some flexibility, there is a downside. The new higher speed communication services will have expensive bandwidth that must be used efficiently in order to offer a reasonably priced service to the consumer. Passengers are unwilling to pay premium prices for onboard services they can use on the ground for minimal or no cost. The standard delays inherent in the Internet also encourage re-hosting popular content to speedily deliver to the passenger.

Internet Service

IFOL works with a large number of web contents of up-to-date news, sports and financial information and entertainment sites, for example, Forrester Research, Hoover's Online business news and Fidelity Investments. It designs to broaden and improve the traveler's experience by providing a premier collection of inflight information, entertainment and communications services or conducting real-time e-commerce transactions or a dinner reservation for that evening in the city they are flying to from a

lot of restaurant web sites. The services are affordable and reliable to travelers in commercial airplanes, business jets and cruise ships where access to these services is expensive, difficult or unavailable. IFOL believes airlines could provide Internet access service as little as $4.95 a flight while Connexion's high-speed service is fixed at US$20 to 25 per hour range and InFlight Network considers a flat monthly fee of $20 to $25 for unlimited use.

2.4.2 InFlight Network Technology

InFlight Network, a consortium of Rupert Murdoch's News Corp. and Rockwell Collins, has demonstrated its two-way broadband Internet service in September 2000. Using the data capabilities of the Globalstar system, they provide 200 KBPS web-browsing capability at 30,000 feet and the access to e-mail and Internet service on its Boeing 767 aircraft.

InFlight Network, the satellite-based, broadband digital communications network, was formed as the first global inflight entertainment network to offer live coverage of news, sports and entertainment events, in addition to recorded audio/video programming and broadband Internet access and e-mail services. It will also support multiple video channels, with programming automatically tailored to the length of flight and specific destinations. IFN service will enable affiliate airlines to deploy high-speed, full Internet access and e-mail services quickly. The new service will eliminate the need to wait for the build-out of new satellite networks or to invest in expensive new antennas. IFN looks forward to working with leading web sites and portals in extending Internet access to the frequent flyer community. IFN affiliate airlines will be able to provide their passengers with differentiated, airline-specific, co-branded programming options of business and entertainment channels in multiple languages.

In contrast, an inflight broadband service that IFN, Globalstar and Qualcomm Inc. proposed would offer data speeds above 200 Kbps. When user demand increases and ground terminal capacity can absorb the greater data load, that data rate could be increased to more than 800 Kbps--faster than most DSL or cable modems. With the same technology of Broadband Internet data and entertainment, it will be transmitted directly to aircraft via geostationary satellites, with the return link carried over the worldwide Globalstar satellite network that operates in low-Earth-orbit to cut the time delay for satellite-to-Earth communications by a split second. The Globalstar satellite network will serve as a two-way channel for Internet access, e-mail, downloading of data and other applications. The venture would use Qualcomm's Code Division Multiple Access (CDMA) technology and the Globalstar satellite network will serve as an independent two-way channel for Internet access, e-mail, downloading of data and other applications. Globalstar provides affordable satellite-based digital voice and data services to a broad range of subscribers and users.

2.5 The Future Internet Connectivity

The Airborne Internet

Land-based lines are limited physically in how much data they can deliver because of the diameter of the cable or phone line. In an airborne Internet, there is no such physical limitation, enabling a broader capacity. The computer normally comes with a standard 56K modem, which means the downstream rate of 56 kilobits per second (Kbps). That speed is far too slow to handle the huge streaming-video and music files that more consumers are demanding today. That's where the need for bigger bandwidth -- broadband -- comes in, allowing a greater amount of data to flow to and from the computer.

The airborne Internet will perform much like satellite-based Internet access, but without the time delay. Bandwidth of satellite and airborne Internet access are typically the same, but it will take less time for the airborne Internet to relay data because it is not as high up. Satellites orbit at several hundreds of miles above Earth. The airborne-aircraft will circle overhead at an altitude of 52,000 to 69,000 feet (15,849 to 21,031 meters). At this altitude, it will be undisturbed by inclement weather and flying well above commercial air traffic.

Networks using high-altitude aircraft (Figure 2.5: HALO) will also have a cost advantage over satellites because the aircraft can be deployed easily – at no cost of launching into space. However, the airborne Internet will actually be used to compliment the satellite and ground-based networks, not replace them. These airborne networks will overcome the last-mile barriers facing conventional Internet access options. The "last mile" refers to the fact that access to high-speed cables still depends on physical proximity and that for this reason, not everyone that wants access can have it. It would take a lot of time to provide universal access using cable or phone lines, just because of the time it takes to install the wires. An airborne network will immediately overcome the last mile as soon as the aircraft takes off.

The airborne Internet will not be complete wireless. There will be ground-based components to any type of airborne Internet network. Airborne- systems will require that an antenna be attached to the on-ground platforms. The consumers will have to install an antenna on their home or business in order to receive signals from the network hub overhead.

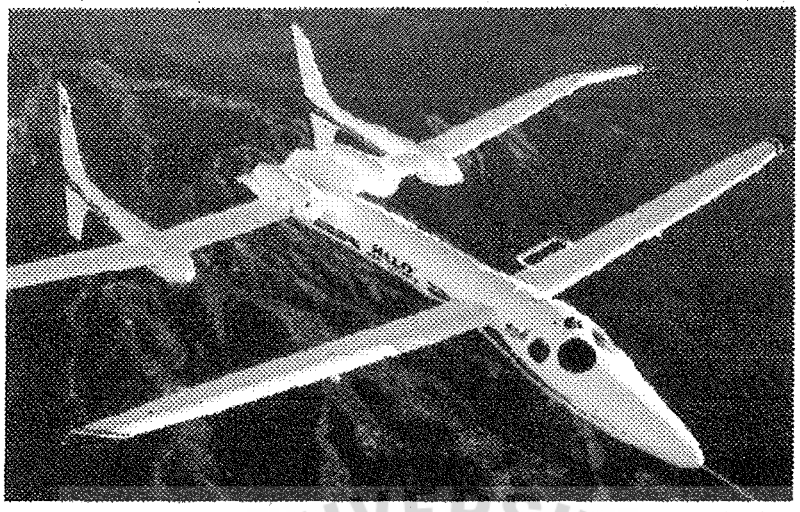

Figure 2.6. Halo the Future Airborne Internet Aircraft.

The networks will also work with established Internet Service Providers (ISPs), who will provide their high-capacity terminals for use by the network. These ISPs have a fiber point of presence -- their fiber optics is already set up. What the airborne Internet will do is to provide an infrastructure that can reach areas that don't have broadband cables and wires.

The airborne Internet probably becomes the optional enhanced Internet access for the airlines in the future, not to take satellite place but supplementing. The examples of the airborne Internet in the present are AeroVironment (Helios), Angel Technologies (Proteus), and Sky Station International.

III. INFLIGHT INTERNET SERVICE UTILIZATION

3.1 The Inflight Internet Service Utilization

Expectedly, as the commercial Airline Company providing travelers with connective tools both in the air by equipping with Internet connections will be soon in commonplace. The ultimate service of the Internet capabilities as the core benefits to the users either the airline crew itself or its passengers are so tremendous that once the inflight Internet is connected, the users can benefit as the home Internet. They are able to utilize from a multitude of personalized real-time services including Internet and corporate Intranet access, E-Commerce, live entertainment, transmission and receipt of data and destination information. (Figure 3.1: Satellite enhanced Inflight Internet Services)

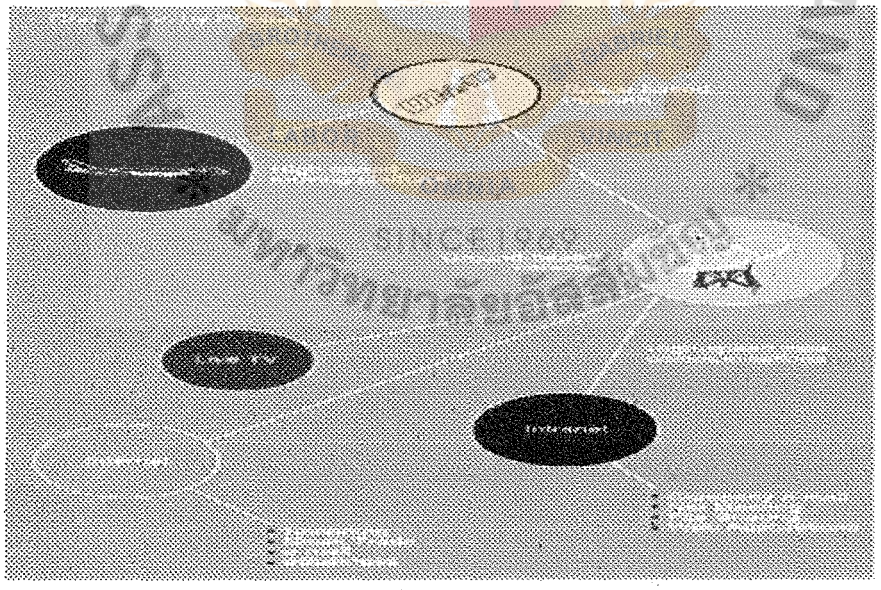

Figure 3.1. Satellite Enhanced Inflight Internet Services.

Live Entertainment: Television Video, Audio, and Games on Demand.

Live entertainment offering is designed to meet each airline's unique needs. With major media companies of choice to design a single-channel live TV programming lineup to keep airline passengers entertained and informed. Channels of live radio, featuring news, weather, sports, and longer programming. In addition to live TV and radio, the airline can offer full-length feature films, a variety of music, and interactive games. Passengers can access the entertainment of their choice through their laptops or view the airline-selected entertainment shown on the cabin screen. Entertainment: watch on demand TV programs, pay per view, live TV program such as PGA, Tennis Wimbledon, CNN, ESPN, CNBC.

InFlight Traveler Destination Information: Interactive Maps and other Tropical Information.

Passengers can view moving maps and a host of other information interactively on their laptops. Access to high resolution satellite images, road atlas style images, and bird's eye views with zoom-in capability are also available, as well as destination time and weather, miles traveled, miles to go, altitude and speed, and a function that identifies topographic features and points of interest and offers international facts. It provides passengers with access to in-flight information to make their destination planning easier. They can view flight routes, check destination weather, view airport concourse maps, get connecting flight information, receive re-accommodation confirmations, and more. The service allows travelers to plan their itineraries, obtain gate information, check local weather, shop at their favorite retailers, and more. Leisure travelers never miss out on news, sports, financial information, or special events. E-Ticketing has also played role as a platform for the reservation or unintentionally

booking. The passenger onboard can access to the travel agency to rearrange the forward flight or reroute their business flights on time.

3.2 The Benefit to the Airline Passengers

The service allows business travelers to regain control of their time by offering connectivity to their corporate Intranet for company e-mail and full network access. Nowadays the airline passenger especially the business travelers want high-speed access to their Intranet system and the Internet so they can communicate with the office and make their travel time more productive and to enhance the Internet capabilities such as to send, receive email and update email, surf webs. The passengers may feel secure in the Internet environment because they can be in touch with the ground. The traveling manager can handle his business at all time everywhere. The corporate employees can benefit the service to access the Intranet to catch up on emails and work in multiple time zones, corresponding with family and business associates during the flight which is very important to frequent business travelers particularly on long haul flight communication and collaboration Participation. The service allows business travelers to regain control of their time by offering direct high-speed connectivity to their corporate Intranet for company e-mail and full network access.

Businesses realize increased productivity from their traveling employees. By offering employees the freedom to control their time, businesses can strengthen employee morale. Corporate travelers could have trouble receiving their company e-mail unless their technology departments work out arrangements with the airlines or Internet system providers.

Leisure travelers have the freedom of the inflight entertainment. They are able to choose their own content. The service allows travelers to plan their itineraries, obtain

gate information, check local weather, shop at their favorite retailers, and more. Leisure travelers never miss out on news, sports, financial information, or special events.

