THE IMPACT OF PROPAGATION ON THE EFFECTIVE OPERATION OF A HIGH ALTITUDE PLATFORM BASED COMMUNICATIONS SYSTEM

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HIGH ALTITUDE PLATFORMS (HAPS) in the form of aeroplanes, and airships, are being designed to operate at altitudes of ~22km for long periods.

HAPS would be a means of delivering broadband communications to locations where:

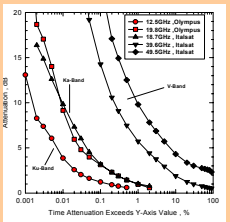
- the provision of optical cable and satellite services is uneconomical,
- existing infrastructure has been temporarily disrupted or destroyed.

The operation of such platforms would also be appropriate in regions where obstruction from buildings, topographical features, and vegetation constrains the use of some higher frequency terrestrial broadcasting systems. Those difficulties would be significantly reduced by employing HAPs based systems in which high elevation slant paths assist in clearing many of the obstacles.

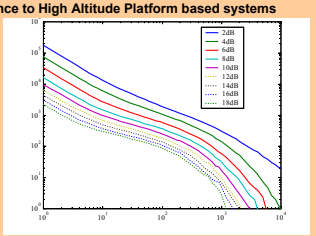
Atmospheric propagation issues

ITU-R have allocated frequencies near to 47 GHz (28 GHz in Japan) for High Altitude Platform based communication systems. At these frequencies the attenuation caused by rain and cloud can degrade link quality and availability severely. The ability to predict the losses that will occur along the slant path to a platform will be important for the development of successful systems. The RCRU has been operating a receiving ground station in the South of England to measure signals from beacons carried on the geostationary Italian satellite, ITALSAT F1. During that time nearly four years of atmospheric attenuation measurements have been collected at 18.7 ~40, & ~50 GHz. Those observations have enabled RCRU to establish a calibrated database of time series measurements with which to study the short and long term performance of HAPs based systems.

Atmospheric propagation statistics of relevance to High Altitude Platform based systems

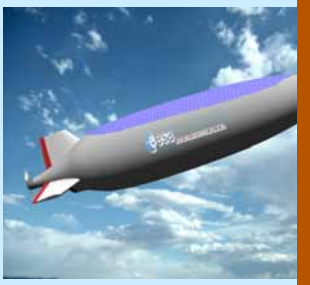


Annual total attenuation statistics measured in Southern England



Number of measured fades as a function of fade duration at 49.5 GHz

HALE (High Altitude Long Endurance
[Proposed to ESA by Astrium and
Lindstra



High Altitude Platform applications

Typical HAPS characteristics

Altitude 23 km
Speed 25 m/s
Payload 1,000 kg
Payload power 10 kW
Size ~220m x 55m

SAC Coverage ~ 19,000 km^2
Elevation angle:
- UAC >31.5°
- SAC >17°
- RAC >4.5°

Uplink: 47.9-48.2 GHz
Downlink 47.2-47.5 GHz

Typical Urban Capacity:
75040 channels at 64 kbps
Typical Suburban Capacity
35520 channels at 64 kbps

Services: 2 - 10 Mbps
Internet browsing/hosting
TV/Internet access
Full motion video conferencing
Local/long distance telephony
On-line remote monitoring
Security

Latency < 0.5 ms
(*cf* 250 ms for GSO)

Mission requirements:
- High availability
- High reliability
- Station keeping
- Long term (5 years)

A tethered balloon facility to address HAPS communication system and propagation blockage issues

The elevation angle of receiving antennas inside the coverage area of a HAP will range from a minimum value (~5 deg.) up to (~90 deg.). Propagation issues such as blockage by buildings and vegetation, as well as scintillation effects, will need to be addressed during the development phase of HAPS-based systems. Preliminary experiments to evaluate and test such systems are currently being performed with the use of a tethered balloon.

To establish the performance that could be expected from a High Altitude Platform based communication system, and to assist in an evaluation of the manner in which such systems would be operated in practice, the establishment of a central facility consisting of a tethered balloon for use by UK industry and the research community is recommended. Ready access to an elevated platform would enable the UK to take a lead in the development of HAPS based communication systems.

Advantages of a permanent elevated platform test facility:

- Licensing and permission to fly issues would be the responsibility of the facility operator.
- The platform would be available for use at short notice to take advantage of particular weather conditions.
- A suitably selected site would give access to a wide range of environments for testing purposes.

A typical tethered balloon attached to it's mast
(manufactured by
Cameron Balloons Ltd.)

Characteristics of a mobile tethere… that would be suitable for use at an elevated platform test facility

Operational altitude	Up…
Length of balloon	~16…
Payload	~65…
Payload power	Typ…
Envelope	Hel…
Maintenance	Regular h…
Operations	We…
	Ope…
Transportable	Wo…

…s (or up to 2 km at special sites)

…' (via tether)

…s
…dent
…ed and thunderstorm sensitive)
…f need to be present
…e deflated

Characteristics of a suitable site fo… …ted platform test facility:

- rural setting to minimise impact on loc…
- close proximity to a wooded area for ve…
- within reasonable distance (2-5 km) of …
- close proximity to existing terrestrial li…
- existing research site to minimise oper…

…udies
…area for building blockage studies
…ference studies