EXPLAINERS

What Is a High-Altitude Pseudo-Satellite and Why Does the Indian Air Force Need It?

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EXECUTIVE BRIEF & KEY FINDINGS

The Indian Air Force's move to acquire fixed-wing High-Altitude Pseudo-Satellites marks an important step towards building a persistent stratospheric surveillance and communications layer. Operating between conventional aircraft and satellites, HAPS can remain over a designated area for extended periods while carrying ISR, telecommunications and remote-sensing payloads. Their greatest advantage lies in persistence. Unlike conventional UAVs that require repeated sorties or low-Earth-orbit satellites that pass over a location at intervals, HAPS can maintain prolonged coverage of sensitive sectors.For India, this capability could strengthen border monitoring along the Line of Actual Control and other strategically important regions, provide airborne communications relay, support electronic and optical surveillance, and reduce dependence on more expensive satellite or crewed-aircraft missions for certain tasks. HAPS are also recoverable and re-taskable, allowing payload upgrades and operational repositioning. They are not, however, replacements for satellites, AWACS or high-endurance UAVs. Payload limitations, stratospheric weather, energy constraints and vulnerability to sophisticated air-defence systems remain significant challenges. The IAF's interest in HAPS therefore reflects a broader effort to close surveillance and communications gaps through a layered ISR architecture spanning ground, air, stratosphere and space.

On 3 July 2026, the Defence Acquisition Council approved the procurement of a Fixed-Wing Based High Altitude Pseudo Satellite, or FW-HAPS, for the Indian Air Force. The Ministry of Defence was unusually clear about what it expects the platform to do. It is intended for persistent Intelligence, Surveillance and Reconnaissance, telecommunications and remote sensing.[1] This was not an isolated decision. In February 2026, the DAC had already granted approval for an Airship-Based High Altitude Pseudo Satellite for the IAF, intended for persistent ISR, Electronic Intelligence, telecommunications and remote sensing.[2] Taken together, the two decisions indicate that India is not merely experimenting with an unusual type of unmanned aircraft. It is beginning to build a new stratospheric surveillance and communications layer. The name can be confusing. A High-Altitude Pseudo-Satellite is not actually a satellite. Nor is it simply another long-endurance drone. It is best understood as an aircraft designed to perform some of the functions associated with satellites while remaining inside the Earth's atmosphere. And for India, that distinction matters.

What exactly is a HAPS?

A High-Altitude Pseudo-Satellite operates in the stratosphere, normally at altitudes around 18 to 20 kilometres and potentially higher. The International Telecommunication Union defines high-altitude platform stations as stations located on objects at approximately 20 to 50 kilometres above the Earth and positioned, nominally, over a particular location.[3] At around 20 kilometres, a HAPS flies almost twice as high as a commercial airliner. It is above most civilian air traffic and much of the weather that affects normal aviation, but it is still nowhere close to space. That gives it an unusual advantage. It can look down on a very large area like a satellite, while remaining close enough to the ground to provide high-resolution sensing, relatively low-latency communications and the ability to remain focused on a particular region. The European Space Agency describes HAPS as a missing link between drones operating closer to the Earth and satellites orbiting in space.[4]

Fixed-wing HAPS generally resemble extremely light, long-winged unmanned aircraft. Solar cells mounted across the wings generate electricity during daylight hours. Part of that energy powers the motors and payload, while the remainder charges batteries that keep the aircraft flying through the night. This explains the enormous wingspans associated with such aircraft. The objective is not speed. It is efficiency. A HAPS may cruise at only a fraction of the speed of a combat aircraft. Its job is to climb into the stratosphere, reach its assigned area and stay there. For days, and eventually, potentially for weeks or months.

A HAPS is a drone, but it is not an ordinary drone

Technically, many fixed-wing HAPS are unmanned aerial vehicles. The distinction is therefore one of mission, altitude, endurance and architecture rather than a completely separate category of aircraft. A conventional military UAV is normally sent on a sortie. It takes off, flies to an area, carries out surveillance or another mission, returns to base, is serviced and then flies again. Even high-altitude long-endurance UAVs have finite fuel and require repeated launch, recovery and maintenance cycles. A solar-powered HAPS is designed around a different idea. Instead of repeatedly visiting the battlespace, the platform attempts to remain above it. India's National Aerospace Laboratories has described HAPS precisely in this role, as a bridge between UAVs and satellites capable of providing long-duration surveillance, communications and environmental monitoring. CSIR-NAL is itself developing an indigenous high-altitude platform and has tested sub-scale vehicles powered by solar energy and batteries.[5] A fixed-wing HAPS is therefore less like a reconnaissance aircraft sent on patrol and more like an airborne observation post that can be left in the sky.