Value added service airlines offer to its passengers. Airlines with inflight Internet service allow frequent business travelers to increase productivity while in the air, which is very important new ways this technology could be used to enhance customer service. Every single dollar Singapore Airline passengers spent on inflight Internet access can be rewarded as the mileage accumulation, for instance. The competitive advantage an airline could have by incorporating this capability into customer service.

3.3 The Benefit to the Airline Operators

They can benefit from the added convenience of fast interactive communication between ground and onboard crew for important passenger-related information such a flight connection, or requiring the ground emergency preparation for the sick passengers, passenger hospital record, insurance history, personal data for instance.

In case of flight delays, they would have little time to check in at the airport to make his flight, the connection can be arranged and be informed to those passengers real time. In addition, airline operators also will benefit from real-time access to operational data not currently available through traditional communication channels. For example, the diagnostic information about the jet could be sent to the ground, allowing quicker maintenance. In case of the irregularities like the hijacking, the information can be sent to the ground to report the accidents in the airplanes.

In case of onboard sick passengers, they may use personal identification number to access the source of their medical data, their laboratory results and other information over the Internet to provide personal medical information and consult online. However,

this also raises serious question about the devised security system and authenticated access protection of individual privacy.

There is great opportunity in the air traffic management arena. Regional weather disturbances, minor equipment outages or labor strife can quickly impact the efficiency of the entire system. The technology exists to increase the safety of the air traffic management system while increasing the efficient handling of the expected growth in traffic.

3.4 The Benefit to the Airline Business

According to the inflight Internet access demand survey of the advertising research company Ipsos-ASI Interactive, Hoover's Online and Lycos to poll more than 300 travelers. Travelers have a strong interest in inflight e-mail and access to Internet services, and a clear willingness to pay for use of these services. The same study demonstrates an interest in the entertainment value of this medium and reveals a genuine interest in on-line shopping during flight. Participants in the survey, ages 25-65, must have taken at least one trip on an airline during three months and must have access to a laptop or other portable computing device for their travel. 55 percent of those surveyed pointed that e-mail is the primary reason why they would utilize this new service. The majority of respondents, 77 percent, are willing to pay to send and receive e-mail if they know the associated costs ahead of time. Among the prospective services are e-mail (80%), weather (75%), news (63%), stock quotes (49%), travel (46%), reservations (45%), and entertainment (41%). In addition, many travelers indicated that email connectivity was assumed a necessity. Travelers have a need to use the laptop. For the business traveler, it makes efficient use of that downtime on an airplane. Most users in the survey have an e-mail account in addition to their corporate

e-mail account. 58 percent said they regularly check e-mail while traveling, 32 percent check e-mail upon arrival at the final destination, five percent download e-mail to a portable computer before traveling, and five percent wait to get back to the place of origin to check e-mail.

More than 10,000 business passengers have registered for its email and Internet service on Air Canada and Singapore airlines. Of those 10,000 users, 79 percent surveyed indicated they would change carriers to be able to access the Tenzing e-mail service while in flight. They felt that all else being equal, they would choose to fly Tenzing-equipped planes versus aircraft without the Tenzing service. In addition, many travelers indicated that email connectivity was rather a necessity. With positive responses from passengers of Singapore Airlines regarding to the email product, passengers are pleased to have the option of staying connected to email and to the news and information options available online. (Source: Tenzing survey prepared by Ipsos – NPD and Web Surveyor)

The airlines can realize their needs of the inflight Internet service as the value-adding service to their passengers. Many aspects of airline business can benefit from the inflight Internet connectivity as follows.

(1) The airline operator gets a leadership position in the marketplace. The true broadband communication service for airline passengers, is the market leading initiation to bring today's high-speed, cable-quality Internet and company Intranet data services to the airborne environment. The inflight Internet service will best meet our mutual customers' expectation, that is, for real-time connectivity and the ability to stay connected with their office, family and colleagues. Lufthansa assumed to strengthen its network by

creating value for the passengers and offering new, state of the art onboard broadband services on long distance jets.

(2) The service for airlines builds the momentum in the marketplace. The critical market mass is needed to effectively support and enable a service launch to make these services readily available to the global airline community. The commitment of leading U.S. airlines, American, Delta and United and German Airline, Lufthansa is to pursue the creation of a joint business venture to bring broadband Internet services to commercial air travelers and to develop a level of service standardization throughout the global airline industry.

(3) The business concept has improved to offer the airline market a broad and profitable range of airline based services. Some airlines may focus particularly on business travel. Inflight Internet is value adding service to the airline passenger. For example, the Singapore Airlines complements every single US. Dollar spent on inflight Internet service as one point bonus of Asia Mile, the travel mileage awards. Frequent Flyer Program of Air Canada Aeroplan members are rewarded each time of using inflight Internet connecting. The airliners may enjoy huge popularity, winning top business, consumer and trade awards from around the world. The airline has pioneered a range of innovations setting new standards of service, which its competitors have subsequently sought to follow. The customers are encouraged by the value-added inflight Internet technology with quality, fun and innovation.

3.5 The Benefit to the Technology Ventures

In such new network, each technology venture in the inflight Internet connectivity market such as the technology providers, communication system, inflight Internet access providers, inflight Internet content provider, software and hardware developers, electronic manufacturers and other related business for instance, have to develop the specialty in its own areas. This means that every segment of the market can increase their selling opportunities of their related-product and services. Those Boeing revenues would be shared among those Boeing's related a half a dozen partners providing content or hardware.

3.5.1 The Benefit to the Aircraft Maker

It is the new moneymaking opportunities as each aircraft equipped with broadband Internet connection and then sell to the airlines or the private businesses. The American actors have bought one corporate business jet, a high-tech feature from Boeing Company which the list price of Boeing Business Jet (Figure 3.2. BBJ the inflight Internet enabled airplane) is $37.5 million, which does not include the plush interior that can add another $10 million.

Figure 3.2. Boeing Business Jet Internet Enabled Executive Aircraft.

3.5.2 The Benefits to the Technology Providers and their Ventures

The technology provider like Connexion of Boeing or FlightConnect of Tenzing also gain revenue when airlines required the installation of the system. 17 leading airlines use Connexion. Three largest U.S. airlines committed to fitting 500 aircraft with services. Lufthansa Airline has installed intercontinental fleets, Boeing747s. The agreement of installment of broadband communication service to be installed on Lufthansa's intercontinental fleet on a DLH 747 aircraft but no financial terms of contracts were disclosed. The onboard connectivity market of Boeing is a $7 billion to $10 billion. Next decade revenue of the Inflight Internet market estimated to increase by $ 50 million. Tenzing has deployed its system in nearly 500 planes of those 6 airline customers and also declined the term of installment on Airbus' stake at $44.4 million. Virgin Atlantic Airways deploys Inflightmail of Tenzing project to allow passengers either send and receive email via their laptop or seatback video screen. It also integrates inflight digital entertainment system manufactured by Matsushita Avionics Corp.

provides more than 200 hours of digital Video on-demand. Singapore Airlines has invested S$200 million (US$115.3 million) to develop "cyber cabin" completed with email and web site access on two of its aircrafts flying between Singapore and Los Angeles in February 2001. Varig Airlines has been equipped entertainment system, MAS-3000 provided by Matsushita and equipped with a Tenzing server. Connexion, the technology initiator leases the Ku-band satellite transponder from Loral Skynet and Communication Inc.

3.5.3 The Benefits to the Inflight Internet Access and Content Providers

The Internet Service providers and the content provider ventures can have money opportunity from co-branding ads on the web site and commissions on retail sales made via a portal under design. Also they can sell the connectivity to the corporate for the Intranet access of corporate travelers. Boeing has put the "potential market" at $40 billion to $50 billion a year by 2010, and expects to capture 10 to 12 percent of the market. According the connectivity market analyst Jacobs, how big of that opportunity is uncertain. He assumes 30 percent of laptop users log on for 30 percent of their flying time, at a cost of $10 an hour. A more realistic estimate is $4 billion to $5 billion. Inflightonline.com starts generating revenues from commercial airlines. IFOL provides the software to the airlines operating a hybrid mix of server-based in-flight entertainment or high-speed cabin network systems across their fleet for rapid deployment of services and continuity of a basic set of services passengers expect. This software develops a customized in-flight portal with the airline's brand. Also advertising and gained revenue from featured and online E-Commerce web sites supports IFOL. Most of IFOL services will be free to passengers, providing e-

commerce opportunities and branding opportunities, to business entities that want to expose their traveling related products to the passengers.

The other provider going straight for that market is InFlight Network (IFN). To take advantage of technology already available, IFN gains revenue from those advertiser-supported business models, global and national advertisers, as well as local and regional advertisers. They enable to deliver full-motion broadcast video spots to aircraft via inflight Internet. Web-based video spots and banner ads will also be delivered to PC users on targeted aircraft and airport premises. IFN plans a basic web browsing service that all users will be able to log on to for free, with ads sent to passengers. The ads may be targeted for specific destinations, so on the flights to Orlando, Fla., it's likely to see ads of Walt Disney or Universal Studios. As for corporate tools such as e-mail access, several options, such as one-time fees or subscription rates, will be available. It's likely other service providers will sign on and offer the IFN service.

IV. MARKET ANALYSIS AND PROPOSED SYSTEM

4.1 Inflight Internet Connectivity Marketing Analysis

4.1.1 Market Targets

The targeted service area initially launched has covered only in the contiguous United States, where the technology initiates, and the size of the market is large. Geographically, in the US. Continent and the European, the air transportation is one of the major channels in their daily lives. Ultimately, the service will be available everywhere airplanes can fly. It will be rolled out internationally as the market matures The service is available to North American airline customers at first in 2000, transatlantic by end of 2002, in Europe, Canada, South America, Australia and transpacific routes are targeted to begin receiving the service during 2003 and Asia in 2005. The service is targeted squarely at the business travelers, remote staff. The biggest target group is the corporate accounts.

With the commitment of the three major American airlines, American Airlines operates just more than 700 aircraft today, while Delta Airlines and United Airlines each have 600-strong fleets to serve either domestic or intercontinental flights. The European market service is developing the critical market mass needed to effectively support and enable a service launch to make these services readily available to the global airline community to bring these breakthrough communication services to the global marketplace. Lufthansa Airlines is the pioneer customer among European airlines, starting the inflight Internet access service to passengers.

4.1.2 Market Characteristics

In the beginning, some airlines might be skeptical about adopting a particular technology, for fear that it was not widely and the first-generation systems were so

complicated or primitive that did not work or one that would be outdated within months. Airlines have to investigate all of them because it is a large capital investment to put technology onboard that concerns many things and it might lose millions of dollars on the system. After many airlines have opportunity to experience first-hand the tremendous benefits of broadband communication, rather than the inflight phone service, the on-board e-mail and Internet capability is more inevitable for the airline industry. Many private aircraft and commercial airline customers have concentrated on their core businesses and are looking for commercial aviation support services. Airlines want a technology that makes sense both for passengers and the airline financially.

(1) The Internet connectivity market is so huge.

Each of the airlines and the aircraft makers bring together a critical market mass to help ensure success for this service with airline passengers and the global airline industry. This raises the two incompatible Internet connectivity systems emerging for air travel, with Boeing's Connexion dominating firstly in the U.S continents, and Tenzing's gaining momentum everywhere else.

Boeing tends to make these services available to the airlines and the 3,000,000 airline passengers who board some 42,300 flights on Boeing-built planes daily. According to Boeing studies, current long-term forecasts show the worldwide commercial airplane fleet of about 14,500 jetliners growing at a rate of 4.8 percent a year. In the next 24 hours alone, 4.7 million people will board 41,500 flights around the world.

