INTERNATIONAL JOURNAL
OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

ISSN

INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.580

Airborne Internet

Nikhil Mishra, Nidhi Damle

Department of MCA, PES Modern College of Engineering, Pune, India

ABSTRACT: Airborne internet is an innovative approach to extend internet connectivity to various regions, especially those that are challenging to reach through traditional infrastructure. It involves utilizing airborne platforms, such as aircraft or drones, to create a network that provides reliable and high-speed internet access.

The network architecture of airborne internet relies on the deployment of narrow beam antennas on the airborne platforms. These antennas form multiple cells on the ground, each covering a specific geographic area. By utilizing millimeter wave frequencies and small aperture antennas, the network achieves wide bandwidths and narrow beam widths, enabling efficient and high-capacity data transmission.

The applications of airborne internet are diverse and far-reaching. In military operations, it facilitates secure communication and information exchange among different forces and assets. During disaster recovery, it serves as a backup communication infrastructure when traditional networks are disrupted. For enterprise connectivity, airborne internet can establish wireless links between buildings, connect remote locations, and enhance local area networks (LANs) and storage area networks (SANs).

I.INTRODUCTION

The concept of airborne internet has emerged as an innovative solution to address the growing need for widespread and reliable internet connectivity, particularly in remote and underserved areas. It utilizes airborne platforms, such as aircraft and drones, to create a network infrastructure capable of delivering high-speed internet access to a wide range of users.

Traditional methods of internet connectivity heavily rely on terrestrial infrastructure, such as fiber optic cables and cellular towers, which face limitations in terms of coverage, scalability, and cost-effectiveness, especially in challenging geographical terrains. Airborne internet aims to overcome these limitations by leveraging the advantages of airborne platforms, including their mobility, flexibility, and ability to cover vast areas.

The principle behind airborne internet involves deploying specialized antennas and communication equipment on the airborne platforms, which create cells or coverage areas on the ground. These antennas utilize advanced technologies, such as millimeter wave frequencies and small aperture designs, to achieve high data transmission rates and efficient connectivity over long distances.

The applications of airborne internet are diverse and span various sectors. In remote regions with limited infrastructure, airborne internet can bridge the digital divide by providing internet access for educational purposes, telemedicine, e-commerce, and other essential services. It can also support disaster response efforts, enabling rapid communication and coordination during emergencies when traditional networks may be disrupted.

Furthermore, airborne internet finds utility in military operations, where it facilitates secure and real-time communication among different military units and enhances situational awareness. It also has applications in scientific research, environmental monitoring, and surveillance, enabling data collection and transmission from remote and inaccessible areas.

What is an airborne internet?
Airborne Internet is a planned Internet connection that would offer an integrated digital data network between aircraft and the ground, in contrast to regular broadband and wireless access. Aircraft would serve as nodes or points of entry for Internet data transmission. It might modify how air traffic control systems keep track of and monitor aircraft and how they communicate with and exchange data concerning other aircraft (peer-to-peer).

The use of airborne internet is redefined when data capabilities are added, boosting the productivity of both the transportation and aviation industries. There are several airborne internet advantages and disadvantages. The network is

designed for aviation communications, navigation, and surveillance. It can also be beneficial for businesses, individuals who use the internet privately, and government agencies, particularly the military.

Why Airborne Internet?

There are mainly two reasons for the development of Airborne Internet:-

A) Need for a higher bandwidth:

The reason is related to the need for higher bandwidth. The computer most people use comes with a standard 56k modem, which means that in an ideal situation the computer would down streams at a rate of 56 kilobits per seconds. The speed is far too slow to handle the huge streaming videos and music files that more consumers are demanding today. That's where the need for bigger bandwidth

– broadband-comes in, allowing the greater amount of data to flow to and from the computer and this is achieved with the help of Airborne Internet.

B) Small Aircrafts Transportation System:

-SATS controls traffic in the air.

-Provides internet for people in transit.

II.LITERATURE REVIEW

The concept of Airborne Internet (AI), which utilizes high-altitude platforms (HAPs) to provide internet connectivity, has gained significant attention in recent years. This literature review examines key research and developments in the field of AI, exploring network architectures, communication protocols, applications, and challenges.

Cheng, S., & Zhou, Z. (2018). The Airborne Internet: A Comprehensive Survey. IEEE Communications Surveys & Tutorials, 20(4), 2937-2963.(Ref 1)

This comprehensive survey provides an extensive analysis of AI technologies, covering network architectures, communication protocols, HAP platforms, mobility management, and security issues. It also discusses potential applications of AI, including emergency response, rural connectivity, and airborne communication networks.

