High Altitude Aeronautical Platform Stations

A

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In

" Electronics and Communication Engineering" By

Anukalp Kumar

(Roll No. 2020041039)

to

Dr. Gagandeep Bharti

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Department of Electronics and Communication Engineering

MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY

GORAKHPUR-273010

Department of Electronics and Communication Engineering

MADAN MOHAN MALAVIYA UNIVERSITY OF TECHNOLOGY, Gorakhpur-273010

CERTIFICATE

This is to certify that the report work entitled " High Altitude Aeronautical Platform Stations" submitted in partial fulfillment in the requirement of the degree of Bachelor of Technology in " Electronics and Communication Engineering" , is a bonafide seminar work carried out by **Mr. Anukalp Kumar** under my supervision and guidance.

Date: ____________

Dr. Gagandeep Bharti
Electronics and Communication Engineering Department
M.M.M.U.T. Gorakhpur

CONTENT

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DATE: ____________

PLACE: ____________

Anukalp Kumar

ABSTRACT

Today's global communications infrastructures of landlines, cellular towers, and satellites are inadequately equipped to support the increasing worldwide demand for faster, better, and less expensive service. At a time when conventional ground and satellite systems are facing increasing obstaclesand spiraling costs, a low-cost solution is being advocated.

This seminar focuses on airborne platforms- airships, planes, helicopters or some hybrid solutions which could operate at stratospheric altitudes for significant periods of time, be low cost and be capable of carrying sizable multipurpose communications payloads. The airborne-internet aircraft will circle overhead at an altitude of 52,000 to 69,000 feet (15,849 to 21,031meters). At this altitude, the aircraft will be undisturbed by inclement weather and flying well above commercial air traffic.

List Of Figures

1. INTRODUCTION

2. HIGH ALTITUDE AERONAUTICAL PLATFORMS (HAAPS)

High Altitude Aeronautical Platform Stations (HAAPS) is the name of a technology for providing wireless narrowband and broadband telecommunication services as well as broadcasting services with either airships or aircrafts. The HAAPS are operating at altitudes between 3 to 22 km.A HAAPS shall be able to cover a service area of up to 1'000 km diameter, depending on the minimum elevation angle accepted from the user's location. The platforms may be airplanes or airships (essentially balloons) and may be manned or un-manned with autonomous operation coupled with remote controlfrom the ground. HAAPS mean a solar- powered and unmanned airplane or airship, capable of long endurance on-station – possibly several years.

A high- altitude telecommunication system comprises an airborneplatform –

typically at high atmospheric or stratospheric altitudes – with a telecommunications payload, and associated ground station telecommunications equipment. The combination of altitude, payload capability, and power supply capability makes it ideal to serve new and metropolitan areas with advanced telecommunications services such as broadband access and regional broadcasting. The opportunities for applications are virtually unlimited. The possibilities range from narrowband services such as paging and mobile voice to interactive broadband services such as multimedia and video conferencing. For future telecommunications operators such a platform could provide blanket coverage from day one with the added advantage of not being limited

1.2 GENERAL ARCHITECTURE

A typical HAAP-based communications systems structure is shown.

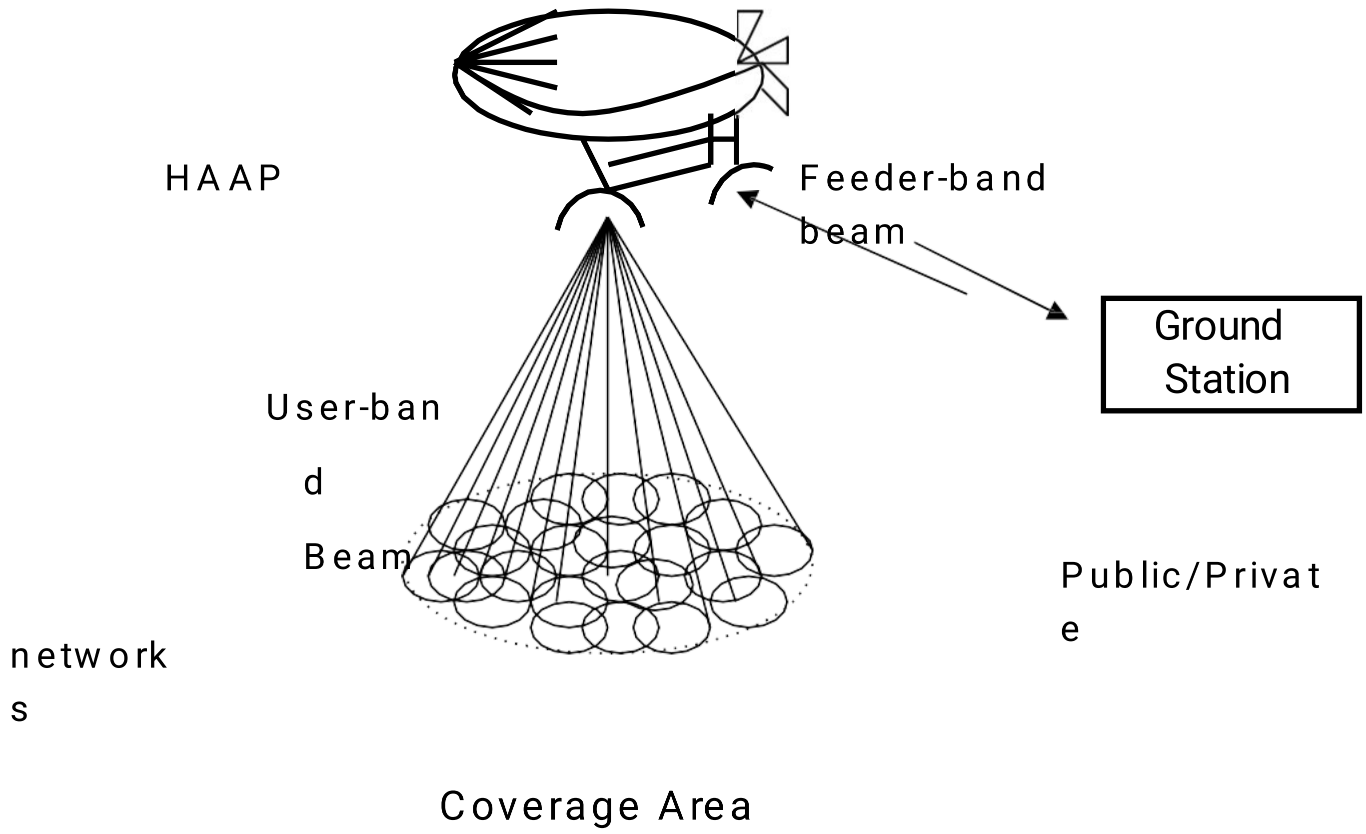

Fig.1 GENERAL ARCHITECTURE

The platform is positioned above the coverage area. There are basically two types of HAAPS.