Boeing analysts see a potential market for such services that could be as big as $70 billion over 10 years. Source of Boeing estimates its market

for inflight connectivity could grow to $45 billion a year in the next decade. Boeing would try to capture as much of that as possible and those revenues would be shared to a half a dozen Boeing partners providing content or hardware. As many as 12 other technology ventures are proposed to use satellite technology to provide inflight Internet access.

According to source of the Air Traffic Control record, in the airline market, airlines now fly 1.8 billion passengers a year -- about the same as the population of China. By 2016, airlines are expected to carry up to 4.5 billion people each year. In the United States, about 70 percent of business travelers, who make up 48 percent of all passengers, carry laptops onboard airplanes, and apparently many of these passengers want to be connected during flight.

(2) Inflight Internet market has anticipated high growth rate in its components of the industry.

The Internet access providers Connexion's benefit estimates the growth $45 billion next decade. Boeing has projected the Internet usage and satellite-based entertainment aboard commercial aircraft, estimated the growth rate of a $20 billion market by 2004. If all laptop-carrying passengers on commercial aircraft paid $17.50 an hour to use the service on each flight, the addressable market, based on the same usage by laptop-carrying passengers paying an identical price, could reach $40 million by 2009. That is the year when Boeing expects to be ready to provide its service globally.

Boeing realistically only will be able to reach agreements to offer its only service on certain airlines, but it still could serve a sizable market if a significant number of the 30 airlines it has contacted about partnering with agree to proceed. The company has an extensive global reach with customers in 145 countries and manufacturing operations throughout the United States, Canada and Australia.

(3) The Inflight Internet technology is very competitive, driven by system quality and prices.

The market is driven by price, quality of service. Boeing and Tenzing are proposing different technological answers to the current problems associated with inflight Internet while all of the services depend on satellites. (Table 4.1: Summary of Connexion Technology and Table 4.2: Summary of Tenzing Technology)

On one side of the ring is Connexion by Boeing, a recently launched group at Boeing Co. On the other side are two upstarts: Tenzing Communications Inc. and InFlightOnLine Inc. to build lower-cost airborne Internet systems who believe to undercut the higher-priced option offered by Boeing. But the upstarts also are ahead in the market, especially Tenzing, which has signed deals for test programs aboard aircraft operated by the likes of Cathay Pacific Airways, Scandinavian Airlines Systems and Air Canada. In the moment, these proposed Satellite-Based inflight Internet services conclude competitive technology. Connexion, the Boeing affiliate, partnered with Inmarsat and Airia, InFlight Network (IFN) by Rockwell, Collins/News Corp./Globalstar, Thomson, CSF Sextant and Astrium.

FlightConnect by Tenzing partnered with InFlight Mail by Honeywell/Seattle Labs, InFlightOnLine, LiveTV, GTE & ATT, Aircell, AirTV, ICO Global/Teledesic.

As of the inflight Internet fee, from the studies of Boeing, Connexion believes that most users of airborne online services will be business travelers, and most of them are willing to pay service fee of Connexion as much as $20 an hour for broadband, full-capacity telecommunication infrastructure to get a real-time Internet service equivalent to what users have on the ground. While Tenzing offers a cheaper cached or prepackaged Internet stored in an on-board server computer, which would periodically forward e-mail to the ground and back an optional broadband real-time access. Flightconnect of Tenzing and InFlightOnLine may have achieved an early lead by stretching the capabilities of existing lower-capability hardware. As the airlines want to upgrade, they can do that at a cost advantage. In their drive for profitability, many airlines will not be willing or able to spend thousands of dollars for the Boeing phased array antenna. Instead, Tenzing offers a clever blend of software that will store most of the data needed for a selection of web site onto a server on board the aircraft, and use the limited online access to update those web sites and for e-mail. Tenzing lower-cost cached web access will be free, paid for by advertising, while a business traveler will pay just $15 for a full day of e-mail, continued on any connecting flights.

Among the inflight Internet service provider market, IFOL offers a prepackaged Internet and has developed numerous web content partnerships

which would comfort the traveling passengers to book a car, and make a dinner reservation online. IFN, an airline entertainment systems maker, develops its own network for air-to-ground communications in a system competitive with Boeing's and other similar business. The IFN system was successfully operated over parts of North America. The Globalstar satellite network is used to serve as a two-way channel for Internet access, e-mail, downloading of data and other applications. The venture would use Qualcomm's Code Division Multiple Access (CDMA) technology. Pricing has not been disclosed, but the three-company venture intends to offer lower cost broadband Internet and e-mail services to commercial airline fleets. TelAstra is also skeptical about whether the aircraft passenger market for satellite- based entertainment or communications providers will become as large as Boeing.

Table 4.1. Summary of Connexion Technology.

Connexion	by BOEING
Technology Partner Satellite	Airia, InFlight Network (IFN) by Rockwell, Collins/News Corp./Globalstar, Thomson, CSF Sextant and Astrium, CNN inflight, ESPN, CNBC, Eurosport Inmarsat, Loral Space and Communications, Mitsubishi Electronic Corporation (MELCO) group, Finmeccanica and Alenia Aerospazio
Feature	Provide two-way broadband data services to passengers and crew at 5 Mbps to receive communications and 1.5 Mbps for outbound transmissions, company. The service uses Loral Skynet's Ku-band transponders and proprietary phased array antennas. With advancements in new technologies. Connexion speed 128 kilobytes; most of US$100 million Airborne antennas, Airborne Cabin File Server, Routers and Associated Wiring, Network Operations Center(NOC)
Airborne antennas	At 5 Mbps and support responses at T1 rates; 55 inches stretch across the top of a plane's upper fuselage. That helps avoid interruptions. The phased array antenna locks on a satellite by steering its signals electronically. There are no moving parts. The antenna remains in constant contact with the satellite.
Airborne Cabin File Server	Support the interfaces such as Ethernet, modem and others through two Type-II PCMCIA slots.
Space System	Satellite transponders of Ku-band Loral Skynet.
Availability	North American airline customers at first. Late 2003, in Europe, over the Atlantic and Pacific oceans and Asia.
Internet Fee	The pricing remains open to change. Free of charge or paid TV programme. Approximately $17.50 per hour For internet access, flat-rate options for each leg of a trip.

Table 4.2. Summary of Tenzing Technology.

Tenzing	TENZING COMMUNICATIONS Inc., the Seattle-based Tenzing wireless technology vendor
Technology Partners	**Cached or Narrowband**
Access Partner	iPass, Equant, Level3, CompuServe, France Telecom, Pacific Internet, Deutsche Telekom, and many other leading network operators.
Web Content Partner	AcrossFrontiers, Actijob, BizTraveler, Canada Film Board, DoAsia, e-street.com, Execubooks, FT.com, GetAsia,
	Grand Prix Canada, Intowine , Knowledge Anywhere, Lonely Planet, MSNBC, Points.com, Restaurant Row, Time, Time Canada, Travlang, Wall Street Journal, Wines, World Travel, Worldroom, Yahoo, Amazon.com.
Technolgy Partner	iPass, Telia Homerun, Skynet global, SITA, Nokia, Hughes Global Services, Inmarsat, AIRIA, COMSAT, ARINC, Bell Mobility SkyTel, VerizonAirfone (GTE), Miltope Corporation, General Dynamics, Matsushita Avionics Systems.
Feature	Temporary Solution: with Onboard proxy server. The inflight LAN will carry data at rates up to 11Mbps, Cached or Narrowband. The proxy server in turn will communicate with ground-based networks up to 64Kbps a ground-to-air satellite data link
Onboard LAN	USB ports in its seats, an 802.11b wireless network;56 kbps
Satellite	Inmarsat Holdings Ltd.'s Aero-H service. Inmarsat 64Kbps,2 channels (nearly 20 times faster than previously available)
Internet connection fee	Differently on each airline. The flight from Hong Kong to Vancouver, the Cathay Pacific system charges US$ 5.99 per minute, estimated at US$10 to 20 to download up to 500KB of mail (and send a similar quantity)
Technology	**Broadband**
Technology Partners	FlightConnect by Tenzing;with Hughes Global Services Inc., InFlight Mail by Honeywell/Seattle Labs, LiveTV, GTE & ATT, Aircell, AirTV, ICO, InFlightOnLine.com,
Availability	six airline customers: Air Canada, Varig airline, Virgin Airlines, Singapore Airlines, Scandinavian Airlines, Cathay Pacific Airways

(4) The affordability and its trends to decrease price due to the competition in technology and the number of providers.

At the very beginning of the technology, the inflight Internet service provided via the telephone system which the ISP dial-up connection costs the users US$12 per minutes. As the technology developed, the cached system service of Tenzing in Cathay Pacific can offer the inflight Internet at the rate of US$5.99 per minute while Connexion offers a bit higher rate with real time service.

Tenzing offers both broadband and narrowband solutions to airlines, allowing carriers and their passengers the most affordable choice in technology implementation. Tenzing's offering allows airlines a lower cost entry into offering the inflight email and web access services today. About the charge fee, 49 percent of respondents claim they would be able to afford $9.95 per session to access Internet content, 70 percent at $4.95 per session and 88 percent would use the service if there were no cost.

(5) Technology is reliable.

The technology and market is led by the Boeing Company, the largest aerospace company in the world and the United States' leading exporter of aerospace include commercial jetliners, military aircraft, rotorcraft, electronic and defense systems, missiles, rocket engines, launch vehicles, and advanced information and communication systems. The major three leading airlines; Delta Airlines, American Airlines and United Airlines, each will contribute funding, certain intellectual property, and other assets necessary to carry on the business of the proposed venture. In

technological terms of development, Boeing together with the Loral Space and Communications, Tokyo-based Mitsubishi Electric Corporation (MELCO) group, and Rome-based Alenia Aerospazio, a Finmeccanica Company, plan to create an inflight communication ventures. The innovative venture combines the core strengths of the world's largest aircraft manufacturer with the company's capabilities in space-based communication technologies.

In December 2001, with a license granted by the the Federal Communications Commission (FCC), Boeing Company will enable passengers on airplanes to transmit and receive broadband data in-flight, using its revolutionary Connexion by Boeing service. The license is the result of an extensive yearlong application review and approval process conducted by the FCC and other U.S. Government agencies. This is a tremendous boost to roll out this service in the United States and around the world.

4.2 Proposed System on Inflight E-Commerce Business

It can be seen that the Inflight Internet technology is a powerful sales and market tool to boost the E-Commerce. The technology is quite complicated and might take years to complete the harmonized integration throughout the global area network. Thereafter the technology enhances the global communication platform to completely describe the meaning of the word "Internetworking". The E-Commerce related and other business solution can expand on the global Internet basis.

Several market trends offer an encouraging view of the new market solution. Currently, the total number of Internet users is approximately 304.46 million. As of

December 1999, Internet users in the United States were 106 million, a rise from 52.6 million in mid 1997 and 83.6 million at the end of 1998. (Source: Nua)

What Internet users do on line: 90 percent send e-mail, 85 percent surf the World Wide Web, 46 percent look up weather, 77.8 percent use search engines, 52 percent visit company/product sites, 33.8 percent read newspapers and magazines. (Source: Wall Street Journal) Approximately 3.5 million people use online trading in the United States. (Source: JD Power & Associates) In addition, online purchasing doubled to 52 million users in 1999 from 1998. (Source: Stratis Group).

In 2001, the future of online shops in US market was encouraged by the faster growth in E-Commerce sales than in off-line retail sales. Despite the downturn in the economy, more money was spent on the online shops in the final quarter than in the same quarter a year earlier. The online sales reached $10 billion in the final quarter of last year, 13.1% more than in the fourth quarter of 2000. That's excluding travel and food services. The online sales growth outpaced the growth in retail sales. Total online sales for 2001 were approximately $32.6 billion, an increase of 19.3% from 2000. Online sales had a sharper growth rate than total retail sales, which rose 3.3% over 2000 sales figures. (Source: the U.S. Census Bureau 2001) One of the reasons online sales grew in the fourth quarter was the influx of first-time buyers using the Web, particularly after the Sept. 11 terrorist attacks on the U.S. People have made their first online transactions -- charitable donations and then they came back to make additional purchases. In the current sluggish economy, more people do their holiday shopping because of the better prices online (Source: An analyst at Forrester Research Inc. in Cambridge, Mass., 2002). Spending on Internet infrastructure and E-Commerce will

reach $2.8 trillion by 2003 — a total that exceeds the gross domestic products of Germany, France, or the United Kingdom (Source: Nortel Networks & IDC Report).