Nor is a HAPS a replacement for a satellite

Satellites remain vastly more powerful for many strategic missions. They can observe enormous areas, operate globally, provide secure communications over continental distances and perform missions that atmospheric aircraft cannot. A military space architecture consisting of electro-optical, synthetic aperture radar, electronic intelligence, communications and navigation satellites cannot simply be replaced by aircraft flying at 20 kilometres. But satellites have their own limitations. A low Earth orbit satellite moves rapidly relative to the Earth's surface. Unless a constellation is available, it will only pass over a particular location during specific windows. An adversary that understands those orbital patterns can sometimes plan activity around satellite passes. A geostationary satellite can maintain permanent coverage of a region, but it orbits roughly 36,000 kilometres above the Earth. Such spacecraft are expensive, technically complex and cannot be recovered when a new sensor needs to be installed.

A HAPS offers something different. It can remain over one region for long periods, return to the ground, receive a new payload and later be deployed somewhere else. That combination of persistence and flexibility is its real attraction. Analysts at the Center for Strategic and International Studies have noted that recoverability also allows HAPS payloads to be upgraded or replaced, something that is fundamentally more difficult with an orbital platform.[6] The platform therefore complements satellites rather than making them redundant.

Persistent surveillance is the real prize

For the Indian Air Force, the most important word in the DAC announcement is arguably not surveillance. It is persistent. Modern militaries already possess plenty of systems capable of observing a target. The harder problem is observing it continuously. Consider a sensitive sector along the Line of Actual Control. A satellite might photograph the area during its pass. A UAV might remain on station for several hours. Reconnaissance aircraft can be tasked when required. Ground radars and electro-optical systems can watch selected approaches. But between these systems, gaps can remain.

A HAPS positioned in the stratosphere could watch the same region continuously for a much longer period. Depending upon the payload fitted, it could monitor roads, staging areas, airfields, logistics routes, temporary structures, vehicle concentrations or changes in activity patterns. This changes the nature of surveillance. Instead of receiving snapshots of activity, analysts can begin to observe behaviour. When did a convoy arrive? How long did it remain? Did engineering activity increase? Is a temporary logistics node becoming permanent? Are vehicles moving at unusual hours? Has a radar begun operating from a new position? Persistence allows apparently insignificant activities to be placed in context. This is particularly important in situations below the threshold of war, where military movements may be incremental and deliberately ambiguous. The Indian Express, reporting on India's indigenous HAPS programme, noted that unlike satellites in low Earth orbit, which continuously move relative to the ground, a stratospheric HAPS can loiter over a region and remain focused on it.[7] For intelligence organisations, time over target is often as valuable as sensor resolution.

Why this matters along India's borders

India's surveillance problem is unusually difficult because it is not concentrated in one kind of terrain. Along the northern frontier, the military must monitor mountainous areas where terrain can obstruct line-of-sight sensors and communications. The western frontier combines mountains, plains and desert. The wider security environment also extends towards the Indian Ocean, where long-range surveillance and communications become increasingly important. A stratospheric platform can provide an elevated sensor position without requiring a conventional aircraft to remain permanently airborne. From altitude, the line-of-sight horizon expands dramatically. A HAPS operating over friendly

territory could therefore observe or electronically monitor a much wider region, subject to the limitations of the sensor being carried. That last qualification is important. The aircraft itself does not create intelligence. Its payload does.

A HAPS carrying electro-optical and infrared sensors performs one role. A platform carrying a communications package performs another. Synthetic aperture radar, signals intelligence equipment, communications intelligence systems or data-relay payloads create still other possibilities. The Indian Air Force had already signalled these requirements before the latest DAC approval. In 2025, reports on an IAF Request for Information for HAPS said the service was seeking platforms for persistent ISR as well as airborne data relay, ELINT and COMINT roles. The reported requirement also envisaged stratospheric operations and long-endurance flight.[8] The July 2026 approval therefore appears to formalise a capability requirement that had been developing for some time.