Lighter-than air HAAPS are kept stationary, whileairplane-based HAAPS are flown in a tight circle. For broadcast applications, asimple antenna beams signals to terminals on the ground. For individualized communication, such as telephony, "cells" are created on the ground by some beam forming technique in order to reuse channels for spatially separated users, as is done in cellular service. Beam forming can be as sophisticated as the use of phased-array antennas, or as straightforward as the use of lightweight, possible inflatable parabolic dishes with mechanical steering. In the case of a moving HAAP it would also be necessary to compensate motion by electronic or mechanical means in order to keep the cells stationary or to "hand off" connections between cells as is done in cellular telephony.

2.0 HALO NETWORK CONCEPTS

2.1. BASIC CONCEPTS:

High-Altitude Long Operation (HALO) aircraft present a *new layer* inthe hierarchy

of wireless communications -- a 10-mile-tall tower in the stratosphere above rain showers and below meteor showers (i.e., high above terrestrial towers and well below satellite constellations).

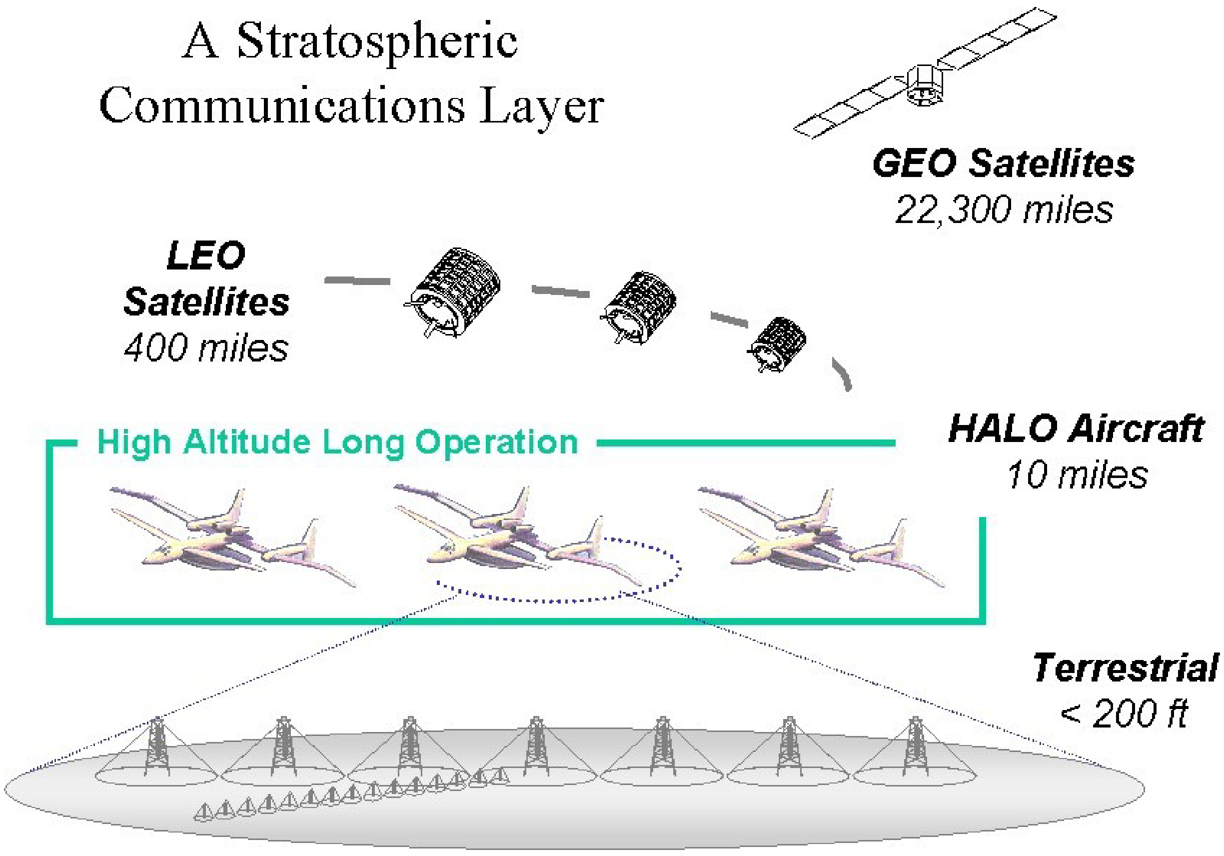

Fig.2 HALO NETWORK

HALO airplane will be the central node of a wireless broadband communications network. The HALO Network, whose initial capacity will be on the scale of 10 Gbps, with a growth potential beyond 100 Gbps. The packet-switched network will be designed to offer bit rates to each subscriber in the multimegabit-per-second range.

The airplane's fuselage can house switching circuitry and fast digital network functions. A MMW antenna array and its related components will be located in a pod suspended below the aircraft fuselage. The antenna array will produce many beams -- typically, more than 100. Broadband channels tosubscribers in adjacent beams will be separated in frequency. For the case of aircraft-fixed beams, the beams will traverse over a user location, while the airplane maintains stationary overhead, and the virtual path will be changed to accomplish the beam- to-beam handoff. The aircraft will fly above commercial airline traffic, at altitudes higher than 51,000 feet. For each city to be served, a fleet of three aircraft will be operated in shifts to achieve around-the-clock service. Flight operational tactics will be steadily evolved to achieve highavailability of the node in the stratosphere.