In the next 24 hours, 3 million people will board 42,300 flights around the world. 48 percent of air travelers in the United States are business travelers. 70 percent of them carry a laptop on board. (Source: The Boeing Company) Approximately 52 million travelers used the Internet to plan trips and make travel reservations in 1999, up 54 percent from 1998 and up 1,500 percent since 1996. (Source: Travel Industry Association of America)

According to the inflight Internet access demand survey of the advertising research company Ipsos-ASI Interactive, Hoover's Online and Lycos to poll more than 300 travelers. During a two-hour flight, 49% would spend 30-60 minutes of their flight time using this service. It nearly doubles among the majority of respondents (92%) with a flight more than two hours long. The study also suggests that passengers have a genuine interest in on-line shopping during a flight. 85 percent of respondents claim to have purchased merchandise on the Internet using their credit card. 62 percent of those who have purchased items on the Internet said they would consider purchasing products online during flight.

Some online businesses can ultimately benefit such as the travel- and airline-oriented; flight reservation and flight confirmation. Travel agency can be in touch with their customers all the way. Dinner reservation, hotel reservation can be made or confirmed before the arrival.

The online hotel ventures have formed the Hotel Distribution Service (HDS) whose members consist of the 5 of world largest chained hotels (Hilton Hotels Corp., Hyatt Corp., Marriott International Inc., Six Continents Hotels Inc., Starwood Hotels &

Resorts Worldwide Inc.) and Pegasus Solutions Inc., creating a real-time connection from all of the member hotel reservation systems to Web sites, which will serve as the "merchant of record" for booking rooms including travel agencies. Pegasus already manages the connection links between many hotel reservation systems and the global distribution systems that publish fares and availability to travel agencies both online and offline. The airline passengers can directly access Orbiz.com, a consumer site specifically for HDS, for hotel reservation and travel agencies. Orbitz.com would have right to sell rooms, guarantee the hotel a minimum price. The passengers can get lower price than one offered by the hotel individually while Orbiz.com can gains a little profit. With the real-time connection, hotels could change the minimum price and room availability at any time. HDS will also allow a traveler or travel agent to search for the best deals by location -- not necessarily by brand -- through the merchant-of-record model. Booking business such as Disneyland, banking, car rental, airline ticket, as-seen-on TV product with no physical stores is included. (Source: an analyst at Forrester Research Inc. in Cambridge, Mass.)

The Inflight Internet access and content providers like InFlightOnLine and InFlight Network have agreements with more than 50 content providers and online E-Commerce companies and will soon double that number to boost the E-Commerce market in the air.

E-Commerce awaits the inflight Internet connectivity matures and to be available globally. There is a sizable market to support the online business. The price of inflight Internet access is affordable. The success of the e-commerce on aircraft still relies on the inflight Internet environment from now on.

V. PROJECT IMPLEMENTATION

5.1 The Implementation Case of Inflight Internet Access Technology to Thai Airways

The Internet connection becomes a commonplace and changes all the time. It goes out-of-date once the new technology replaces it. The technology of the inflight Internet access has emerged throughout the airline market. Many of competitor airlines have adopted it to provide the value-adding service. It would be very beneficial to the airlines with the technology-enabled as a competitive advantage.

In the implementation by Thai Airways, there are some worries that it might not be successful because of the unfamiliarity of technology know-how, inadequate experts or lacks of initiators in the organization and the executive attitude toward the new technology.

The technology relies on the aircraft maker, Boeing, or the other technology providers. TG has to buy the expertise from the airline maker. According to the terms of buying agreement, they cannot repair or even adjust the aircraft during the negotiation period. The investment and the operation are absolutely costly and higher than implementing other service to add value to customers like food, movie and giveaways. Thai Airways is labor-intensive oriented, does not focus on new technology. It has no technology advancement support.

TG cannot fully utilize the service of the inflight Internet access because it lacks the support from the ground database. The airborne Internet system must be supported by other environment systems such as the efficient crew database to support the crew information. The sick passengers onboard cannot access the insurance or hospital database for instance. The received benefit does not maximize the capabilities of the

Internet. The ground database platform should be developed to support the inflight Internet. Thai Airways might be unable to fully exploit the system as the other airlines.

The number of Internet users on Thai Airways has never been officially surveyed. The number of flights of TG solely is not so frequent as one of the domestic US. airlines. Thai Airways flies to Los Angeles 7 flights a week. Only 15 percent of the passengers are business travelers while 49 percent are US airline passengers. Compared to the US market, market size is not so huge as the one in US Continent. The number of passengers in the biggest aircraft fleet carries approximately 20,000 passengers a month or less than 240,000 passengers a year. It seems the market size does not support the investment. And the E-Commerce business in Thailand is another reason to support the inflight Internet and online business.

With the maturing of technology and the very competitive airline market, the technology rolls out globally, the inflight Internet service-equipped American and European Airlines become the TG competitors. The inflight Internet technology will no longer be denied. The next version of Boeing aircraft would be mandatory equipped, not optional. Thai Airways executives have to reconsider. However, Thai Airways should wait until the technology matures. Generally, the cost of technology declines regarding the replacement of new technology and time. The technology know-how is necessary to the airlines, including specialists and maintenance staffs.

5.2 Implementation Case: Thailand's Onboard Duty Free and Tax Free Sales as E-Commerce

The inflight Internet services include inflight e-mail, web content, a business-focused web portal, targeted E-Commerce services and frequent content updates throughout the traveler's experience.

Clearly, the inflight Internet as an E-Commerce tool to the new businesses, the Onboard Duty Free Sales is another business that can benefit from the inflight access technology. Similar to any Online shopping, customers can perform anywhere, any time such as home or in the office. It the growth in the online shopping market as well as the growth in the technology, the increase in number of travelers each year, the number of Internet users, the passengers with the laptops can be seen.

Duty Free Goods is the specific imported items of perfumes, cosmetics, and accessories which are levied the import tax if consumed in the country. And the tax free items are those country's product for export. These products such as woodcraft, thai ceramic souvenirs, handmade woven article, are levied tax the government but can be purchasable with the tax exemption by those who are the traveling passengers with the exemption of the government tax since they use the product outside the country. Certain volume of each carry-in item is restricted with the limitation in quantity according to the regulation of the country.

Present System of the Onboard DFS

Generally, the traveling passenger can purchase duty free items from the representative stores at the airports or in downtown prior to the traveling flight and the onboard sales carts, which is performed by the flight attendants. The onboard sale carries the item carts that weigh as much as those meal and drink carts. The transportation weights are really burdened. The Inflight Internet technology can supplement or replace the initial system in the future.

Steps to Process

According to the new sophisticated technology of the inflight Internet access, any business can exploit from it as a tool of E-Commerce. The proposed system is done as

the online onboard duty free service. There are steps to process the online onboard DFS system.

(1) Registration: On the technology-enabled airlines, the passengers with the laptops can access the duty free web site after the registration or applying for the membership by referring to their travel document like passport number, flight and date of traveling.

(2) Makes a purchase: The passengers can access the DFS web site via Internet. In the cached system, the DFS web site can be loaded in the cabin file proxy server as one of its contents to allow any users to perform the online shopping. The duty free merchandisers negotiate with member airlines flying to its country to provide the CDROM catalog to passengers who wish to buy duty free items. The CDROM duty free service includes the DFS items and the instruction to convey the online purchase process. For the changes in items or their prices, the CDROM catalogs can be updated before the flight. As the content updates while inflight, all of the orders will be sent to the DFS ground server some time before the arrivals at its destination. In the real time Internet system, the airline passengers can access the DFS web site to view the items and process the online purchase. The passengers can ask for the CD-ROM of DFS product catalogs instead of the paper brochure to display personally on their laptops to save time downloading the graphics. And passenger with no personal laptop can view the DFS program from the onboard Internet vender terminals, which may be provided in some airlines. After they have chosen the items, they can make a purchase via the inflight. The fee will be

responsible by the passengers. Contrarily, the airlines will support the fee of the vender terminal. Actually, with the travel information, the airline passengers can purchase the DFS inflight or even before the trip from home or office.

(3) The delivery and the payment: The delivery can be done at the destination only, or there may be home delivery service if the passengers cannot transport it themselves. The payment by credit cards is acceptable with the identical name of the travelers only. Passengers can sign credit card slip at the reception point or pay cash at airport pickup counter. The credit card can be authenticated once they swipe the card. The pre-registration in the DFS web site would assure the authentication of the cardholders. The cash payment is acceptable at the DFS pick-up counter at the destination airport. The passengers must present the airline ticket or boarding pass and pick up as soon as they arrive at the destination. The home delivery can be arranged for the piggybacking passengers if it exceeded certain amounts purchased and within the airline destinations, perhaps by the later time in the following flights.

The DFS Web Site

The DFS web site is ideally like the other online shopping web site to encourage the customers and provide convenience. The duty free web page must be fast, interactive and accurately graphical. The web site must provide the items, product description, all possible currencies shown in price table. Price comparison is important. The web site URL must be knowingly to the public. Duty Free web site may display its banner on frequent access web sites and related web sites like airline web sites. The

web site must have multiple language support for the non-English speaker passengers. The registration is necessary. The passenger should fill in the necessary data in the web site before making a purchase.

On the DFS ground server, the customer profile will illustrate the personal record of purchase; the detail of items purchased, date of purchase and the delivery place and date. Status indication is to remind them of the delivery. The table enables the busy business travelers to match his schedule according to their flight plan. They can check whether they forget to pickup items. The DFS server will alert them via the reminding email to the passengers who opt to pick up and sometimes forgot the last delivery. The DFS news can be periodically delivered to the registers via email.

While the orders are made online, the item numbers, credit card number, travel information such as flight number, date and destination of arrival for the delivery are required. The authentication is necessary. The confirmation of the purchase order must be sent back to the passenger, perhaps with the pick up registration number to avoid the falsely pickups. Then they are sent to the destination DFS store to prepare for the delivery.

The content providers play a role as the third party in the inflight Internet market. It makes agreements with duty free merchandisers of each member group. The DFS merchandiser can negotiate with the content provider such as IFOL who provides the Internet access system to the airline whose systems support the online shopping web site. Content provider can collect commission from linked web site or banning, but perhaps free of charge in the prime period.

Rather than news, movie programs, DFS web site can be one of its outstanding choice of content to provide to the airline passengers that enhances the productivity and

enjoyment and also deliver quality goods and services selected especially for the frequent business and connected travelers. The successful Duty Free web site can be one of the targeted web content and E-Commerce outlets.

The Advantage and Limitation of Online Onboard DFS

On the DFS web site, though the passengers can view DFS items of all countries, comparing quality and prices, they can buy only the one of their destination. The web site will ask to tick their destination to allow the purchase. Suppose the passengers are traveling from Bangkok to Frankfurt, they are allowed to buy only the German DFS. They are unable to pick up items from the Australian DFS because they cannot pick up the items there. This is the limitation of DFS frontier.

Comparing to the present system, the passengers can view and touch the product and consider the real things. The items though virtually looked sometimes they occur some graphic error or delays in graphic transfer.

The broadband two-way real time system is more efficient to the online shopping web site. The orders are responded at once to the passengers and their discussion of the detail online can make the purchase more precise. Compared to the cached system, there might be an error in transmission. The purchase order cannot be reached to the ground servers.

