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A BRIEF OVERVIEW ON HIGH ALTITUDE PLATFORMS(HAPs)

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ABSTRACT

High Altitude Platform Stations (HAPs) are communication facilities situated at an altitude of 17 to 30 km and at a specified fixed point relative to the Earth. They are mostly solar-powered, unmanned, and remotely operated. These platforms have the capability of carrying multipurpose communications relay payload, which could be in the form of full base station or, in some cases, a simple transponder as is being used in satellite communication systems. HAPs, when fully deployed will have the capability of providing services and applications ranging from broadband wireless access, navigation and positioning systems, remote sensing and weather observation/monitoring systems future generation mobile telephony, digital TV etc. HAPs are also known to be low cost when it comes to its implementation and are expected to be the next big provider of infrastructure for wireless communications. It is too hard to establish a Base station for particular small village for broadband communication or any wireless communication. Even it's too costly to launch a satellite for particular rural area However before, it is implemented different models has to be built to test its performance. Rainfall poses a serious issue to HAP since due to its position rainfall creates the maximum attenuation scenario.HAP provides facilities of wireless communications. HAPs have been proposed mobile services in stratosphere. It have advantages of both terrestrial as well as satellite. It also provides services like 3G, emergency services and Wi-MAX. HAP networks are provides different services like military application, earth monitoring, traffic monitoring and control. In terms of services, HAP offering low cost and high facility services

Keywords: Wireless communications, Base station, Propagation, High Altitude Platforms (HAPs).

I. INTRODUCTİON

Wireless communication has stood out as one of the fastest and rapidly growing segment of the communications industry with the ability to provide high speed, quality and real-time information exchange between portable devices globally. It is defined basically as information transfer over a distance (without the use of known electrical conductors or cables. It is convenient and often less expensive to deploy relative to the fixed network. This technology has in no little way improved the level and standard of our living in this modern age. Research has shown that the worldwide cellular and personal communication subscriber base went beyond half a billion users in the late 2001 and it's been projected to attain a 2 billion mark which is like 30% of the world population by the end 2008[3].

A very good example is the design of next generation cellular networks to facilitate high-speed data communications traffic in addition to voice calls. New technologies and standards are also being implemented to make wireless networks replace fiber optic and/or copper lines between fixed points that are several kilometers apart known as fixed wireless access. In many geographical areas, mobile telephones are the only economical way for providing phone service to subscribers. Base stations are erected quickly and with low cost compared to the cost involved when digging the ground to lay copper especially in some harsh terrain. Mobile telephones are only a small part of the cellular development; many new types of wireless devices are being introduced.

Presently, there can't be said to be a single cellular network. Devices support one or two of a countless number of technologies and generally work within the boundaries of a single operator's network. New standards for the next generation wireless devices are being developed, which will use higher frequencies to increase capacity and also help eradicate the problem of incompatibility issues, encountered presently.

The need to improve on the existing bandwidth available for mobile communication devices and application has made researchers and telecommunication experts delve into more technologies that can provides the needed bandwidth. There has been several works on improving the bandwidth provision from satellite and terrestrial communication [2]. While these are unfolding, there has been several other technologies been looked into that could possibly provide a better bandwidth as required by users of these mobile services. The advantages and disadvantages of terrestrial and satellite systems are well known and have been extensively documented in several works over the years [1]. The drawbacks, in particular, have made engineers continuously search for alternative means of making broadband fixed wireless access available to the ever-growing population of users worldwide