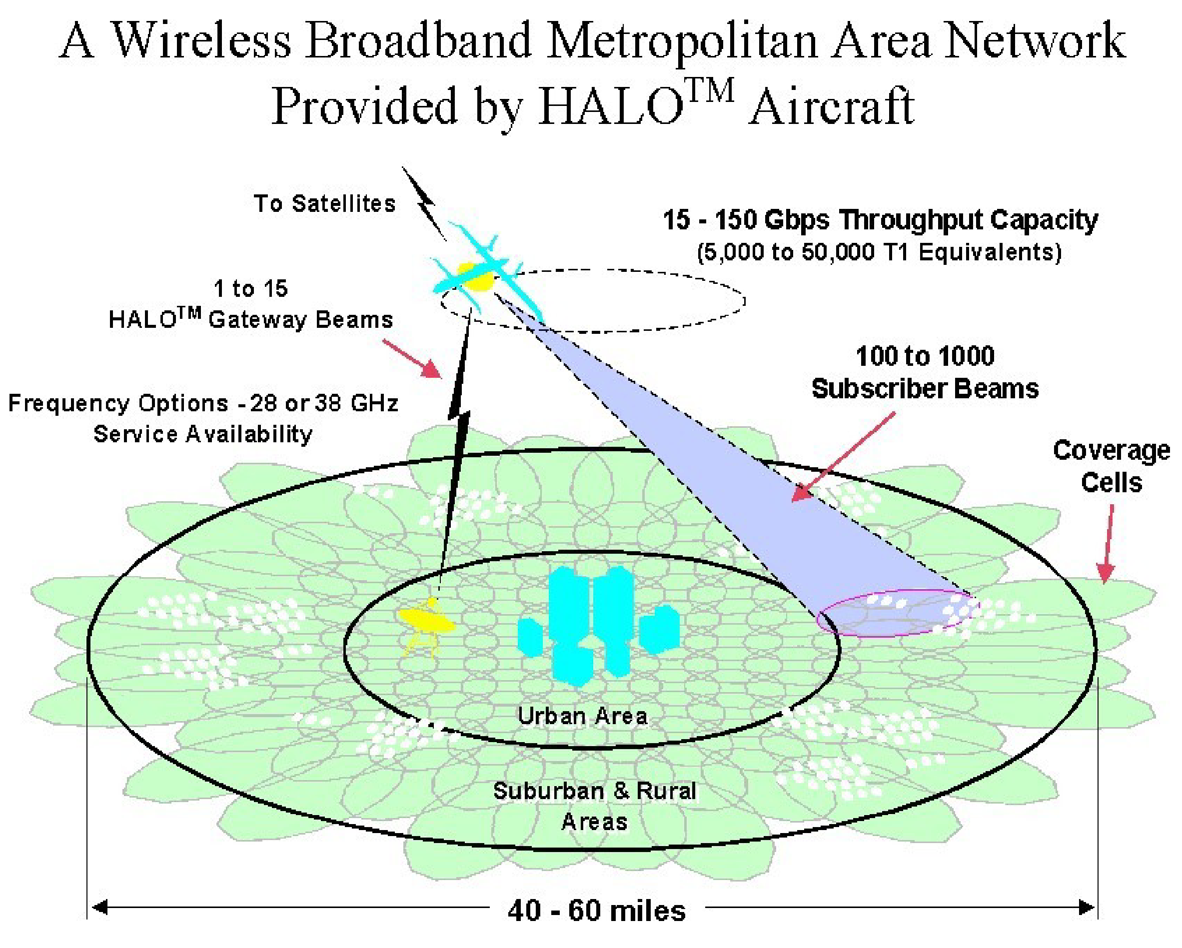

Fig.3 The *High-Altitude Long Operation* (HALO) Network is a broadbandwireless metropolitan area network (MAN) consisting of HALO aircraft.

operating at high altitude and carrying an airborne communications networkhub and network elements on the ground.

The HALO Network combines the advantages of two well-established wireless communication services: satellite networks and terrestrial wirelessnetworks like cellular and personal communication systems. Satellite networks was deployed at low earth orbit (LEO), medium earth orbit (MEO), highelliptic orbit (HEO), and geosynchronous earth orbit (GEO)

. Their disadvantages include expensive high-power user terminals, long propagation delays.

Also, system capacity will be practically fixed and can be increased incrementally only by adding satellites. In contrast, terrestrial wireless networks have advantages such as low-cost, low-power user terminals, short propagation delays, and good scalability of system capacity. However, their disadvantages include low look angles and complex infrastructures. They require many base stations that must be interlinked over cables or microwave links. They often require significant reengineering to increase capacity when using cell-splitting techniques.

The HALO network will be located in the atmosphere, at an altitude of15 miles above terrestrial wireless, but hundreds to thousands of miles below satellite networks. It will

provide broadband services to businesses and small offices/home offices in an area containing a typical large city and its neighboring towns. To each end user it will offer an unobstructed line of sight and a free-space-like channel with short propagation delay, and it will allow the

use of low-power low-cost user terminals. The HALO network infrastructure is simple, with a single central hub. Consequently, thedeployment of service to the entire metropolitan area can occur on the first day the network is deployed; and the subsequent maintenance cost is expected to below. The system capacity can be increased by decreasing the size of beam

spots on the ground while increasing the number of beams within the signal footprint, or by increasing the signal bandwidth per beam. The HALO network can interface to existing networks. It can operate as a backbone to connect physically separated LANs through frame relay adaptation or directly through LAN bridges and routers.

The HALO Network will be able to offer wireless broadband communications services to a "super metropolitan area," an area encompassing a typical large city and its surrounding communities. The aircraft will carry the "hub" of the network from which we will serve tens to hundreds of thousandsof subscribers on the ground. Each subscriber will be able to communicate at multi-megabit per second bit rates through a simple-to-install user terminal.The HALO Network will be evolved at a pace with the emergence globally of key technologies from the data communications, millimeter wave RF, andnetwork equipment fields.