5.2.1 4Ps Analysis

Products

All DFS items are acceptable and expected by the travelers to purchase while they go abroad. The product includes the country's duty free and tax free product. For example, they are cosmetics, electronics, fashion and accessories, jewelry, lighter, liquor, luxury gifts, package food, pen, perfumes, sunglasses, tobacco and watches. The

items are differentiated among each member DFS by the package such as a thing that Thailand's DFS offers package set of 6 brand name lipsticks while Singapore's DFS offers one with trio set of same brand name. The passengers can compare those items and their prices. Passengers might prefer the big value packs but they cannot pick up at the destination.

Price

Those prices of the DFS items are differentiated by the different packages or with complimentary. The price competition must be high because the passengers can compare the price before making decisions. Prices of the same product are slightly different due to the cost of transaction. The delivery might be complimentary or slightly charged to the passengers.

Place or Distribution

The initial system, the passengers can buy DFS items from the 27 representatives' shop at the airports and in towns or inflight DFS sales carts. From the initial system, Thailand DFS now derives its customer base from more than 25 million international travelers and tourists that visit Thailand each year.

With the launch of online onboard DFS on its own national flag airline and member airlines, it enhances the passengers to spend their long flight time to thoroughly look up all items and decide on the delivery. This increases the market size to global as well as the volume of the sales. The payment is based on the credit card only. The credit card information is authenticated by the servers in cooperation with the card issuers and credit card holders.

Promotion

Among the Star Alliance group, the members have negotiated the market plan but each airliner has to promote and present its own entities as the first priority in-group for the passengers to choose.

While the airline promotes the inflight Internet usage by adding mileage points from every minute of the Internet access, the DFS will supplement the lucky draw prize to whom accesses the DFS web site and purchases exceeding the specific amount, for example, with the free one domestic air ticket. Thailand's DFS compliments their customers with the "Buy One Gets One Free" incentive program to the passengers. This also promotes the brand awareness of airline as well as DFS simultaneously.

The airlines and DFS would have co-branding opportunity that the airline web page would include the DFS's URL on the top left corner of the airline's homepage and the DFS offers it in the same way as to the Airlines' URL. Rather than targeted on Thai Airways passengers, Thailand DFS merchandiser can penetrate the member airline market such as a group of the Star Alliance, the largest anti-competitiveness group to benefit from the huge platform of global travelers. Thailand DFS in corporation with Thai Airways makes agreement with the Star Alliance members to exchange the Online onboard DFS merchandise program on those airlines. The airline members help promote the members' DFS. This will bring together the varieties of DFS items from different countries' DFS for their passengers' to shop while inflight. They can make an order based on their own choices and preference before the arrival time at the destination and it can match their travel plan for the delivery.

The Star Alliance airline network strives to bring together fifteen of the world's finest harmonized timetables to minimize inconvenience from the flight connection while each airline not only lost none of their individual identities but also preserves and promotes its own unique traditions and cultures. The Star Alliance group consists of Air Canada, Air New Zealand, All Nippon Airways, Ansett Australia, Austrian Airlines, British Midland, Lauda Air, Lufthansa Airlines, Mexicana Airlines, Scandinavian Airlines, Singapore Airlines, Thai Airways International, Tyrolean Airways, United Airlines and VARIG Brazilian Airlines. Other Internet benefits include the services of the access to 894 airports in 129 countries, over 500 business lounges to earn and redeem frequent flyers miles or reward points on any member airline, plenty of alternatives to choose about 7,200 flights every day (one every 12 seconds), world-wide recognition of status and other privileges in reservation, standby and boarding, baggage handling and the most flexible round-the-world fares, for instance. It means that in cooperation with the Star Alliance market, the successful strategy can gain more of the 15 airline customers from 129 countries or 7,200 flight a day. The more passengers destined for Thailand, the more opportunity offers to the Thailand DFS to sell.

5.2.2 Benefit and Cost Analysis

Benefit of the online onboard DFS, another channel of sales and promotion using new technology, is to increase the volume of sales and provide the convenience to the passengers, carrying things while traveling. This can reduce weight burden to the aircraft and the transportation fees can be cut off. The airlines and the DFS merchandisers can get mutual benefits of their customer service. This increases in the channel of sales; size of market. The member airlines with technology-enabled, destined to Thailand can integrate the DFS service.

.The cost of the initial system, the DFS has to pay the rental fee to the airline for the DFS carts and the airport shop storefront. With the technology the DFS can reduce the number of showroom, shops. The airline has invested on the technology while the DFS merchandiser has utilized the existing inflight Internet access technology of the airline by implementing its web site as one of the inflight contents with no additional hardware. It is the simplest integration with the available system. It includes the acknowledgement cost to the airline because the airline staff like flight attendants must acknowledge the new technology adopted by the airlines to assist the passengers while inflight. The DFS has to pay the inflight Internet access provider for the access and transaction.

5.2.3 Summary

The success of the online onboard DFS depends on how much it can meet the objectives to expand market and increase channels of sales. The DFS makes an agreement among airline members to barter the web site in what proportion. Number of airline aircraft that wishes to install the Internet access system and join the network. Number of the Internet users in specific areas must be surveyed such as member airlines heading to Thailand. The online onboard DFS may supplement and totally replace the existing onboard DFS system, depending on the strength of it. The successful technology can enhance it to replace the old system in the future in some airlines if they reach more of the target groups such as the passenger traveling inbound and outbound either by Thai Airways, the national flag carrier, or the other.

In addition, the possibility of the online onboard DFS depends on the executive attitudes. The airline executive could see the benefit of technology as the strength of the business strategy in such a competitive market. Some airlines' sales points are

based on food and drink service, the child care service, for instance. Nowadays it cannot be denied that the new technology plays more roles in customer service in such competitive airline business rather than the seat comfort, the inflight movie, or food and drink service. The DFS executive could realize the prosperous benefits of the online onboard sales at the same time.

VI. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

With no surprise, it is time to have the Internet on aircraft emerge. With the development of the inflight Internet, the value of the Internet lies in its capabilities to connect many users from across the globe regardless of the location. The move technology onto the aircraft the mobile platform make Internet sound as the perfect borderless connection mean. The connectivity technology of inflight Internet will make new dimension of communication and businesses to the globe emerge.

With the existing system, the technology falls into **two broad groups**: first of those using existing narrowband air-to-ground telephone links and the latter implementing new satellite-based broadband systems. Either systems use some form of on-board server/caching systems that are kept updated during flight, albeit trickle charge when using the aircraft telephone system. Between those satellite-implemented services; Connexion and Tenzing technology, one system is easier to maintain and train than two separate systems. A standard might result in poor Internet service and irate travelers who are already annoyed by air travel. Broadband technology of Connexion service will bring high standard, but slowly develop and expand to the remaining areas. Started up in the US continent, apparently many of these passengers want to be connected during flight. The European and Asia-Pacific market will gradually adopt when the technology spreads according to the anticipated plan in a few years. Meanwhile Tenzing has already offered either narrowband or broadband technology to the Europe and Asia market areas.

Whilst the price determination is a huge issue of whether the new technology costs too high and at what appropriate rate is to be fairly charged, price is not the only

factor that determines the usage of inflight Internet access to encourage the market demand. It depends on whether the passengers can really benefit as much as they do from home or the inflight Internet connectivity market can gain revenues. Furthurmore, the inflight Internet can accommodate the airline passengers such an urgent check-in, flight and destination information, transaction or E-Commerce.

6.2 Recommendations

Although the study is based on the US sources, showing the positive trends in the U.S market, the project would like to support that this technology can be used here to enhance the airline customer service together with the online onboard Duty Free Sale. This shows what a little creativity can do when working with high quality, user-friendly technology. This service is what can be used to serve the needs of airlines and travelers as the competitive advantage an airline could have by incorporating this capability into customer service.

For the next few years, business travelers to Asia and Europe will aim at an airline with Internet access as their priority. The demand for inflight Internet access will increase accordingly. The cost of system installment for aircraft will be consistent soon because of the high competitiveness among its ventures. The airlines can afford the system and the airline passenger can also afford the inflight Internet service and do the online shopping while inflight. The inflight Internet service will be another strength of all airliners rather than the meal service, comfort and their prestige.

All of airlines should integrate the technology of the inflight Internet to enhance their own market business and develop the air community to the total internet connectivity by the technology.

APPENDIX A

AIRCRAFT COMMUNICATION SYSTEM

AIRCRAFT COMMUNICATION SYSTEM

SATCOM

The satellite communications system of the aircraft (SATCOM) provides both voice and data communication used for cabin and flight deck. The SATCOM system supplies full duplex telephone quality voice communications. The SATCOM system supplies voice/data signals over long distances and more reliable than VHF and HF communication system. The SATCOM system relays reports, cockpit and cabin communication for the aircraft communications addressing system (ACARS) as an alternate to the VHF air/ground radio link. The SATCOM system make a radio frequency (RF) link through a satellite transponder to a ground earth station (GES). The GES uses communication networks to complete the communication link for each call destination.

The SATCOM system provides 6 channels for communications. One channel is reserved for the flight deck data and communications control. One to two channels can be reserved for flight deck voice use. The remaining channels are for passenger voice/data service when optionally installed such as the flight telephone system. Before performing ground communication, the satellite equipment must have completed automatically the log-on operation. The SATCOM system supports a number of optional operation configurations, which can be tailored to meet the airline needs.

The SATCOM system is defined by international specifications. The Aeronautical Radio Inc. or ARINC specifies the function, components, interfaces, technical performance parameters and signal protocols. The International Maritime Satellite Organization or INMARSAT specifies protocols and performance requirements for access to the aeronautical INMARSAT satellite network.

The SATCOM system network consists of the 4 elements:

- Aircraft Earth Station AES - The function of AES is to interface and provide for the reception and processing of signals received by a satellite. The AES also transmits signals through the satellites to GES. The four major units of the AES are Satellite Data Unit, Radio Frequency Unit, High Power Amplifier and High Gain Antenna. The Satellite Data Unit is the main SATCOM AES system. It interfaces with the other aircraft systems and the other AES equipment. Radio Frequency Unit translates byte data and voice signals to and from most of the components in the system. High Power Amplifier can radiate up to 60 watts of signal power. High Gain Antenna is a directional antenna, which is continually aimed at one of the satellites regardless of aircraft position and attitude. Steering commands are sent from the satellite unit to the antenna beam steering unit, which actually controls the antenna pointing direction.
- Ground Earth Station GES - the fixed terrestrial radio stations that interface with AES through satellite and the terrestrial networks. Each GES provides system synchronization and coordination for the inbound and outbound message by using the private or public communication network to provide communication links to the end users.
- Terrestrial communication networks
- Space Segment - the satellite network provides two way communication link between the AES and the GES. INMARSAT is the first satellite network available for commercial airplane use. It locates in a geosynchronous orbits (It can be viewed stationary from the earth.)

Airborne Cabin Telephone System

The Airborne Cabin Telephone System or ACTS allows the telephone communication in the cabin using the international direct dialing (IDD). The ATCS has these elements:

- The cordless handset
- The cabin unit: a small telephone exchange interfaces the handset (thru cabin antenna) to the CTU and SATCOM system for transmission.
- The cabin telecommunication unit CTU: interfaces directly with the satellite data unit for data transmission.
- The holster/charger
- The cabin telephone maintenance panels CTM: investigate the internal fault and status log.
- Passenger cabin antenna : are mounted on the top of the aircraft ceiling panels, connecting in series in two parallel row
- The external antenna

The passenger handset is connected by radio signal to the cabin unit. The cabin unit is connected through a CTU to the SATCOM system where the signals are sent to a satellite. A CTU interfaces directly with the satellite data unit for data transmission. The signals are sent through the satellite antenna subsystem to a satellite, beamed to ground station and then connected to the public telephone system.

ACARS

Generally, the aircraft communication addressing and reporting system (ACARS) serves as a router to address the Air Traffic Control messages to the appropriate aircraft, airline host computer or other Air Traffic Control agency and permits direct exchange of data between the aircraft and the airline ground based computer through VHF radio or SATCOM.