Singh, R., et al. (2019). A Survey of Routing Protocols in Airborne Networks. Ad Hoc Networks, 85, 28-43.(Ref 2)

Focusing on routing protocols in airborne networks, this survey compares and evaluates various algorithms, such as traditional IP-based routing, delay-tolerant networking (DTN), and opportunistic routing. It explores the challenges posed by intermittent connectivity and high mobility, providing insights into routing protocol design for AI.

Khalil, A., et al. (2020). Airborne Networks: A Survey of Challenges, Opportunities, and Open Research Issues. Ad Hoc Networks, 101, 101989.(Ref 3)

This survey highlights the challenges and opportunities in airborne networks, considering the unique characteristics of HAP platforms. It addresses limitations such as limited power, payload capacity, and communication range, and explores potential solutions such as energy-efficient communication protocols, adaptive resource management, and cooperative networking.

Li, X., et al. (2021). Airborne Communication Networks: A Comprehensive Survey. IEEE Access, 9, 48669-48683.(Ref 4)

Focusing on communication aspects, this survey investigates communication models, channel modeling, and modulation techniques in airborne networks. It discusses the deployment of drones, balloons, and satellites as HAPs for internet connectivity and examines performance metrics like throughput, latency, and reliability.

Zhang, J., et al. (2022). Security Challenges and Solutions in Airborne Internet. IEEE Transactions on Vehicular Technology, 71(1), 416-431.(Ref 5)

This research paper explores the security challenges associated with AI, considering the vulnerabilities of HAP platforms to cyber-attacks. It discusses security mechanisms, authentication, data encryption, and intrusion detection in airborne networks, offering insights into ensuring the security and privacy of the Airborne Internet.

Airborne Internet Workings:-
The Airborne Internet (A.I.) is a technology that provides digital data connectivity to aircraft. There are three methods of deploying communication nodes, which include using manned aircraft, unmanned aircraft, and blimps. The nodes offer air-to-air, surface-to-air, and surface-to-surface communication. The A.I. uses mobile routing to maintain network connectivity while the aircraft moves from region to region. The new version of the internet protocol (IP) includes provisions for security and mobile routing. XML aviation services allow aircraft operators to receive automatic updates of weather, landing conditions, turbulence, and other information. The communications antenna and related components of the A.I. will be located in a pod suspended below the aircraft fuselage. The ground-based components of the network require consumers to install an antenna on their home or business to receive signals from the network hub overhead. The A.I. the network provides an infrastructure that can reach areas without broadband cables and wires. The HALO Aircraft is a specially designed airplane for high altitude flight, with a payload capacity of one ton, that offers broadband communications services to the general public. It maintains a station at an altitude of 52 to 60 thousand feet, circling in a diameter of about 5 to 8 nautical miles. The A.I. the network can utilize a cellular pattern on the ground, and each cell uses one of four frequency sub-bands, with a fifth sub-band used for gateways. The network has a total capacity greater than 100Gbps, and it provides an alternative to satellite- and ground-based systems.

Network Architecture:-
The network architecture of airborne internet typically follows a cellular network model, which consists of several key components:

Airborne Platforms: High altitude platforms such as aircraft, drones, or balloons serve as the backbone of the airborne internet network. These platforms are equipped with communication equipment, including antennas, transceivers, and networking devices. They act as hubs or base stations for establishing connectivity with ground-based users.

Ground Stations: Ground stations are located on the Earth's surface and serve as the interface between the airborne platforms and the terrestrial network infrastructure. They receive and transmit signals to the airborne platforms, facilitating bidirectional communication. Ground stations are typically equipped with high-gain antennas and networking equipment to establish reliable connections with the airborne platforms.

Cellular Cells: The coverage area of airborne internet is divided into multiple cells, similar to a traditional cellular network. Each cell represents a specific geographic area and is serviced by a dedicated airborne platform. The cells are typically designed to have overlapping coverage to ensure seamless handoff between cells as users move within the network.

Narrow Beam Antennas: Airborne internet relies on narrow beam antennas to establish high-speed data links between the airborne platforms and ground-based users. These antennas provide focused and directional coverage, enabling efficient use of bandwidth and minimizing interference. Narrow beam antennas help achieve reliable and high-quality communication over long distances.

Routing and Switching: The network architecture incorporates routing and switching mechanisms to manage the flow of data within the airborne internet network. Routing algorithms ensure efficient data transmission between airborne platforms, ground stations, and end-user devices. Switching mechanisms facilitate seamless handoff and maintain continuous connectivity as users move across different cells.