The HALO aircraft will be operated in shifts from regional airports. While on the ground, the network equipment aboard the aircraft will be assessed, maintained and upgraded on a routine basis to ensure optimal performance. The HALO/Proteus airplane has been specially designed
to carry the hub of the HALO Network. In the stratosphere, the airplane can carry a weight of approximately one ton. The airplane is essentially an equipment bus from which
commercial wireless services will be offered. A fleet of three aircraft will be cycled in shifts to achieve continuous service. Each shift on station will have an average duration of approximately eight hours. The HALO/Proteus airplane will maintain station at an altitude above 51 Kft in a volume of airspace. The look angle, defined to be the angle subtended between the local horizon and the airplane with the user terminal at the vertex; will be greater than a minimum value of 20 degrees. (The minimum look angle (MLA)for a given user terminal along the perimeter of the service footprint is defined to occur whenever the airplane achieves the longest slant range from that terminal while flying within the designated airspace.) Under these assumptions, the Many types of organizations -- schools, hospitals, doctors' offices, and small to medium-size businesses -- around the world will benefit from the low pricing of broadband services provided by the HALO Network. Standard broadband protocols such as ATM and SONET will be adopted to interface the HALO Network as seamlessly as possible. The gateway to the HALO Network will provide access to the *Public Switched Telephone Network* (PSTN) and to the Internet backbone for such services as the World Wide Web and electronic commerce. The gateway will provide to information content providers a network-wide access to a large population of subscribers

2.2 DESIRABLE FEATURES

Some desirable features of the HALO Network include the following:

●Seamless ubiquitous multimedia services

●Adaptation to end-user environments

●Rapidly deployable to sites of opportunity

●Bandwidth on demand for efficient use of available spectrum

Signal footprint will cover an area of approximately 2,000 to 3,000 square miles, large enough to encompass a typical city and its neighboring communities. Such a high value for the MLA was chosen toensure a line-of-sight connection to nearly every rooftop in the signal footprint and to ensure high availability during heavy rainfall.

By selecting MMW frequencies, a broadband network of high capacity can be realized. The airborne antenna array can be configured to project a pattern of many cells numbering from 100 to more than 1,000. Each cell on theground will cover an area of a few square miles
to several tens of square miles.

3.SERVICE ATTRIBUTES

Various classes of service can be provided to subscribers sharing the bandwidth of a given
beam, for example, 1 to 10 Mbps peak data rates to smallbusinesses, and 10 to 25 Mbps peak data rates to business users with larger bandwidth appetites. Because each link can be serviced according to"bandwidth on demand," the bandwidth available in a beam can be
shared between sessions concurrently active within that beam. While the average data rate may be low for a given user, the instantaneous rate can be grown to a specified upper bound according to demand. A dedicated beam service can alsobe provided to those subscribers requiring 25-155 Mbps.

4.HALO Network architecture

As the HALO/Proteus aircraft serves as the hub of the wireless broadband communications network. It carries the airborne network elements including an ATM switch, spot beam antennas, and multibeam antennas, as well as transmitting and receiving electronics. The antenna array providescellular-like coverage of a large metropolitan area. A variety of spectrumallocations could be utilized by a HALO network. The following two spectrum allocations as examples for creating a high-capacity HALO network offering wireless broadband services:

1. Local multimegabit data service (LMDS) at 28 GHz
2. The microwave point-to-point allocation at 38 GHz the antenna ray produces beams on the ground of two lines.
3. The shared beam provides services to 100– 1000 subscribers.
4. The dedicated beam provides a connection to a gateway serving high-bandwidth

   users, or to the network gateway through which a user froma non-HALO network can

   access the services of, and exchange information with, any end user of the

   HALO Network.

The HALO network utilizes multiple beams on the ground arranged in a typical cellular pattern. Each beam spot in the pattern functions as a single cell.Each cell covers more than several square miles of area. Adjacent cells have different frequency sub bands. The pattern has a periodic nature and each sub band in the set so chosen (i.e., each sub band of the frequency reuse plan) is used multiple times within the service area. Through frequency reuse, about 2800 mi^2 of area can be covered. The total capacity achieved by only one platform can be in the range of 10– 100 Gb/s.

The cells created by the antenna array would be fixed on the ground, and there would be no overlapping area between adjacent cells. The cellular pattern would cover a metropolitan-scale area. The altitude of aircraft would be 16 km.

It would have an orbit diameter of 14.8 km (ring 3 level). By assuming a constant ground speed, the orbit would have a period of approximately 6 min.

Each cell on the ground is covered by one spot beam. However, the spotbeam that covers a particular cell change due to the motion of the aircraft. A given beam covers a given cell on the ground for a duration of time called *dwell time*. Once the duration is exceeded, the beam must ratchet over by oneor more beams to cover a new cell on the ground. The ratcheting actionrequires a burst modem in the user terminal and the use of electronically stabilized beams aboard the airplane.

2.5 Subscriber units (user terminals)

The user terminal entails three major sub-groups of hardware: the radio frequency unit (RU), which contains the MMW Antenna and MMW Transceiver, the Network Interface Unit (NIU), and the application terminals such as PCs, telephones, video servers, video terminals, etc. The RU consists of a small dual-feed antenna and MMW transmitter and receiver mounted tothe antenna. An antenna tracking unit uses a pilot tone transmitted from the HALO aircraft to point its antenna at the airplane.

1. Implementation and Requirements

2. ONBOARD EQUIPMENT

Depending on the application, HAAP-based communications system could be implemented in many ways. A typical design will seek high reliability, low power consumption and minimum weight and size for theonboard portion of the system. That would lead to an architecture which placesmost of the system on the ground by limiting airborne components to a multichannel transponder, user-beam and feeder-beam antennas and associated antenna interfaces.

