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THE AIRBORNE INTERNET TECHNOLOGY USING HALO

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ABSTRACT

The word on just about every Internet user's lips these days is "broadband." We have so much more data to send and download today, including audio files, video files and photos, that it's clogging our wimpy modems. Many Internet users are switching to cable modems and digital subscriber lines (DSLs) to increase their bandwidth. There's also a new type of service being developed that will take broadband into the air. In this paper, we'll learn about the future of the Airborne Internet. We'll take a look at the networks in development, the aircraft and how consumers may use this technology. 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 airborne Internet will function much like satellite-based Internet access, but without the time delay. 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. This paper addresses some of the trends and issues involved in developing an Airborne Internet capable of achieving this goal. Understanding relationships between these trends and issues and the objectives and functional requirements of the program will allow various participants in this complex program to keep activities in proper perspective. The all-round development and improvement are the key areas of research work performed in this paper.

Key Words – Airborne, Broadband, HALO.

1. INTRODUCTION

Airborne Internet is a private, secure and reliable peer-to-peer aircraft communications network that uses the same technology as the commercial Internet. It is an implementation which connects aircraft to a ground-based Internet access node, including the information which is passed across this communication link. It provides airborne access to wealth of Internet information and resources. It is convenient and has several uses like flight planning, en route reservations, travel arrangements. It is useful in providing the information about weather, surrounding airspace environment and for aircraft-to-aircraft communications. The security applications include flight tracking/deviation monitoring, in-flight video monitoring, cockpit voice/video recording. This Airborne Internet (A.I.) is an approach to provide a general purpose, multi-application data channel to aviation. In doing so, A.I. has the potential to provide significant cost savings for aircraft operators as it allows the consolidation of many functions into a common data channel. A primary application for A.I. is to track aircraft for the air traffic control system. Many other applications can utilize the same A.I. data channel. The applications available are only limited by the bandwidth available. A.I. began as a supporting technology for NASA’s Small Aircraft Transportation System (SATS). But there is no reason that A.I. should be limited to SATS-class aircraft. All of aviation, and even transportation, has the potential to benefit from A.I. The principle behind the A.I. is to establish a robust, reliable, and available digital data channel to aircraft. How does satellite Internet operate .How do you access the Internet other than dial-up if you live too far from a phone company office for DSL and there is no cable TV on your street? Satellite Internet access may be worth considering. It's ideal for rural Internet users who want broadband access. Satellite Internet does not use telephone lines or cable systems, but instead uses a satellite dish for two-way (upload and download) data communications. Upload speed is about one-tenth of the 500 kbps download speed. Cable and DSL have higher download speeds, but satellite systems are about 10 times faster than a normal modem. Firms that offer or plan to offer two-way satellite Internet include StarBand, Pegasus Express, Teledesic and Tachyon. Tachyon service is available today in the United States, Western Europe and Mexico. Pegasus Express is the two-way version of Direc PC.

Two-way satellite Internet consists of

- Approximately a two-foot by three-foot dish
- Two modems (uplink and downlink)
- Coaxial cables between dish and modem

The key installation planning requirement is a clear view to the south, since the orbiting satellites are over the equator area. And, like satellite TV, trees and heavy rains can affect reception of the Internet signals.

How the Airborne Internet Will Work- The word on just about every Internet user's lips these days is "broadband." We have so much more data to send and download today, including audio files, video files and photos, that it's

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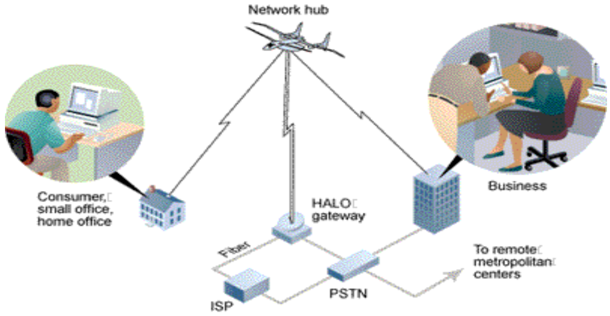