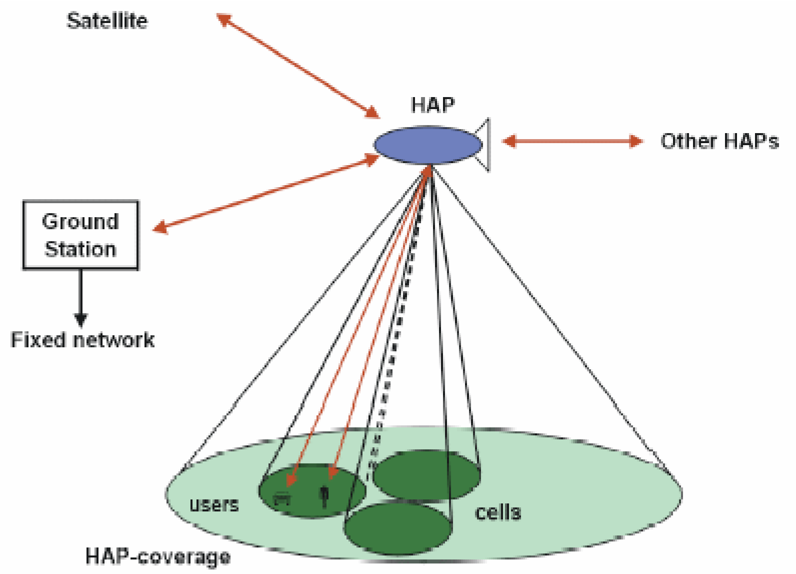

Fig.1 HAP coverage area

II. HIGH ALTITUDE PLATFORM STATIONS (HAPS)

HAPS are, generally, solar-powered, unmanned, remote-operated and electric motor-propelled aerial platforms held in stationary position, at altitudes between the 17 – 22 Km range above the earth's surface (stratospheric layer of the atmosphere) [7]. They are somewhat new and are being proposed as means of providing wireless multimedia communications infrastructure for both metropolitan and remote areas. These platforms carry multipurpose communications relay payload, which can range from a complete base station to just a simple transponder, like we have on most satellites. Due to an interest in aerial platforms and due to advancement in technology, which have yielded better and stronger materials, which are UV resistant and leak-proof to helium, these airships are making their way back to our world. HAP´s can be considered as being hybrid architecture; they have some zones in common with terrestrial communications, particularly Fixed Wireless Access, but are similar to satellites in terms of power constraints and general network architecture. In a mobile communication context is the fact it could replace or support the terrestrial network, avoiding problems with environmental impact and electromagnetic pollution. Platform design has several constraints related to the applications to achieve: power available for the payload, stability, and maximum transmit power of the transmitters, link availability and so on.

2.1 Aerial Platforms

The history of HAPS has brought about three distinguishable types of proposed aerial vehicles. These types of platforms can be balloons, aircrafts or airships. They are categorized depending on the way they are managed and maintained.

1. Unmanned Airships: these are mainly balloons and are semi-rigid or non-rigid huge and mainly solar powers balloons, which can be well over 100m in length and could carry a payload of about 800kg or more. This typed of aerial vehicle is aimed at staying up for a period of 5 years or more.

2. Solar-powered unmanned aircraft: These types of aerial vehicles are also known as High Altitude Long Endurance platforms (HALE Platforms) and they make use of Electric motors and propellers as propulsion while during the day, they get power supply from solar cells mounted on their wings and stabilizers which also charge the on-board fuel cells. There has not been an agreed span off light duration for this category of vehicles but proposals declare that they can stay aloft for six months or more.

3. Manned aircraft: this category of vehicles has average flight duration of some hours, which is mainly due to the fuel constraints and human factors

III. COMPARED WİTH TERRESTRİAL SERVİCES

1. HAP can provide multi-cellular services over a large area (390km)
2. Reduced cost, risk, and site acquisition problems
3. Environmental impact
4. Installation/ maintenance overhead
5. No need for local terrestrial backbone
6. Unobstructed line of sight paths
7. Large system capacity, through
8. Use of mm-bands
9. Flexible adaptive resource allocation
10. Rapid deployment

IV. COMPARED WITH SATELLITE SERVICES

1. Larger overall system capacity:
2. Small spot beams (cells) readily feasible without huge on-board antennas Close range/ low delay

3. Lower cost
4. No launch vehicle
5. Less demanding than space systems

V. HAP ARCHITECTURE

The figure2 depicts a general HAP Architecture and communication scenario. A single HAP with up- and downlinks to user terminals can be used to provide services along with a backhaul link if required. HAPs may also be interconnected in a network of HAPs and a satellite link may also provide direct connections from the HAP. Some researchers and authors have found out that HAPs could cover a whole country giving specific examples of 16 HAPs covering the whole of Japan with a minimum elevation angle of 10° and that 18 HAPs would cover the whole of Greece including all the Islands. The lower the minimum elevation angle of HAPs, the larger the coverage area enjoyed but this gives rise to a higher propagation or blocking loss at the edge of the servicing area. Practically for Broadband Wireless Access, a minimum elevation angle of 5° is expected but it is more commonly acceptable to have a minimum elevation angle of 15° to avoid or guard against excessive ground clutter problems. This implies that for example, a platform placed at an altitude of 20Km (HAPs altitude) will have a coverage of 200km approximately. However, ground stations that connect HAPs network with other terrestrial networks can be placed on roofs of buildings

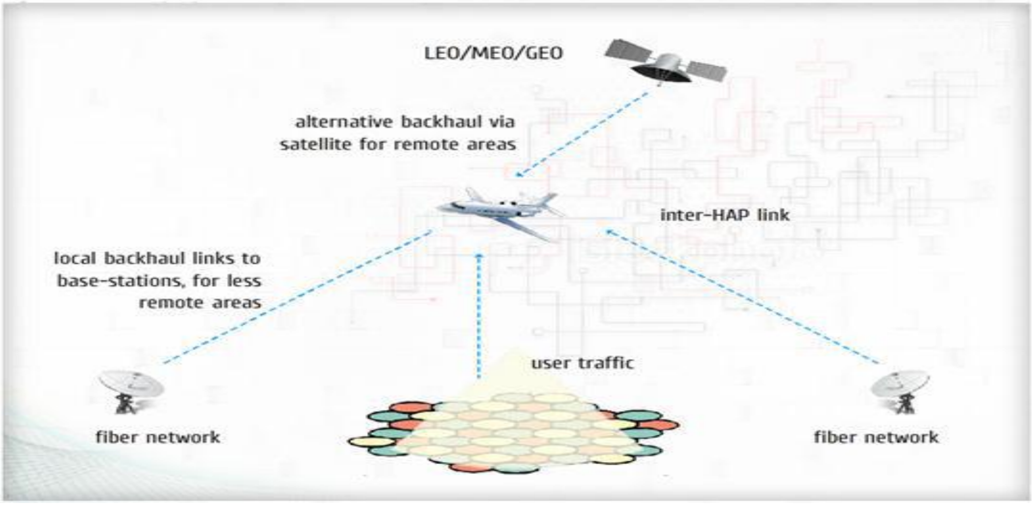

Fig.2 HAP architecture

VI. SERVİCES AND APPLİCATİONS

HAPs have an advantage over terrestrial networks in the area of multicasting where the many of the benefits of GEO satellites are provided in addition to uplink channels for interactive video and internet access. HAPs also serve well in areas with low population e.g. islands, oceans, developing towns, etc where the cost per subscriber in terrestrial systems will be too high for the low traffic densities because of the access points needed to cover these areas. Communication services provided by HAPs are broadly divided into low data rate services for mobile terminals and high data rate services for fixed terminals. Some of them are listed below; 17-22 km.

The main application for HAPs is the Broadband Fixed Wireless Access, which is capable of providing very high data rates to the user.

2. The use of 3G bands. Even the 2G services can be comfortably deployed via HAPs. One HAPs base-station fitted with a wide band width antenna or a number of directional antennae covering smaller cells can serve a very wide area.

3 Broadband Fixed Wireless Access Applications

4. Emergency and disaster scenarios

5. Military Communications

6. Earth monitoring and positioning

VII. ADVANTAGES OF HAPS

Replace Extensıve Ground Based Infrastructure

- 1 Hap Can Provıde Multı Cellular Servıces Over Large Areas
- We Do Not Need A Local Terrestrıal Backbone
- Backhaul Can Be Provıded To A Place Where Fıbre Optıcs Are Avaılable

Better Propacatıon In Many Scenarıos (Altıtude ~22 Km)

- Lıne Of Sıght Paths
- Raın May Affect The Hap Systems Less Than Terrestrıal Systems

Large System Capacıty

- Use Of Mm Bands (47/48 Ghz, 2x300 Mhz Bands)
- Frequency Re-Use
- Flexıble And Adaptıve Resource Allocatıon

VIII. ANTENNAS FOR HAPS

A very good performance factor for HAPS lies in the Antenna system. Researchers in HAPS systems have stated some required functions for a successful broadband HAP antenna and they are listed below:

1. Use of high radio frequency in order to secure a sufficient bandwidth.
2. Directional antenna with a high gain to cope with attenuation in high frequencies. It's been found out that co-channel cells are interference limited by antenna beam overlap. Minimization of interference can be attained by side lobe minimization. Beam forming can use either phased-array antennas or lightweight,
3. Multi beam antenna that accommodates 100 beams or more, both for transmission and reception, to cover views as wide as 120º or more from the stratosphere with a high gain and to achieve effective use of the frequencies involved.
4. Cancellation of the influences of altitude/position variations of the HAP on the footprint on the ground by means of beam control.
5. Reduced weight, size, and power consumption of the mission payload.
6. Must operate reliably in the stratospheric environment possible inflatable parabolic dishes with mchanical steering

CONCLUSION

HAPS, which is a rather developing, low-cost and efficient communication technology has been considered in this thesis work as to how it could be used as substitution to or complement satellite and terrestrial communication. HAP combines the benefits of satellite and terrestrial systems. There are still obstacles in it's development such as the one dealt in this thesis i.e. attenuation caused by rainfall. The simulation results show us that altering modulation techniques with the surrounding attenuation can solve this problem. HAP is still on the drawing board and the problems that are arising are being solved one by one. It can be safely assumed that HAP will be the future of telecommunication industry.

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