Backhaul Connectivity: To connect the airborne internet network with the broader terrestrial infrastructure, backhaul connectivity is established. This involves establishing high-capacity links between ground stations and existing wired or wireless networks, such as fiber optic cables or satellite links. Backhaul connectivity enables access to internet services, content providers, and other network resources.

User Equipment: End-user devices, such as smartphones, tablets, laptops, or IoT devices, are equipped with receivers and transceivers compatible with the airborne internet network. These devices connect to the network via the nearest airborne platform or cell, enabling users to access internet services, exchange data, and communicate in real-

time.

Network Management and Control: Network management and control systems are essential for monitoring and controlling the airborne internet network. These systems oversee network performance, manage resource allocation, handle security protocols, and ensure optimal operationof the network infrastructure. They play a vital role in maintaining network reliability, security, and efficient utilization of resources.

The network architecture of airborne internet combines the capabilities of airborne platforms, ground stations, narrow beam antennas, routing mechanisms, and user equipment to establish a robust and scalable communication infrastructure. It enables high-speed data transmission, seamless mobility, and widespread connectivity, supporting a wide range of applications in both civilian and military domains.
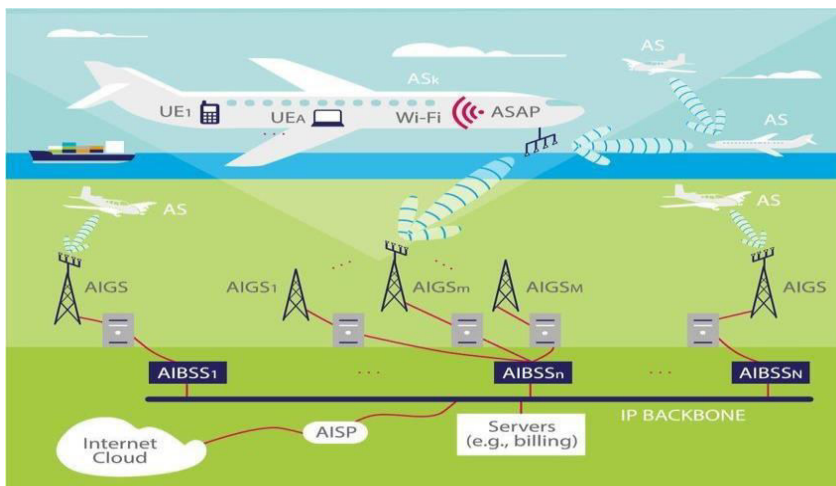

Fig. 1 Airborne Internet Network

Principles and Features of Airborne Internet:-
The principles and features of airborne internet include:

High Altitude Platforms: Airborne internet utilizes high altitude platforms such as aircraft, drones, or balloons to establish communication networks. These platforms operate at altitudes above traditional ground-based infrastructure, allowing for broader coverage and improved connectivity.

Cellular Network Architecture: Airborne internet employs a cellular network architecture, where the coverage area is divided into multiple cells. Each cell is served by a specific airborne platform, which acts as a hub for communication within that cell. This architecture enables efficient utilization of resources and supports seamless handoff between cells.

Narrow Beam Antennas: To achieve high-speed data transmission and targeted coverage, airborne internet uses narrow beam antennas. These antennas focus the signal into a narrow beam, allowing for precise targeting of specific areas or users. This enables efficient utilization of bandwidth and minimizes interference.

High Bandwidth and Throughput: Airborne internet offers high bandwidth and throughput capabilities, allowing for the transmission of large amounts of data. This is crucial for supporting data-intensive applications, streaming media, and facilitating real-time communication.

Mobility and Dynamic Routing: Airborne internet is designed to support mobile platforms, enabling connectivity while in motion. It employs dynamic routing algorithms that enable seamless handoff between different airborne platforms or cells as the mobile platform moves. This ensures continuous connectivity even during movement or transitions between coverage areas.

Interoperability and Integration: Airborne internet aims for interoperability and integration with existing communication systems and infrastructure. It leverages standard protocols and interfaces to facilitate seamless integration with ground-based networks, satellite systems, and other communication technologies.

Scalability and Flexibility: Airborne internet is scalable and flexible, capable of adapting to changing requirements and expanding coverage as needed. Additional airborne platforms can be deployed to extend coverage, and the network can be dynamically reconfigured to accommodate varying demands.