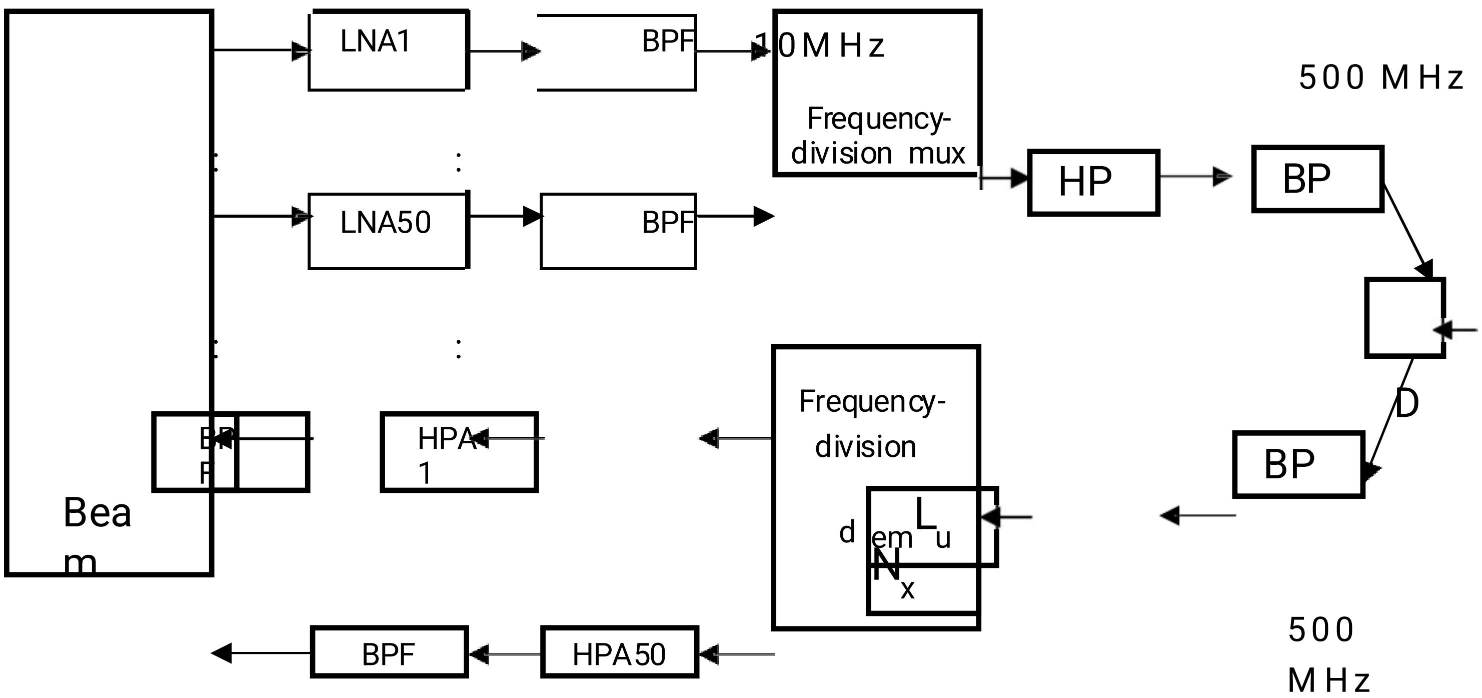

Fig.4 10 MHz Single- beam antenna (to ground station)Multibeam antenna (to users)

The figure shows a code-division multiple access (CDMA) system built around a standard satellite-like transponder bandwidth of 500 MHz The transponder bandwidth can accommodate up to 50 antenna beams with 8spread spectrum carriers/beam (assuming 1.25 MHz bandwidth). Carrier signals coming from a ground cell (i.e., from a particular beam) and received bythe onboard antenna are first amplified in low-noise amplifiers (LNAs). They are then limited to the standard 10MHz bandwidth by band-pass filters (BPFs),and frequency division multiplexed. Before transmitting to the ground station, multiplexed signals are amplified in the high-power amplifier (HPA), BPFed tothe transponder bandwidth and passed through the diplexer (D). Signal path in the opposite direction is similar and includes an additional demultiplexing stage. If commercial off-the-shelf equipment is to be used onboard, it will haveto be placed in a chamber with climate and air-pressure control to prevent freezing, overheating due to reduced heat convection) and dielectric breakdown.

3.2 GROUND INSTALLATIONS

Communications between the HAAP and the ground would typically be concentrated into a
single ground installation or perhaps into two locations for redundancy. There would be considerable advantage to collocating RF units, base stations and mobile switching centers (MSCs).

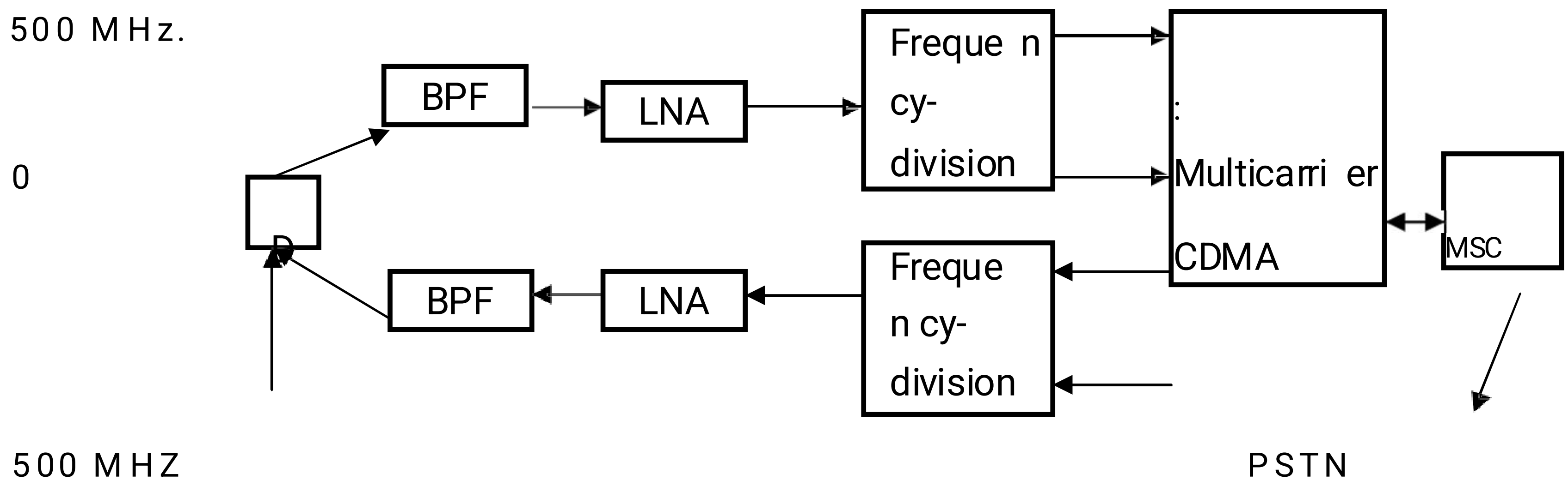

Fig.5 Single-beam antenna (to airborne platform)

The ground system in figure corresponds to the onboard equipment from the previous figure. Carrier signals coming from the air-borne station arefiltered by a BPF, amplified in LNAs, demultiplexed in the demux and passed to the CDMA base stations. In this case the base station consists only of a radiochannel frame, since there is no need for power- amplifier and antenna- interface frames for every base station; a common wide band power amplifier and an antenna will serve all the collocated base stations. From the basestations, the signals are passed in the usual manner to the mobile MSC and public switched telephone network (PSTN). The return signal path towards the airborne station is similar except for the inverse multiplexing operation in the MUX and high-power amplification by HPA.