The data link exchanges data through dedicate VHF ground station supporting uplink and downlink data exchange. These station are connected to SITA (131.550,131.725), ARINC (131.450,131.550) (Figure A1: ARINC Coverage Areas) and/or other data network providers such as air Canada (131.475). The data networks are then connect to the airlines or other host computers. While the aircraft is outside the VHF ground network coverage, the SATCOM will be utilized.

Air-to-ground (downlink) message includes flight operating data, aircraft performance and passenger/cabin data service. The aircraft communication report and addressing system management unit (ACARS-MU) sends downlink via SATCOM when connection to Ground Earth Station (GES) is already established or log-on. Downlinks require the ground acknowledgement, which is generated by the ground station upon receipt of an error-free downlink. The management unit retransmits the message if it does not receive the response within 15-20 seconds.

Ground-to-air (uplink) message is all response data. It is capable to access up to 50 uplinks. On the receipt of uplink, the management unit performs an error-check. If the message is error-free, the management unit generates an acknowledgement for transmission to the ground. If the message contains errors then management unit

generates a negative acknowledgement for downlink. The ground will retransmit the uplink.

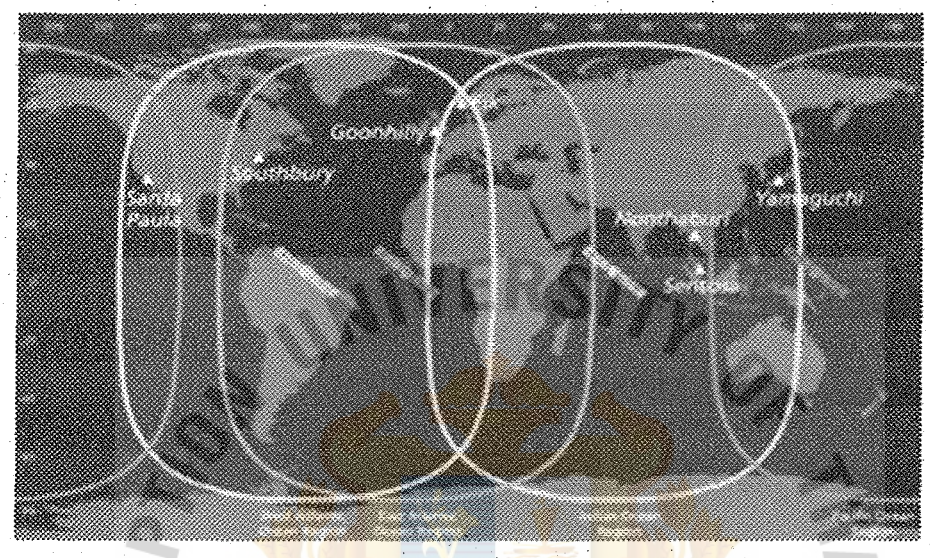

Figure A.1. ARINC Coverage Areas.

APPENDIX B

INFLIGHT ENABLED COMMERCIAL AIRLINES
AND EXECUTIVE AIRCRAFTS

Air Canada

Air Canada also uses the caching system developed by Tenzing on six Boeing 767s to offer a wired inflight Web and e-mail service to executive-class passengers on long-haul flights across Canada. Because of limited throughput of the air-to-ground data links, the system caches all the messages being sent and received, so it's not real-time, with response times around 15 minutes. The service also provides a selection of sites catered to frequent travelers that offer business news, stock quotes, and entertainment. Tenzing system caches not only Web content, but also e-mail messages, lining them for transmission and reception. It works on providing secure access to corporate e-mail accounts, which typically reside behind a firewall on a company network. The system requirement and download the Tenzing Global software is required to unlimited access to comprehensive Web content and email solution for both the air and the ground; enjoy POP3 email service that transmits and receives messages; access a database of Web sites like Yahoo, and weather, news, and sports, as well as popular magazines and training courses. These venues will be updated daily or weekly, depending on the site.

Alaska Airlines

Alaska Airlines is one of 17 leading airlines working with Connexion by Boeing on finalizing the Connexion by Boeing service.

Alaska Airlines and Boeing executives came up with a creative use of this technology that could be used to enhance customer service. It became the first airline to print out a boarding pass online while inflight. Using the Connexion by Boeing service, the executive was able to check in via the Internet at www.alaskaair.com and print his boarding pass. That sounds the competitive advantage an airline could have by

incorporating this capability into customer service. Alaska customers can purchase tickets, check in and print boarding passes online from their home or office, and check in for their flight with a wireless device on the way to the airport.

British Airways

British Airways, the British biggest Airlines, has planned to launch the inflight Internet service for its first class passengers, rather than other service. Initially British Airways will use the global interactive communications medium to give millions of computer users worldwide a chance to learn more about the airline's latest innovations. For the more technical-minded, information on the new First cabin will make imaginative use of Server Push animation, as well as Virtual Reality "Quicktime" movies. Contents already on its home pages, which have been extensively updated after controlled trials, include worldwide schedules, airline facts and figures, aircraft information with pictures, Concorde on video, job vacancies and contact phone numbers. A cyberSkyflyers service will be added shortly, with pages offering children's activities themed on the airline.

Special care has been taken to make the site easy for everyone to use, not just those with high performance PCs. It is 'browser aware', and will provide whatever version the user's computer can handle, from text-only to Netscape 2.0 with plug-ins. Longer term it will feature Shockwave interactive animations, a chance to "chat" to senior airline managers via the Net, commenting on service and receiving replies, and an on-line radio station. Once technical and security issues have been resolved, customers may also be able to book tickets via the Net -- but only if it offers better service than current booking methods.

C-32A (the US. Executive governmental aircraft)

Boeing will equip up to four C-32A aircrafts with an integrated, two-way communications capability using the satellite-based Connexion by Boeing broadband and data service. The funds have been obliged $9.5 million.

The C-32A is a specially configured Boeing 757-200 for the United States Air Force. The aircraft provides safe, reliable worldwide airlift for the Vice President, cabinet members and other government officials. Four C-32As are currently in service.

Current world events have heightened the need for global leaders and executive aircraft operators to maintain real-time, two-way broadband connectivity while in the air, as well as stay abreast of world news as it happens. The Connexion by Boeing service can offer significant support in all these areas.

Cathay Pacific Airways (CX)

Cathay Pacific plans to outfit 62 of its planes with 1.5Mbps wireless LANs feeding a satellite link. Using wireless LANs to provide passengers with Internet connections can save airlines a lot of money when it comes to retrofitting their planes for the addition of such services.

Cathay Pacific Airways has partnered with Tenzing Communications, Inc and General Dynamics to offer inflight high-speed email service and in-seat power, which constitute just part of the StudioCX. Inflight high-speed email service is now available on select flights in First Class, Business Class and some certain rows in Economy Class. In addition, passengers are able to utilize our in-seat power and keep your laptops running at full speed. Expectedly, the installation is to be completed on the entire fleets by the end of 2003. Tenzing software is available at no charge. Inflight representatives

will be available on selected Cathay Pacific flights beginning in September 2001, and are available at The Wing, Cathay Pacific's First and Business Class lounge, starting in October 2001. Passengers have to bring their own laptops. Subscription to Tenzing and install the appropriate software is necessary.

Lufthansa Airlines (LH)

Lufthansa Airlines the industry-leading European air carrier has been installed the Connexion by Boeing service. The initial installation will be an intercontinental fleet, DLH 747 aircraft, which will be equipped with the service to conduct a three-month development program prior to installation on the fleet with a demonstration installation in late 2002/early 2003.

Financial terms of the arrangement were not disclosed. LH aims to develop the critical market mass needed to effectively support and enable a service launch to make these services readily available to the global airline community.

Scandinavian Airlines (SAS)

During 2000, SAS flew 23 million passengers to 105 destinations in 31 countries, nine of which were outside Europe, six in Asia and three in the US. SAS marks as one of the first European commercial airline using this technology to feature wireless Internet technology on its planes in 2001. The airline has an agreement with Sweden's Telia and US-based Tenzing Communications to implement technology. The users can access at the same speed as an office desktop connection. SAS passengers will be able to pick up e-mail from their usual POP3 mailbox, and also will be able to access a limited range of travel-related Web sites and airline portals, cached on an on-board

server and regularly updated over Inmarsat. The aircrafts will house both e-mail and proxy servers and wireless LAN. The server will link to a ground station during the airborne.

SAS plans to further develop a solution of the integration wireless Internet service. They will be able to use email and Internet services before, during, and after their flight via Telia's advanced wireless roaming network and Tenzing's global terrestrial Internet Service Provider (ISP) service or their local service provider. Also, this will include airports, conferences or hotels. The agreement in conjunction with European wireless access provider, Telia Mobile and Telia HomeRun, provides a transparent service for passengers inflight or on the ground and offers secure, corporate, behind firewall email access for its customers.

Singapore Airlines (SQ)

This service is available on one Singapore Airlines 747-400 three classes of service, flying between Singapore and Los Angeles. Passengers have to download free software on the ground before flight to use the service.

Singapore Airlines has invested S$200 million (US$115.3 million) to develop "cyber-cabins" complete with e-mail and Web-site access on two of its aircrafts in February 2001.

Singapore Airlines utilizes the inflight Internet connection as emergency medical-assistance to add a service value that allows cabin crew team to consult medical staff on the ground if a passenger becomes ill on board. The patient data is retrieved directly from the medical or insurance database and supports as first aid.

Varig Airlines

Varig Airlines, Brazilian and the South America's largest airline, with Tenzing Communications Inc. launches Tenzing's email and web service on the first fleet of six new 777s, which enables Varig Airlines passengers to send and receive email while in flight and surf the best of the Web from over the Pacific.

Passengers will access the service by plugging their laptops into VARIG's inflight entertainment system, MAS-3000, provided by Matsushita and equipped with a Tenzing server, and dialing into the Tenzing Global network. Users can register at the Tenzing or VARIG Web sites or by using CDs provided in the VARIG passenger lounges.

Virgin Atlantic Airways

Virgin Atlantic Airways, Britain's second largest long-haul carrier, is the first European airline who deploys Internet service onboard. Virgin Atlantic uses the Tenzing technology service on its fleet of Boeing 747-400 and 747-200 as well as Airbus 340-300 and new Airbus 340-600 to install the Tenzing system and onboard servers.

The Tenzing system utilizes satellite communications equipment for downlink communications with an on-board proxy server delivering content to passengers over an on board Local Area Network. Virgin Atlantic did not disclose how much it plans to charge passengers for the new in-flight service.

The Inflightmail project of Seattle Lab with Honeywell, the aircraft equipment - maker Company allows the passengers either to send and receive email via their laptop or send personal notes via their seat back video screen.

Virgin Atlantic also integrates into advanced inflight entertainment system to allow passengers access to the most innovative features to-date, upgrading its Inflight Digital Entertainment system manufactured by Matsushita Avionics Corporation. The new system will provide passengers with more than 200 hours of digital Video on-demand entertainment on their individual seatback screens with the highest resolution onboard to date. This system will also provide the facilities available to create a modern business environment.

Virgin Atlantic has rolled out to full fleet since June 2001 on its Boeing and Airbus aircrafts. Virgin Atlantic did not disclose how much it plans to charge passengers for the new inflight Internet service.

APPENDIX C

AIRBORNE NETWORK SERVER

Airborne Network Server

The airborne network server is designed to enable executive aircraft passengers to enjoy computing capabilities similar to those they are accustomed to in their ground-based offices. They can conveniently share files and printers and access e-mail and Internet services while in flight and any general purpose-computing task, especially those that benefit from a centralized database.

The airborne network server, a custom ruggedized packaged PC, is designed for the unique requirements of the aircraft environment. Its' small size and minimum cooling requirements allows it to be mounted in any convenient location in the cabin. Passenger laptops interface to the airborne network server through Ethernet cabling installed throughout the cabin.