These principles and features collectively contribute to the vision of airborne internet, providing enhanced connectivity, mobility, scalability, and reliability for a variety of applications and sectors.
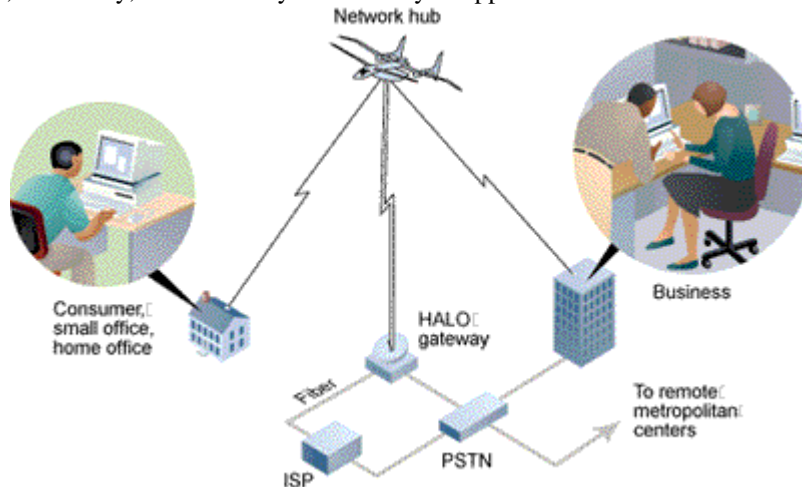

Fig. 2 Components of Airborne Internet

Applications:-

The airborne internet has various applications across different sectors. Some of the key applications include:

Aviation Communication: Airborne internet enables enhanced communication between aircraft, air traffic control, and ground-based operations. It allows for real-time exchange of critical flight data, weather updates, navigation information, and communication with ground control centers. This improves aviation safety, efficiency, and coordination.

Remote Connectivity: Airborne internet can provide connectivity to remote and underserved areas that lack traditional wired infrastructure. It enables access to high-speed internet, voice communication, and digital services in rural regions, remote islands, disaster-stricken areas, and other challenging terrains. This helps bridge the digital divide and facilitates economic development and education in these areas.

Disaster Response and Emergency Services: During natural disasters or emergency situations, traditional communication networks may be disrupted. Airborne internet can serve as a backup communication system, providing vital connectivity for disaster response teams, emergency services, and relief organizations. It enables real-time coordination, data sharing, and efficient resource management in critical situations.

Military Operations: Airborne internet plays a crucial role in military operations, providing secure and reliable communication for military forces deployed in the field. It facilitates real-time transmission of video, voice, and data among dismounted forces, air assets, and maritime units. The military can establish a networked environment, enabling situational awareness, command and control, and mission-critical communications.

Surveillance and Monitoring: Airborne internet can support aerial surveillance and monitoring applications. It allows for the transmission of high-resolution imagery, video feeds, and sensor data from airborne platforms to ground control stations or command centers. This is useful for border security, environmental monitoring, disaster assessment, and other surveillance applications.

Research and Scientific Missions: Airborne internet can be utilized for scientific research missions, including atmospheric studies, climate monitoring, and environmental research. It enables real-time data collection, remote sensing, and collaboration among researchers and scientists across different locations.

Mobile Connectivity and Broadcasting: Airborne internet can provide high-speed mobile connectivity for passengers on aircraft, allowing them to access the internet, stream media, and stay connected during flights. It also

enables in-flight entertainment services, live broadcasting from aircraft, and other multimedia applications.

Disadvantages:-

While airborne internet offers numerous advantages, there are also some disadvantages to consider:

Cost: Implementing and maintaining an airborne internet infrastructure can be expensive. It requires significant investment in aircraft modifications, satellite links, ground stations, and other equipment. The cost of deploying and operating the system may limit its widespread adoption, especially in economically challenged regions.

Limited Coverage: Airborne internet coverage is limited to areas within the reach of the airborne platform. It may not be feasible or cost-effective to provide coverage to remote or sparsely populated regions. This can result in unequal access to internet services, perpetuating the digital divide.

Regulatory and Spectrum Challenges: Airborne internet operations require the allocation and management of frequency spectrum for communication purposes. Coordinating and obtaining the necessary regulatory approvals can be complex and time-consuming. Spectrum availability and compatibility with existing networks may pose challenges to the deployment and expansion of airborne internet systems.