3.3 POWER SYSTEM & MISSON REQUIREMENTS

Various power system components and mission requirements affect the sizing of a solar powered long endurance aircraft. The aircraft power system consists of photovoltaic cells and a regenerative fuel cell. For the power system, the greatest benefit can be gained by increasing the fuel cell specific energy. Mission requirements also substantially affect the aircraft size. By limiting the time of year, the aircraft is required to fly at high northern or southern latitudes a significant reduction in aircraft size or increase in payload capacity can be achieved.

Due to the high altitude at which these aircraft will be required to fly (20 km or higher) and the required endurance (from a few weeks to a year) the method of propulsion is the major design factor in the ability to construct the aircraft. One method of supplying power for

this type of aircraft is to use solar photovoltaic (PV) cells coupled with a regenerative fuel

cell. The main advantages to this method over others such as open cycle combustion engines or air breathing fuel cells is that it eliminates the need to carry fuel and to extract and compress air at altitude which can be a significant problem both in gathering the required volume of air and in rejecting the heat of compression.

In order for a solar powered aircraft to be capable of continuous flight, enough energy must be collected and stored during the day to both power the aircraft and to enable the aircraft to fly throughout the night. The propulsion system consists of an electric motor, gear box and propeller. As the efficiency increases, the corresponding reduction in aircraft size decreases. Fuel cellperformance has a significant impact on size and performance of a solar powered aircraft. There are modest size reductions with increasing fuel cell efficiency; however, the size reductions which are gained by an increase in the specific energy of the fuel cell are substantial.

Aircraft size increases significantly with increasing altitude. Thespecified time of year (date) and latitude determines the charge/discharge period for the energy storage system as well as the amount of total solar energyavailable. The winter solstice, December 22, is the

date with the longest discharge period and smallest amount of available solar energy. This

date was chosen as the baseline because it is the time of lowest daily average solar flux in the northern hemisphere and therefore represents a worst-case situation. Any aircraft power system and mission configuration which is feasible at this date would be capable of operating throughout the year. However, by varying the required latitude throughout the year, aircraft size can be reduced.

Payload and payload power required also has an effect on the aircraft size. Mission requirements will mostly determine the amount and type ofpayload. In most situations lightweight, low power instruments, similar tosatellite equipment, will need to be used. If very light weight amorphous silicon arrays or any thin film array of similar performance can be mass produced, they would have significant advantages over individual-celled rigid arrays. The main advantage would be their incorporation onto the wings of the aircraft. Since they are flexible and can be made in large sheets they can conform to the shape of the wing. This allows for fairly easy installation directly over the wing surface. Also, there would be no need

to wire each individual cell together as is necessary with individual rigid cells. In order to make the commercial construction and maintenance of this type of aircraft practical, light weight, flexible PV arrays will need to be used.

1. VARIOUS HAAPS PROJECTS

HAPS have been proposed using both airship technology and highaltitude aircraft.

1. Airship Technologies

The idea is to keep unmanned Zeppelin-like balloons geostationary at an altitude of 3 km to 22km.Each HAPS shall provide mobile and fixed telecommunication services to an area of about 50 km to 1'000 km diameter, depending on the minimum elevation angle accepted from the user's location. To provide sufficient capacity in such large areas, spot beams have to be foreseen. One of the main challenges is to keep the platforms stationary. Windsof up to 55 m/s can occur at these altitudes.

4.1.1. Sky Sta

Sky Station is th system planned by the US company " Sky

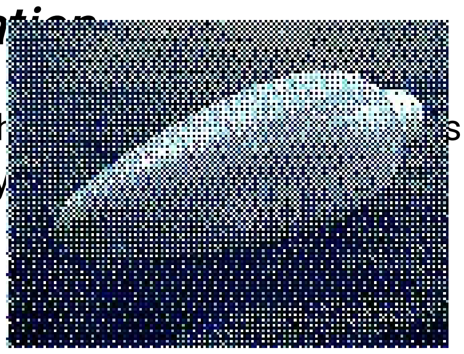

Fig.6 Sky Station

Station International" . The number of platforms will depend on the demand (250 platforms are announced). The balloons will be covered with solar cells, giving energy to the electrical motors. The data rates foreseen for the fixed services are 2 Mbps for the uplink and 10 Mbps for the downlink. The data rates foreseen for the mobile services are 9.6 - 16 kbps for voice and 384 kbps for data.

4.1.2. StratSat

StratSat is an airship system planned by the UK based company " Advanced Technology Group (ATG)" . With both civilian and military applications, the StratSat cost effective and safe solution for geo-stationary telecommunications payloads above large customer concentrations. The airship in the stratosphere is well above conventional air traffic and presents no threat. Its cheap launch

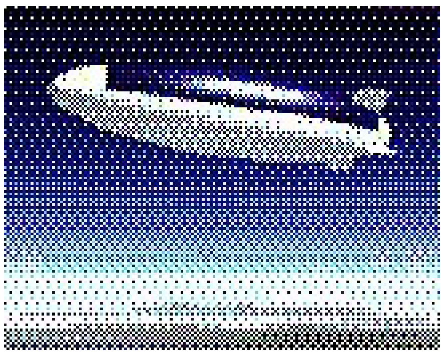

Fig.7 StratSat

costs, compared to the conventional satellites allows those in the industry to talk of reducing the cost of calls from a mobile telephone, by an order of magnitude, thereby capturing a high proportion of the market.

The solar array provides the sole source of renewable energy for the airship. The array is placed over the upper quarter of the hull and extends over approximately three-quarters of the length of the craft.

2. Aircraft Technologies

Although the commercial applications are only starting now to appear, the topic of communication using an aircraft is not new. Airplanes have been used to broadcast TV over Vietnam from 1966 to 1972. High Altitude Aircraftswill operate at an altitude of 16 km to 19 km, high above commercial airline traffic and adverse weather.

1. HALO-Proteus

Angel Technology Corporation (USA) offers broadband telecommunication service using manned aircraft. A piloted, FAA-certified High Altitude Long Operation (HALO) aircraft will provide the " hub " of the network. Operating continuously over each market in three eight hours shifts.