This airborne computer is very versatile due to its extensive interface capabilities and removable hard drive. The removable hard drive allows a convenient way to transfer data from the office to the aircraft and provides security for sensitive company data. It also allows the computer to be updated and tested on the ground without removal from the aircraft. Interfaces include three RS232 serial ports; a parallel printer port, connections for keyboard, mouse, floppy drive and CD-ROM; digital and analog video output; and a USB port. There is also the ability to support a variety of interfaces such as Ethernet, modem and others through two Type-II PCMCIA slots. An optional ARINC 429 PCMCIA interface allows utilizing aircraft data such as position reporting and maintenance information. For example, the JetLan of PENTAR Avionics **CMU-200** (Figure C.1. CMU-200)

The communication management unit is a small, 2 CMUs' box with all the capabilities needed to support today's aircraft and ground communication networks. This digital CMU allows any pilot to benefit from ACARS datalink capability.

It provides a variety of features and versatile options in a small, low-cost, lightweight package. The CMU-200 is designed to interface with any ARINC 739 compliant display including most modern flight management systems.

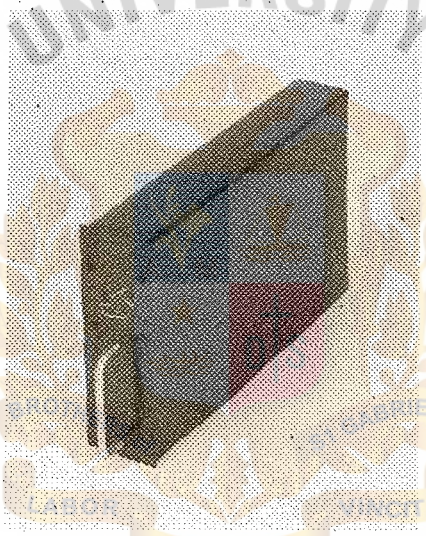

Figure C.1. CMU-200.

APPENDIX D

COMPANY PROFILES

AIRBUS

French aircraft maker Airbus has acquired a stake in Tenzing, a maker of inflight access systems, in a move that propels it into an inflight market with competitor Boeing.

In July 2001, Airbus bought a 30 percent stake in Seattle-based Tenzing, valuing the private company at $148 million. The agreement makes Tenzing the primary supplier of in-flight Internet services equipment to Airbus.

BOEING

Boeing Company : 7755 E. Marginal Way South Seattle, WA 98108

Ticker Symbol : BA

Phone: 206-655-2121/ Fax: 206-544-1581

Web site : www.boeing.com

Company Overview

Boeing is the leader in the aerospace and defense industry and the largest commercial jet aircraft maker and aerospace firm in the world as measured by total revenues. In 1997, the company became the biggest aerospace firm in the world, in addition to being the sole maker of commercial jets in the U.S. Among its more well-known products are the 737, the 747, the 767, the F-15 Eagle, and the F/A-18 Hornet. The company, which is moving its Seattle-based headquarters to Chicago, is also a major contractor for NASA and launches satellites for the U.S. military. In June 2001 Boeing partnered with airlines to launch Connexion by Boeing, a broadband access provider for passengers on commercial flights.

Boeing is organized into seven major lines of business:

- Commercial Airplanes: Boeing is also the largest partnered aircraft maker company. The Boeing 737 is the best selling jet in history. And today, there are more than 11,000 Boeing airplanes in service of the maintenance and modification market. Also for commercial aviation support services, Boeing also offers unsurpassed technical support, engineering, modification and logistics management services, as well as training for maintenance and flight crews.
- Aerospace and Communications: Boeing is also a NASA's largest contractor missile, rocket engines, launch systems, satellites, and advanced information and communication systems. Also, Boeing was the maker of the first round of rockets used in the Apollo space program and the main contractor for the International Space Station Program.
- Military Aircraft, Missiles and Defense: Boeing is the world's largest manufacturer of commercial jetliners and military aircraft, and provides related services worldwide.
- Shared Services: creating a global partnership and pooling financial and technical resources from a diverse group, the holder of more than 6,300 patents.
- Air Traffic Management
- Connexion by Boeing: Boeing takes a major step toward its goal of becoming a leader in providing two-way, satellite-based broadband services to commercial and corporate aircraft, conceded partial ownership of the proposed venture to the three airlines (AMR Corp.'s

American Airlines, UAL Corp.'s United Airlines and Delta Airlines Inc.) Boeing's focus on in-flight communications also has been spurred by its pending acquisition of the satellite-manufacturing arm of Hughes Electronics Corp., which also has been studying ways to wire airliners for enhanced Internet access. It is the world's premier large-scale system integrator, with plans to develop a space-based air traffic management system to solve the world air congestion problem, as well as a global-mobile communications system that will allow passengers on any moving platform to be connected to high-bandwidth data. It has signed agreements with inflight Internet services provider, satellite company, prospective airline partners as well as additional content and service suppliers to create the inflight communications venture.

- Boeing Capital Corporation.

Key Financial Facts

2000 revenue: $51,321 million

1-yr. growth rate: -12 percent

Personnel Highlights

Number of employees : 198,100

1-yr. growth rate : 1 percent

Boeing has one of the most skilled and knowledgeable workforces in the world. It emphasizes the light capital, the intellectual property. At year-end 2000, Boeing employed a diverse and skilled workforce of 198,000 people. Along with hundreds of people employed at approximately 28,800 suppliers worldwide, they provide Boeing products and services to customers in 145 countries.

CONNEXION

Connexion, known as Boeing's airborne ISP, is the joint venture of Boeing company, the United Airlines parent UAL Corp. (UAL up $0.01 to $33.51), Delta Airlines (DAL: up $0.27 to $43.65) and AMR Corp. (up $0.03 to $36.13). Exact financial terms of the joint venture were not disclosed, nor were estimates about the cost to develop the service. Boeing is the majority partner (BA up $0.55 to $66.26) and the three airlines will hold equity positions. The four partners will contribute funding, certain intellectual property and other assets necessary to carry on the business of the in-flight communication venture. Those companies will provide support in the design and manufacturing of proprietary technology and infrastructure electronics for the Connexion and support the design and manufacturing of the next-generation phased array antenna and the supporting electronics for the Connexion by Boeing service. The new design will improve system performance and overall capability.

Connexion team is accompanied with units of Japan's Mitsubishi group and Italy's Finmeccanica, Loral Space & Communications. They all play important role in these ventures. Alenia Aerospazio, a Finmeccanica Company, and Tokyo-based Mitsubishi Electric Corp (MELCO).

Alenia will provide satellite and transponder capacity options for enabling European coverage, support the overall service rollout and perform aircraft modifications in Europe and will provide the management and technical support for the venture's planned network operations in Europe. Using their Aeronavali modification and maintenance organization in Italy, Alenia will assist with the design and installation of the Connexion by Boeing equipment for airline and aircraft customers throughout Europe.

MELCO will provide satellite and transponder capacity options for enabling Asian coverage and the management and technical support for the venture's planned network operations as well.

Alenia and MELCO bring unique and valued understandings of the markets they serve. The capabilities provided by their people and world-class satellite design and manufacturing facilities will enhance the overall service infrastructure and help to bring forth this exciting new mobile communications service.

Loral Skynet has 10 satellites covering North and South America, Europe and parts of Asia. About 20 US domestic and foreign carriers are putting the high speed Connexion system in their planes. Cost of using the service is not yet set but would be determined partly by the demand for the service. Loral Skynet do Brasil, a wholly owned subsidiary of Loral Space & Communications, is the first in-country, private Brazilian satellite company offering Ku-band services. The company was formed to address opportunities in the fixed satellite services market in Brazil and the Americas. The company has the rights and obligations to use the Ku-band frequencies at the 63 degree West Longitude orbital slot.

In the airborne environment, the Connexion service, an airborne ISP, extends the broadband connection to make connectivity to airline passengers through a mobile broadband service whose prices are expectedly comparable with cellular phone service. Connexion has signed agreements with Inflight Internet service providers, Satellite Company, prospective airline partners as well as additional content and service suppliers to create the inflight communications venture. The first installation of broadband for the three carriers are committed to equipping a total of 1,500 jets with the connection, which would be a large majority of their aircraft. The costs to retrofit an

existing airliner with the service or to build it into new commercial jets range in price from US$20 to 200 million. Other financial terms were not disclosed.

Connexion, the first truly broadband communication service for people on the move, is the market-leading initiative working to bring today's high-speed, cable-quality Internet and company Intranet data services to the airline passengers. The other related technology providers in the market gain a lot of benefits at the same time.

FEDERAL AVIATION AUTHORISATION

FAA is one of the Aviation Organizations. FAA flight guideline for electronic Federal Communications Commission.

FEDERAL COMMUNICATION COMMISSION

The international Bureau of Federal Communications Commission (FCC) action is a critical step toward the development and implementation of the satellite-based element of overall Air Traffic Management architecture. FCC considers an important stakeholder in which supports the importance and urgency of a satellite-based Air Traffic Management system.

INFLIGHTNETWORK

InFlight Network is a joint venture from Rupert Murdoch News Corporation one of the world's leading media companies and aviation electronics specialist Rockwell Collins. Jeffrey M. Wales, CEO of In Flight Network LLC and senior vice president, News Corporation.

InFlight Network LLC has long-term strategic development with Globalstar (GSTRF) and a development agreement with QUALCOMM Incorporated (QCOM) which will enable IFN to provide low-cost broadband Internet and e-mail services to existing commercial airline fleets over parts of North America, proving.

Globalstar, a trademark of Loral Qualcomm Satellite Services, Incorporated, led by founding partner Loral Space & Communications (NYSE: LOR), is a partnership of the world's leading telecommunications service providers and equipment manufacturers, including co-founder QUALCOMM Incorporated, Alenia, China Telecom (HK), DACOM, Daimler Chrysler Aerospace, Elsacom (a Finmeccanica Company), Hyundai, TE.SA.M (a France Telecom/Alcatel company), Space Systems/Loral, and Vodafone AirTouch.

The Company's business areas include integrated CDMA chipsets and system software; technology licensing; Eudora® email software for Windows® and Macintosh® computing platforms; satellite-based systems including portions of the Globalstar(TM) system and wireless fleet management systems, OmniTRACS® and OmniExpress(TM). QUALCOMM owns patents, which are essential to all of the CDMA wireless communications standards that have been adopted or proposed for adoption by standards-setting bodies worldwide. QUALCOMM has licensed its essential CDMA patent portfolio to more than 75 telecommunications equipment manufacturers worldwide. Headquartered in San Diego, Calif., QUALCOMM is included in the S&P 500 Index and is a 2000 Fortune 500® company traded on the Nasdaq Stock Market® under the ticker symbol QCOM.

INFLIGHTONLINE

InFlightOnLine (Http://www.inflightonline.com) is the premier supplier of web server software, inflight and Intranet services provider to passengers onboard commercial airplanes. Its system is "platform independent," meaning that the company can manage its software and Internet services through any of the hardware systems on the market.

InFlightOnLine Offices in Fort Lauderdale, Fla. and Bellevue, Washington.USA, inflightonline.com David Bruner President, Warren Brown executive vice president of corporate communication Inflight Internet Service Provider.

Inflightonline's products and services include secure in-flight e-mail capability, hotel and flight reservation services, streaming audio and video with the capability of managing thousands of movie/audio titles, access to real-time news, weather and sports, as well as financial information and on-line shopping. The servers will open up the Web sites of additional 30 e-commerce stores.

The IFOL servers will open up to a co-branded content page which offer Internet access to its new 1000-store Lycos Shops and more than 50 different web site partners to provide contents on the in-air system such as Lycos, Inc., Fidelity Investments, Lands'End, Hertz and others to provide the broadest variety to the flying public.