Fig 1. Photo courtesy Angel Technologies

This diagram shows how the HALO Network will enable a high-speed wireless Internet connection

At least three companies are planning to provide high-speed wireless Internet connection by placing aircraft in fixed patterns over hundreds of cities. Angel Technologies is planning an airborne Internet network, called High Altitude **Long Operation** (HALO), which would use lightweight planes to circle overhead and provide data delivery faster than a T1 line for businesses. Consumers would get a connection comparable to DSL. Also, Aero Vironment has teamed up with NASA on a solar-powered, unmanned plane that would work like the HALO network, and Sky Station International is planning a similar venture using blimps instead of planes. Now we'll look at the networks in development, the aircraft and how consumers may use this technology at their homes. The Net Takes Flight The computer most people use comes with a standard 56K modem, which means that in an ideal situation your computer would downstream at a rate of 56 kilobits per second. 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 your computer. 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. Several companies have already shown that satellite Internet access can work. The airborne Internet will function 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-Internet aircraft will circle overhead at an altitude of 52,000 to 69,000 feet (15,849 to 21,031 meters). At this altitude, the aircraft will be undisturbed by inclement weather and flying well above commercial air traffic. Networks using high-altitude aircraft will also have a cost advantage over satellites because the aircraft can be deployed easily -- they don't have to be launched 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 who 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 won't be completely wireless. There will be ground-based components to any type of airborne Internet network. The consumers will have to install an antenna on their home or business in order to receive signals from the network hub overhead. 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 are already set up. What the airborne Internet will do is provide an infrastructure that can reach areas that don't have broadband cables and wires.

Fig 2. Photo courtesy Angel Technologies

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Airborne-Internet systems will require that an antenna be attached to the side of your house or work place.

In the next three sections, we will take a look at the three aircraft that could be bringing you broadband Internet access from the sky.

Compare/Contrast to ground based internet

Attribute / Resource	Environment: Ground-Based	Environment: Airborne
Bandwidth	"unlimited" (Gbps)	highly restrictive (~kbps)
Communication Latency	"zero" (ms)	significant (tenths of seconds)
Computational Power	"unlimited" distributed, multi-processor, high-availability	limited avionics designed for aircraft specific uses

2. IMPLEMENTATION SYSTEMS

A HALO Overhead -The Angel Technologies is developing an air borne internet network through its HALO Network. The centerpiece of this network is the Proteus plane, which will carry wireless networking equipment into the air.

Photo courtesy Angel Technologies

The Proteus plane will carry the network hub for the HALO Network

The Proteus plane,developed by Scaled Composites is designed with long wings and the low wing loading needed for extended high-altitude flight. Wing loading is equal to the entire mass of the plane divided by its wing area. Proteus will fly at heights of 9.5 and 11.4 miles (15.3 and 18.3 km) and cover an area up to 75 miles (120.7 km) in diameter.

Proteus Aircraft	
Weight	9,000 pounds at takeoff 5,900 pounds empty
Wingspan	77 ft 7 inches (23.7 m) Expandable to 92 feet (28 m)
Length	56.3 ft (17.2 m)
Height	17.6 ft (5.4 m)
Engines	2 turbofan engines 2,300 pounds of thrust
Range	18 hours
Speed	65 knots (75 mph/120.7 kph) to 250 knots (288 mph/463.5 kph)

At the heart of Angel's Proteus plane is the one-ton airborne-network hub, which allows the plane to relay data signals from ground stations to workplaces and homes. The AI network hub consists of an antenna array and electronics for wireless communication. The antenna array creates hundreds of virtual cells, like mobile-phone cells, on the ground to serve thousands of users. An 18-foot dish underneath the plane is responsible for reflecting high-speed data signals from a ground station to your computer. Each city in the HALO Network will be allotted three piloted Proteus planes. Each plane will fly for eight hours before the next plane takes off and after takeoff it will climb to a safe altitude, above any bad weather or commercial traffic, and begin an 8-mile loop around the city. Floating On Air Sky Station International is counting on its blimps,in the race to deliver high-speed Internet access from high altitudes and calls them as lighter-than-air platforms, and plans to station these airships,one over each city. Each station would fly at an altitude of 13 miles (21 km) and provide wireless service to an area of approximately 7,500 square miles (19,000 square km).

Sky Station Blimp	
Diameter	203 ft (62 m)
Length	515 ft (157 m)
Width	approx. 300 ft (91 m)
Power	Solar and fuel cells

Each blimp will be equipped with a telecommunications payload to provide wireless broadband connections. The blimps will be able to carrying payloads of up to about 2,200 pounds (1,000 kg). Each blimp will have a life span of about five to 10 years. Sky Station says that its user terminals will enable broadband connections of between 2 and 10 megabits per second (Mbps). NASA’s Sub-space Plans: NASA is also playing a role in a potential airborne Internet system being developed by AeroVironment.

Fig 3 Photo courtesy NASA

The Helios aircraft will be equipped with telecommunications equipment and stay airborne for six months straight

Helios Aircraft	
Weight	2,048 pounds (929 kg)
Wingspan	247 ft (75.3 m)
Length	12 ft (3.7 m)
Wing Area	1,976 square ft (183.6 m^2)
Propulsion	14 brushless, 2-horsepower, direct-current electric motors
Range	1 to 3 hours in prototype tests 6 months when fully operational
Speed	19 to 25 mph (30.6 to 40.2 kph)

The Helios prototype is constructed out of materials such as carbon fiber, graphite epoxy, Kevlar and Styrofoam, covered with a thin, transparent skin. The main pole supporting the wing is made out of carbon fiber, and is thicker on the top than on the bottom in order to absorb the constant bending during flight. The wing's ribs are made of epoxy and carbon fiber. Styrofoam comprises the wing's front edge, and a clear, plastic film is wrapped around the entire wing body. The all-wing plane is divided into six sections, each 41 ft (12.5 m) long. A pod carrying the landing gear is attached under the wing portion of each section. These pods also house the batteries, flight-control computers and data instrumentation. Network hubs for AeroVironment's telecommunications system would likely be placed here as well.

It seems that airborne Internet could take off in the very near future. If and when those planes and blimps start circling to supplement our current modes of connection, downloading the massive files we've come to crave for entertainment or depend on for business purposes will be a snap -- even if we live somewhere in that "last mile."

Why all this detail?

The rather lengthy and detailed explanation just provided is to illustrate how the use of IP can very dependably be relied on to deliver network communications. Aircraft use of communication and navigation information must be nearly real time, highly dependable and it must have backup redundancy. IP has inherent redundancy in its digital delivery system, making it an excellent candidate for aircraft use. The reason IP has never been used in an aircraft context before is because until now there has not been a method proposed to keep the aircraft connected to the network, so that the IP connection is never lost. Now it is appropriate to examine how aircraft currently operate so we can draw both analogy and cite the differences between present day aircraft “networks” and an IP based aviation network (Airborne Internet). Roadmap of future activities We intend to continue applying the methodology defined above to develop Airborne Internet alternatives, analyze the advantages and disadvantages of each alternative and arrive at a recommendation. Then, working with other SATS organizations we will refine the architecture and document it for use by system developers. Key elements of the architecture will be prototyped and evaluated to better understand their applicability to SATS. Estimates of performance and cost will be made. A separate security assessment will be produced.

3. CONCLUSION

Thus this airborne internet technology has a wide range of utilities in the field of aviation services like aircraft monitoring and air traffic management, weather information etc., and also provides an opportunity for the passengers to access the internet at very high altitudes that is, in the aeroplanes and other conventional services. Thus it is a further new trend in this mobile world which is establishing the connectivity by building network in the air.

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