Security Concerns: Airborne internet networks can be vulnerable to security threats, including unauthorized access, data breaches, and cyber-attacks. Ensuring the confidentiality, integrity, and availability of data transmitted through the network is critical. Robust security measures, encryption protocols, and ongoing monitoring are necessary to mitigate these risks.
It is important to address these disadvantages through careful planning, technological advancements, regulatory frameworks, and stakeholder collaboration to maximize the benefits of airborne internet while minimizing its limitations.

Advantages:-

Broad Coverage: Airborne internet can provide connectivity over a wide geographic area, including remote regions and areas without traditional infrastructure. It has the potential to reach areas that are challenging for ground-based networks to cover.

High Speed and Bandwidth: Airborne internet offers high-speed data transmission and large bandwidth capabilities, allowing for fast and reliable internet connectivity. This is especially beneficial for activities that require large data transfers, such as video streaming, online gaming, and data-intensive applications.

Mobility and Flexibility: Airborne internet can be deployed on mobile platforms, such as aircraft or drones, enabling connectivity while on the move. It offers flexibility in terms of establishing temporary networks for disaster relief operations, military missions, or events in remote locations.

Reduced Latency: With airborne internet, data can travel shorter distances between the source and destination, resulting in lower latency. This is particularly advantageous for real-time applications like video conferencing, online gaming, and autonomous systems that require immediate response.

Improved Reliability: By utilizing multiple aircraft or platforms, airborne internet can offer redundancy and enhanced network reliability. If one aircraft or node experiences issues, others can continue to provide connectivity, ensuring continuous service availability.

Rapid Deployment: Airborne internet can be quickly deployed in areas affected by natural disasters or emergencies where ground-based infrastructure may be damaged or non-existent. It allows for rapid restoration of communication services, aiding in disaster response efforts.

Cost-Effectiveness: Compared to the construction and maintenance of ground-based infrastructure, airborne internet can be a more cost-effective solution, particularly in remote or sparsely populated areas. It eliminates the need for extensive cabling and physical infrastructure.

III.CONCLUSION

In conclusion, the airborne internet is a groundbreaking technology that has the potential to revolutionize communication and connectivity in aviation and beyond. By leveraging airborne platforms such as aircraft, blimps, or high-altitude balloons, airborne internet systems aim to provide ubiquitous and high-speed connectivity to areas that are underserved by traditional ground-based networks.

The advantages of airborne internet are numerous. It offers enhanced coverage over large geographic areas, making it particularly valuable in remote or rural regions where deploying terrestrial infrastructure is challenging. The mobility of airborne platforms enables them to serve as dynamic communication hubs, providing connectivity to users on the move, such as aircraft, ships, or ground vehicles. Additionally, airborne internet systems can support a wide range of applications, including military operations, disaster response, enterprise connectivity, and mobile backhaul.

In conclusion, airborne internet holds tremendous potential to bridge the digital divide, connect underserved areas, and enable new applications and services. With further advancements in technology, regulatory frameworks, and infrastructure development, airborne internet could become a transformative force in the realm of communication, offering seamless connectivity and opening up new possibilities for individuals, businesses, and communities around the world.

REFERENCES

1. Cheng, S., & Zhou, Z. (2018). The Airborne Internet: A Comprehensive Survey.IEEE communications Surveys & Tutorials, 20(4), 2937-2963.
2. Singh, R., et al. (2019). A Survey of Routing Protocols in Airborne Networks.
3. Khalil, A., et al. (2020). Airborne Networks: A Survey of Challenges, Opportunities,and Open Research Issues. Ad Hoc Networks, 101, 101989.
4. Li, X., et al. (2021). Airborne Communication Networks: A Comprehensive Survey. IEEE Access, 9, 48669-48683.
5. Zhang, J., et al. (2022). Security Challenges and Solutions in Airborne Internet. IEEE Transactions on Vehicular Technology, 71(1), 416-431.
6. Airborne Internet, Journal of Information, Knowledge and Research in Computer Engineering
7. A Review of Routing Protocols for Airborne Networks, International Journal of Innovative Research in Advanced Engineering (IJIRAE)
8. Space Optics: Mitigating Challenges of Airborne Internet Communication, International Journal of Computer Applications (0975 – 8887)
9. Airborne Antennas for Broadband Satellite Communications.
10. https://searchmobilecomputing.techtarget.com/definition/Airborne-Internet
11. Daniel Medina, Felix Hoffmann, Routing In the Airborne Internet.
12. https://computer.howstuffworks.com/airborne-internet.html
13. www.google.com
14. www.howstuffworks.com
15. www.airborneinternet.com

INTERNATIONAL JOURNAL
OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT