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Wireless Communications from High Altitude Platforms

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***Abstract*— The demand for wireless communication is increasing day by day. People want a high speed of communication in less time. No one is interested in use of bunch of wires. So we move to wireless communication. As technology increases a demand also increases. Now everyone wants a fast communication from anywhere to anyone. Even rural area also requires internet facility. 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. So Engineers made a intermediate way to satisfy both facilities of data transfer from terrestrial to satellite and satellite to terrestrial via HAP (High Altitude Platform). HAP is operated at altitude of 17-22km. HAP provides facilities of wireless communications.**

***Keywords*— High Altitude Platforms (HAPs), Broadband Communications, Wireless communications, Base station, Propagation.**

I. INTRODUCTION

In current era demand for wireless communication is notoriously increases. A terrestrial and satellite system provides wireless communication services. Terrestrial systems are used in mobile applications while satellite systems are used where terrestrial system not reached. HAPs are airship or airplanes which altitudes at 17-22km above earth surface. 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.

II. HAP DEFINITION

HAPs are airships or airplanes in stratosphere, at 17-22km altitude.

III. HAP INFRASTRUCTURE

Infrastructure of HAPs is categories in different types which are as follows:

1) Balloons :

- The earliest aerial platforms were balloons.
- It was filled by hydrogen.
- It was used in military applications.

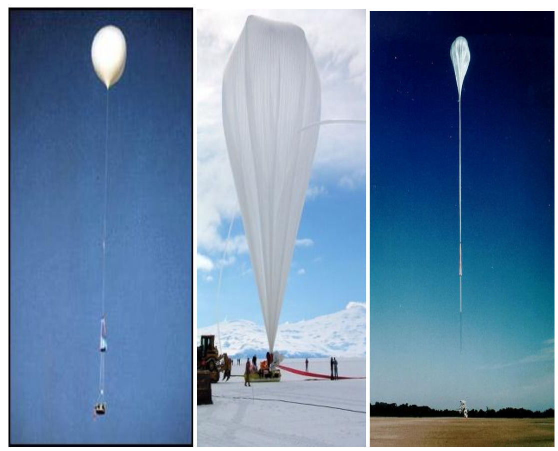

Fig.1 Balloons[5]

2) Airships :

- Airships are helium filled containers of the order of 100m or more in length.
- Electric motors and propellers are used for station-keeping, and the airship flies against the prevailing wind.
- Prime power is required for propulsion and station-keeping as well as for the payload and applications; it is provided from lightweight solar cells in the form of large flexible sheets.

Fig.2 Airship[4]

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3) Aeroplane :

- It is unmanned solar powered plane, which needs to fly against the wind.

Fig.3 Aeroplane[4]

IV. HAPS TOPOLOGIES

It is having wide range of topologies due to their rapid deployment and kind of service to provide. Basically there are three types of it. First, intermediate between satellite and terrestrial system, improving the satellite radio links, coverage and resource management implies. Second, it can be used in the stratospheric, with a terrestrial network. Third, it can be again used as a stratospheric, But also using a satellite for areas without connection to terrestrial networks where satellite links are available.

A. A terrestrial-HAP-satellite system:

It is a mixed infrastructure, includes a HAPs network using a satellite as a link to the terrestrial networks to the final users. It provides best features of both HAPs and satellite communications. It can support high QOS(Quality Of services). First, the capability of the satellites of broadcasting and multicasting are used to transmit information from fiber networks to the HAP network deployed below the satellite. Second, HAPs are used to improve the satellite performance over the earth.

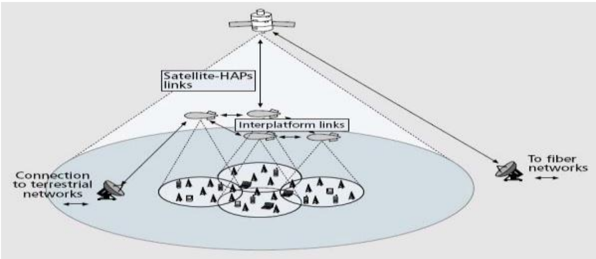

Fig.4 A terrestrial-HAP-satellite system[5]

B. A integrated terrestrial – HAP system:

This system works without the satellite-HAP link. Haps are considered to project one or more macro cells Here HAP network can be connected to terrestrial network through gateway.

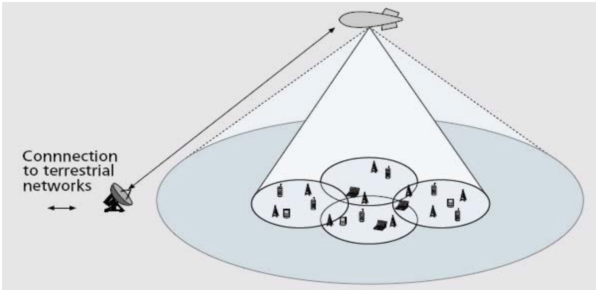

Fig.5 A integrated terrestrial – HAP system[5]

C. A standalone HAP system:

This system is used in many applications. For example broadband for all. In rural or remote area, it is expensive to deploy terrestrial systems. Satellite system is costly to be launched if traffic demand is small. This system may be deployed economically and efficiently.

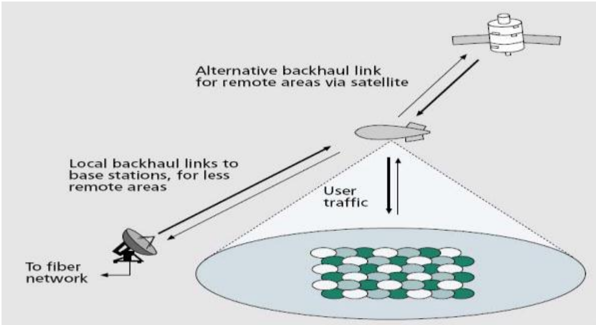

Fig.6 A integrated terrestrial – HAP system[5]

V. HAP APPLICATIONS

HAPs offer such a big variety of services according to the topologies as broadcasting services (TV and radio) , Internet access, telephony etc. Main applications of HAPs are as follows:

i. Broadband Fixed Wireless Access Applications
ii. 2G/3G and 4G applications
iii. Emergency and disaster scenarios
iv. Military Communications
v. Earth monitoring and positioning

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VI. HAP COMMUNICATION SCENARIO [4]

Fig.7 depicts a general HAP communications scenario. Services can be provided from a single HAP with up- and down-links to the user terminals, together with backhaul links as required into the fiber backbone. Inter-HAP links may serve to connect a network of HAPs.

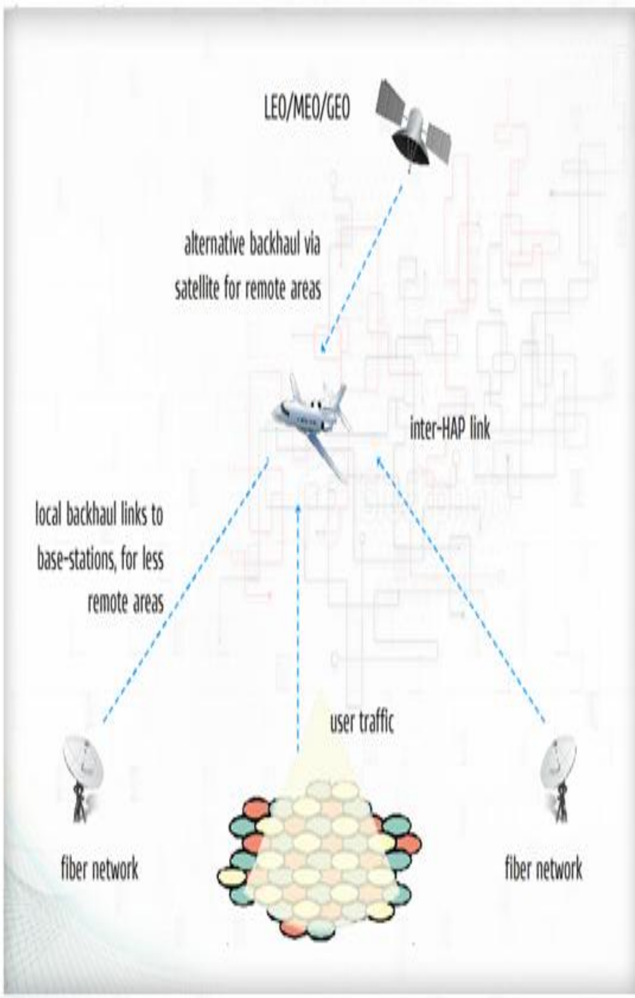

Fig.7 Communication scenario in HAP

HAP coverage region is determined by line-of-sight propagation. The size, number, and shape of cells is design of the antennas on the HAP, with the advantage that the cell configuration may be determined centrally at the HAP. The HAP architecture includes resource allocation techniques, which can provide efficient usage of bandwidth and maximize capacity.

Higher capacity with HAPs is also costly. It represents a power advantage of up to about34dB compared to a LEO satellite, or 66dB compared to a GEO satellite. And compared with terrestrial schemes, a single HAP can offer capacity equivalent to that provided by a large number of separate base-stations.

As shown in fig. 8 Depending on the geography of the area, aerostat is raised an altitude of around 50-70 m AGL on which a payload consisting of a router box and Omni directional antenna will be mounted. The router circuitry receives the signals from a router box located away from the Aerostat, which in turn will be directed to the client antennas located in the surrounding villages within around 10 km range.

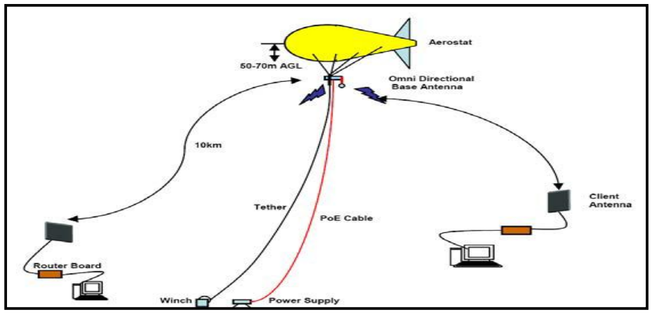

Fig.8 conceptual sketch of the Aerostat based wireless communication system[18]

Power supply for the access point is provided from the ground over the PoE cable which doubles up as a data cable. Access point is a bridge between the Ethernet and wireless interface at the base station. This bridge will transmit the data packets wirelessly to the client side, from the Omni-directional antenna mounted on top of the aerostat. At the client side flat panel antenna receives these data packets with the line of sight connectivity maintained. Tether is used to lift an airship.

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