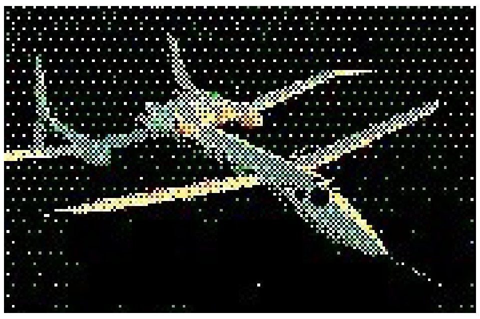

Fig.8 HALO-Proteus

Consumers will be able to access video, data, and the Internet at rates ranging from 1 to 5 Mbps. The technologies of high-altitude manned aircraft are mature. A broadband wireless link at 52 Mbps has been demonstrated in August 1998.

4.2.2. Sky Tower

Through funding support from NASA, AeroVironment has developed an unmanned, solar- electric airplane called Helios which will be capable of continuous flight for up to six months or more at 60'000 feet in the stratosphere, above the weather and commercial air traffic Helios will providea telecommunications platform from this position in the stratosphere, acting as an 11-mile-tall tower— hence the name " Sky Tower" ...

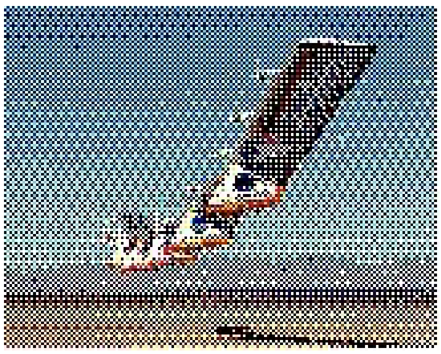

Fig.9 Sky Tower

Sky Tower' s stratospheric commu nications networks are comprised of airborne segments (or payloads) which communicate with user terminals and gateway stations on the ground. The ground gateway stations will serve as an intermediate interface between the aircraft and existing Internet and PSTN connecting systems. When a signal passes from the end users up to the airplaneand then from the airplane to the ground gateway antenna, a ground switching router will determine whether the data should be directed to the Internet, a private data network, or the telephone network. These interactive networksystems are being designed to maximize the overall throughput of the network. Fixed wireless broadband total throughput is projected to be approximately 10 to 20 Gbps per platform with typical user transmission speeds of 1.5 Mbps or higher (125 Mbps is feasible for a single user).

5.0 APPLICATIONS

The large coverage area of a HAAP would tend to give it an advantage intwo types of applications. One is where many widely separated customers receive the same communication as in entertainment broadcasting. HAAP technology might be able to achieve many of the benefits of the GEO-based Direct Broadcast Satellite without having to transmit quite so homogeneously over so large an area. Unlike GEO-based technology, upstream channels are also possible in HAAPs which would enable interactive TV and Internet access capabilities.

The other type of application in which a HAAP’s large coverage area ought to be advantageous is in telecommunications for areas having a low density of customers, especially when prospective customer’s specific geographic locations are unknown. The cost per customer of installing fixed facilities such as wire increases with decreasing customer density. Even thoughcellular, PCS and wireless systems do not depend on traffic density, cost per subscriber rises when the traffic density gets so low that many underutilized base stations have to be installed to achieve geographic coverage. Here both satellites and HAAPs come into play. Even though satellites are more advantageous at times, HAAPs provide a large coverage area along with indoorsignal penetration. HAAP at the same time uses much of the same equipment as terrestrial systems. A single HAAP’s coverage area of 100 km would covera metropolitan city and, in such cases, it is used to support commercial services and advertising with lesser time and investment. HAAPs would eliminate high visible antenna towers that sometimes cause public resistance to terrestrial systems. HAAPs give better signal quality

Traditional arrangement of cells in a hexagonal pattern covering the plane is how wireless coverage is provided in terrestrial systems. But when coverage is established from an antenna mount on a circling plane or an airshiprotating around its central axis due to stratospheric winds, the “ natural” cell shape is a geometric pattern invariant to such platform movements. Suchcoverage is made up of a set of concentric rings. This arrangement is possible since cell shapes and their relative positions are of no consequence to the operations of a cellular system and have certain advantages over traditional pattern. Here each cell has just one or two neighbors which simplify hand off algorithms.

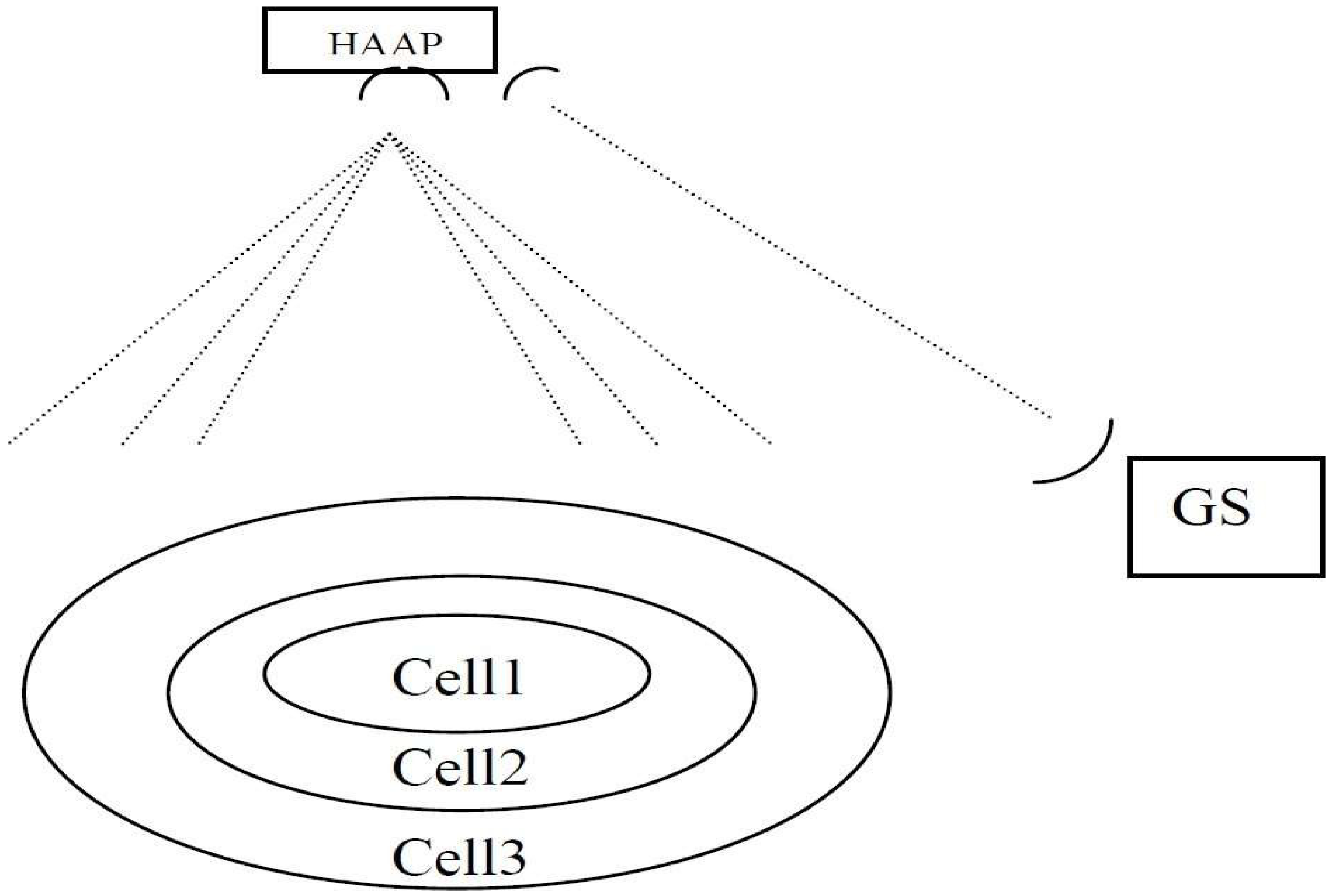

Fig.10 Traditional arrangement of cells

The HAAP takes advantage of the “ smart antenna” systems. Compared to the terrestrial system in which sectorized antennas sent and receive radio waves traveling along the ground, the HAAPs favorable “ look angle” means that its energy can be readily focused onto a confined area.

Depending on the application, the beam can visit a particular cell at regular or irregular intervals. Regular visits are suitable for real time applications and services to meet quality-of-service criteria like delay anddelay variance. Random timed between visits can be used in non-time-critical applications such as internet access.

Stratospheric radio-relay maritime communications system: -

Providing high quality telecommunications services including voice and data transmissions for maritime vessels crossing world oceans is one of the most complex problems in telecommunication engg. Now, only GEO satellite system provide multichannel, long distance, reliable maritime commercial communication services. But due to bulky size of maritime satellite user terminals, satellite-based service is expensive. The HAAPs concept can solve this problem for many large world ocean shipping lanes. Chains of HAAPs positioned above these lanes would operate as stratospheric radio-relay links, terminated by coastal radio centers at each end of the transoceanic link. Operating frequencies for user, feeder and inter-HAAP links are in the bands commonly used in satellite systems. The system can provide multichannel, reliable, cost-efficient.

Maritime communication service, including voice, data, video, paging and broadcasting. Platforms can either be stationary or it may move at very low speeds along a race-like path with endpoints close to land-based gateways.

6.0 ADVANTAGES

HAAPs do not require any launch vehicle, they can move under their own power throughout the world or remain stationary, and they can be brought down to earth, refurbished and re- deployed. Once a platform is in position, it can immediately begin delivering service to its service area without the need todeploy a global infrastructure or constellation of platforms to operate. HAAPs can use conventional base station technology – the only difference is the antenna. Furthermore, customers will not have to use different handsets.

The relatively low altitudes enable the HAAPs systems to provide ahigher frequency reuse and thus higher capacity than satellite systems. The low launching costs and the possibility to repair the platforms gateway could leadto cheap wireless infrastructures per

subscriber. Joint venture companies and government authorities located in each country will

control the Sky Station platforms serving their region to ensure the best service offerings tailored tothe local market. Offerings can change as a region develops. Each platform canbe retrieved, updated, and re-launched without service interruption. Sky Stationplatforms are environmentally friendly. They are powered by solar technology and non-polluting fuel cells. The relatively low altitudes – compared to satellitesystems – provide subs cribers with short paths through the atmosphere and unobstructed line-of-sight to the platform. With small antennas and low power requirements, the HAAPs systems are suited for a wide variety of fixed and portable user terminals to meet almost any service needed. Since most communication equipment are located in the ground station, system administration will be easier than for typical dispersed terrestrial systems. The fixed location

7.0 HAAP ISSUES

In spite of many advantages there are many critical issues that the HAAPs technology is facing. The most critical issue is that- it still remains to be demonstrated that placing a platform at stratospheric altitude and "fixing" it reliably above the coverage area is possible and that it can be done in a cost- efficient, safe and sustained manner. It is still not proven that planes can fly at stratospheric altitudes for long stretches of time, that dirigibles can be stationedat stratospheric altitude, and that the position of weather balloons can becontrolled. Another critical issue is the presence of winds in the stratosphere. The average minimum stratospheric wind velocity is 30-40m/s and occurs between 65 000 and 75 000ft depending on latitude. Even though HAAPs are designed to withstand these winds it may not be able to withstand sudden wind gusts resulting in temporary or total loss of communication.

The technical problems are still substantial: All materials must be lightweight, resistant to radiance at high altitudes, and at least for airships leakproof for helium. The engines must be strong enough to keep the platforms stationary at winds of up to 55 m/s. Flying with solar power is a possible solution. Airships especially offer enough area on their envelope for the integration of solar cells. For long endurance missions only part of the collected irradiance is available for the direct propulsion. The rest has to be used to charge the energy storage for the night time. Sufficient energy has to beproduced and stored for the propulsion and the telecommunication. equipment.

8.0 CONCLUSION

HAAPS will provide wireless broadband communication services. HAAPS has several advantages over terrestrial wireless networks. The latter have complex geometries involving many base stations interlinked by cabling or microwaves. Moreover, each time cell splitting is used to increase system capacity, the network can demand significant reengineering. On the other hand,satellite networks require more expensive terminals with high power to achieve the same data rates possible through HAAPS. Also, the longer propagation delays demand more complex algorithms to achieve interactivity. The capacity of a satellite network can be increased, but at higher expense than the HAAPS, typically only by adding more satellites. And, like terrestrial networks, reengineering of the entire satellite network may be required. HAAPS have striking advantages over proposed large LEO(LOWER EARTH ORBIT) constellations, including ease of repair and rapidly evolving performance.

9.0 REFERENCES

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