Lycos, Inc., (1995) the 's leading multi-brand network, acquired a 10-percent stake in the company, with a major presence throughout the U.S., Europe, Asia and Latin America, one of the most visited hubs on the reaching one out of every two Web users. The Lycos Network is a unified set of Web sites that attracts a diverse audience by offering a variety of services, including leading Web navigation resources, homepage

building and other Web community services and a comprehensive shopping center. The Lycos Network is composed of premium sites: Lycos.com, Tripod, WhoWhere, Angelfire, MailCity, HotBot, HotWired, Wired News, Webmonkey, Suck.com, MyTime, Sonique and Quote.com. Lycos.com, www.lycos.com. Headquartered near Boston in Waltham, Mass., Lycos, Inc.

PENTAR AVIONICS

Pentar avionics, a Seattle-based, is the manufacturer of the JetLAN airborne network server. Revolutionary new computing capabilities are available to business aircraft cabins.

The first PC designed to be permanently installed in and highly integrated with an aircraft cabin. This concept brings unprecedented new capabilities and will have the same impact on the "office in the sky" as the personal computer has had on work place.

CDU-200 is designed to meet the need for an affordable multi-purpose. By combining a standard QWERTY keyboard with an intuitive user interface and a high-speed processor, the CDU-200 simplifies the task of entering text for data link applications. In addition, the CDU is compliant with the ARINC 739 protocol. At only 4.5" high and 2" deep, it can be installed virtually anywhere in the cockpit; even very small cockpits such as helicopters. While VDL-200 meets the compatibility requirements for ARINC 758, the PENTAR VDL-Mode 2 Radio is optimized exclusively for data communications at the fastest data rates available while maintaining a very low-cost, small package. It is available as a stand-alone 1 CMU box that can be interfaced via ARINC 429 to other CMU's or as a single board in the CMU-1000 or

CMU-200 products. In addition, it is available for OEM use in single board applications.

SCREAMINGMEDIA

ScreamingMedia and MELCO Inc. (SCRM: up $0.07 to $3.25), inflight content providers, will aggregate licensed content -- including worldwide, national and local news, sports and features -- from more than 3,000 publications in its digital content network and then filter, deliver and instantaneously integrate that content in the Connexion service.

Inflight Content Providers, will aggregate licensed content -- including worldwide, national and local news, sports and features -- from more than 3,000 publications in its digital content network and then filter, deliver and instantaneously integrate that content in the Connexion service. ScreamingMedia will deliver its own content and its technology solution software will be used to deliver pre-contracted third-party content as well. The company said its Content Engine technology will parse, normalize, process, customize and integrate the content as part of the delivery process. The content will be used to supplement live television and radio content, as well as flight-specific information. Boeing has an effort to add value to the service by signing memoranda of an agreement with American and European news network like CNN Inflight Services, Mitsubishi Electric Corp., Alenia Spazio, Loral Skynet Matsushita Avionics Systems Corp. and CNBC which aggregates digital content for Web sites as well as providing a technology platform for content.

Content providers include CNN, the parent of CNNfn, as well as competitor CNBC. The timing of the first installation will be in the second half of 2002. Boeing

Co., pushing strongly to become the first widely available airborne broadband ISP through its Connexion by Boeing service, moved to expand the content available on the service through a deal with ScreamingMedia Inc. This content complements full /company Intranet access and infuses the Connexion by Boeing service with the time-sensitive data in a global manner.

TELEDESIC

Telesdic was founded in 1990. Principle shareholders are Craig McCraw, founder of McCraw Cellular communications, the world's largest wireless communication company and Bill Gates, the founder of Microsoft the world's largest computer software company. Strategic investors also include $100 million for 10% of the Boeing Company, Motorola, Saudi Prince Alwaleed Bin Talal and The Abu Dhabi Investment Company.

Teledesic (pronounced "tel-eh-DEH-sic") is a private company based in Kirkland, Washington, with offices in Bellevue, a suburb of Seattle Brussels, Belgium; London, United Kingdom; Madrid, Spain; Ottawa, Canada; Riyadh, Saudi Arabia; and Washington, D.C.

Teledesic LLC, a satellite communication service Company has partnered with the satellite manufacturers Alenia Spazio, the Finmeccanica group in Italy, and US. Lockheed Martin Commercial Space Systems to build global, broadband -in-the-Sky satellite communications network. Both Alenia Spazio and Lockheed Martin Commercial Space Systems (LMCSS) have experience building non-geostationary orbit (NGSO) satellite systems.

Alenia Spazio also was the first satellite manufacturer to build commercial geostationary Ka-band satellites. Alenia Spazio has played a primary role in the construction of the telecommunications satellites Intelsat, Hot Bird, Arabsat and Panamsat and has integrated, in less than two years, all 72 satellites of the Globalstar constellation for mobile telephony. It is prime contractor for a number of national and international programs such as Italsat, Artemis, Sicral, Atlantic Bird 1, SkyPlexNet and EuroSkyWay.

LMCSS has experience in building low-cost buses for NGSO systems as well as extensive experience developing Ka-band system payloads, the brains of the satellite. LMCSS designs and builds geostationary and non-geostationary telecommunications and remote sensing satellites for customers worldwide. LMCSS is an operating unit, one of the core business areas of the Lockheed Martin Corporation (LMC). LMC has a 41-year heritage of building reliable spacecraft for commercial and military customers, having launched more than 875 spacecrafts and clocking nearly 1,500 years of on-orbit performance experience.

Boeing refines the system architecture, builds and launches the satellites. The Boeing team of 70 engineers helps streamlining its system of low-earth orbiting satellites. Boeing as the prime contractor because of its pioneering work in space; its experience in managing large, complex global alliances; its commitment to aggressive cost and schedule goals; and the companies' shared vision.

The company has received its Federal Communications Commission license and the necessary international spectrum allocation from the International Telecommunication Union to begin offering service on a global basis.

Teledesic is the first licensed satellite communications network that will enable affordable, worldwide access to advanced telecommunications services such as computer networking, broadband Internet access and interactive multimedia. Teledesic will deliver broadband data and value-added services over a global network optimized for the Internet Protocol. The system will act as a network operator and will support communications ranging from high-quality voice channels to broadband channels supporting videoconferencing, interactive multimedia and real-time two-way digital data flow. The system will use Ka-band to send and receive signals from users. Each satellite acts as a node in a large-scale packet-switching network. Service is planned to begin in 2002. Total cost of the project is estimated at $9 billion.

Teledesic's satellites would orbit at about 700 kilometers--50 times closer to Earth than geostationary satellites. (Figure D.1: Teledesic Satellite)

The Concept of a Network

To ensure seamless compatibility with those fiber networks, it is important that the satellite network have the same essential characteristics as fiber. Those characteristics include broadband channels, low error rates, and low delay. The advanced digital broadband networks will be packet-switched networks in which voice, video, and data are all just packets of digitized bits.

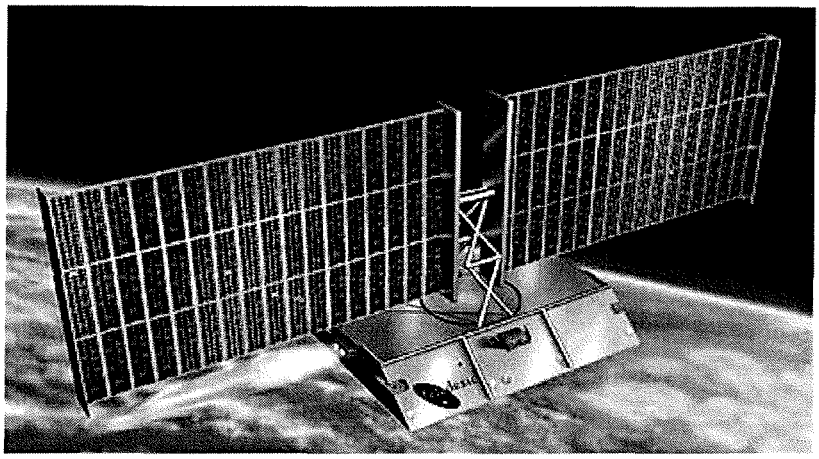

Figure D.1. Teledesic Satellite.

A decentralized network offers other advantages of distributed topology provide greater reliability. Redundancy and reliability can be built more economically into the network rather than the individual unit. Geostationary satellites will continue to have an important role to play, particularly for broadcast applications where their large footprint is advantageous. But increasingly, geostationary satellites will co-exist with non-geostationary orbit (NGSO) satellite networks.

The Teledesic Network will provide a means to help extend these switched, broadband connections on demand anywhere. Teledesic provides for seamless extension of, not competition to existing network. Unlimited gateway rights allow service providers to interconnect their networks with the Teledesic network. (Figure D.2)

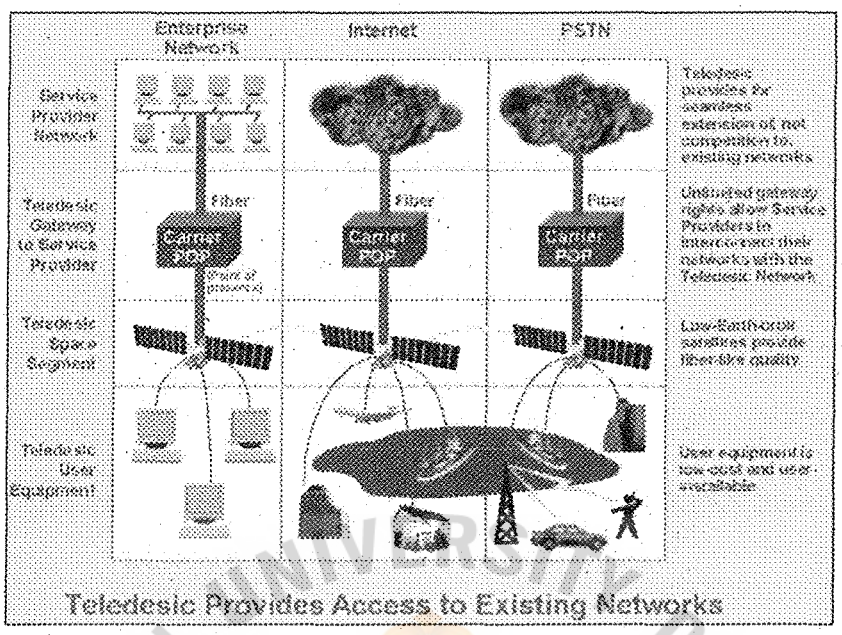

Figure D.2. Teledesic Network.

TENZING

Alan Pellegrini, the President and Chief Operating Officer

Financial Terms

Tenzing partners with Taikoo Aviation Technologies Limited ($ 10 million and subsidiary of Cathay Pacific Airways).

The company previously announced $12 million in funding during its first round, which was led by international telecommunications investment firm Fremont Group. Other investors in the next round include leading venture capital and aerospace companies, TH Lee, Riverside Management Group, JGL Investments, Deutsche Bank and ITOCHU Corporation, as well as private shareholders. Airbus bought a 30 percent stake in Seattle-based Tenzing, valuing the private company at $148 million. The

agreement makes Tenzing the primary supplier of in-flight Internet services equipment to Airbus.

Product and its customers

Tenzing has commitments from six airlines to employ the system, Virgin Atlantic airlines, Cathy Pacific, Singapore Airlines, Air Canada, Scandinavian Airlines and Varig Airlines. The company expects to have the service running in 50 aircrafts by the end of 2001, 200 planes by the end of 2002 and 500 planes by the end of 2003.

Tenzing already has about 8,000 customers signed up in North America to use the service. Selections will be based on the specific needs of the customers in different regional markets

XCELERATE

Ebusiness Solution

Xcelerate designs to equip airplanes with access for passengers, notes that some airlines. Xcelerate removed the first class seats of Delta Airline to focus on business customers as the communications venture plan. It represents the most profitable segment for the airlines. The strategy of the company is to meet up the requirement and the market needs of the airline company and the customers of the aircraft maker.

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