A communications tower at 20 kilometres

Surveillance may receive most of the attention, but communications relay could prove equally important. Military communications are heavily dependent on line of sight. Mountains, the curvature of the Earth and the distance between units can all create problems. Put a relay station 20 kilometres above the ground, however, and the geometry changes considerably. A HAPS can act as a giant communications node in the sky. It could potentially connect ground formations with aircraft, relay information from unmanned platforms operating farther away, provide a bridge between isolated communications networks and supplement satellite communications. The ITU has examined HAPS precisely in this context. Stratospheric platforms can provide broadband connectivity, backhaul links and communications services over areas where terrestrial infrastructure is absent or damaged.[9] In military use, the same principle can support a distributed network of sensors and shooters. Imagine several UAVs conducting surveillance at different locations. Instead of each aircraft requiring a direct link with a distant ground station, their data could potentially be routed through a HAPS overhead. The platform becomes an airborne data relay. This is particularly useful in mountainous regions where terrain frequently breaks direct line-of-sight communications. It also fits the direction in which modern air warfare is moving. Aircraft, UAVs, radars, surface-to-air missile systems, electronic warfare assets and command centres increasingly need to operate as parts of a common network. The value of an individual sensor is determined not merely by what it detects but by how quickly that information reaches somebody capable of acting on it. A persistent relay node high above the battlespace can help keep that network connected.

The advantage over satellites is also economic

Putting something into orbit is expensive. The spacecraft has to survive launch, function in the radiation and thermal environment of space and operate without the expectation that technicians can simply bring it back to a hangar when something breaks. HAPS avoids several of those problems. There is no rocket launch. The platform is recoverable. Payloads can be changed. Solar-powered aircraft have little or no conventional fuel requirement during their mission. Electronics do not necessarily require the same degree of radiation hardening demanded by spacecraft.

CSIS has identified precisely these factors when examining the potential economics of HAPS, including the absence of launch rockets, the use of terrestrial payload technology and the possibility of solar-powered operations.[10] ESA assessments have similarly described HAPS as potentially low-cost, flexible systems that can be deployed significantly faster than satellites.[11] This does not mean that HAPS are cheap. Developing an aircraft capable of surviving in the stratosphere for months is an extraordinary engineering challenge. The airframe has to be extremely light. Batteries must function in intense cold. Solar energy collected during the day must be sufficient to operate the aircraft through the night. Autonomous flight control must function reliably for very long periods. Payload weight and electrical power are constantly competing with endurance. A HAPS may therefore be cheaper than keeping a conventional aircraft repeatedly on station or building and launching a dedicated satellite, but it should not be confused with a disposable

drone.

There is another advantage. You can move it.

A satellite follows an orbit. A HAPS follows instructions. That may sound obvious, but operationally it is important. If tensions increase in one sector, the platform can potentially be repositioned. If the requirement shifts elsewhere, the aircraft can be recovered and moved. If a particular sensor is no longer needed, the payload can be changed. This makes HAPS attractive for crises that develop faster than traditional space procurement cycles. It also offers commanders something that satellites cannot easily provide, theatre-level control over a persistent strategic sensor. The result is a platform sitting somewhere between tactical aviation and space power.

But HAPS has serious limitations

Calling something a pseudo-satellite can make it sound almost invulnerable. It is not. The first major limitation is payload. Fixed-wing solar HAPS are built around extreme weight efficiency. Their enormous wings and lightweight structures are required simply to keep them airborne in the thin air of the stratosphere. Every additional kilogram matters. A HAPS cannot necessarily carry the large radar, electrical-generation systems, defensive aids and communications equipment of a conventional military aircraft. There will always be a trade-off between payload, endurance, altitude and power consumption. This means HAPS should be regarded as part of a layered ISR network, not as a replacement for AWACS aircraft, reconnaissance UAVs or satellites.

Weather still matters

Operating in the stratosphere places HAPS above most conventional weather, which is one of its advantages. But "above the weather" does not mean unaffected by the atmosphere. The aircraft must first climb through lower atmospheric layers during launch and descend through them when it returns. Wind conditions can complicate both phases. Maintaining position against stratospheric winds consumes energy. Temperatures at HAPS operating altitudes can fall below minus 60 degrees Celsius, placing batteries, electronics and structural materials under considerable stress. Clouds below the aircraft can also obstruct electro-optical sensors even when the HAPS itself is flying in clear stratospheric conditions. The U.S. Naval Institute has noted that HAPS generally operate above most convective weather but remain vulnerable to cloud interference, winds during launch and recovery and other environmental effects.[12] For a solar aircraft, weather and season also affect the energy equation. Long nights, reduced solar intensity at some latitudes and the electrical demands of payloads all influence endurance. The challenge is not merely keeping the aircraft in the air during a sunny afternoon. The challenge is generating enough excess energy during daylight to fly through every night, repeatedly, while operating sensors and communications equipment.

It can also be shot down

Altitude provides protection, but not immunity. A platform operating around 18 to 20 kilometres is well beyond the reach of many short-range air-defence weapons. It is also high enough to make interception by conventional fighters more difficult. But sophisticated long-range surface-to-air missile systems are built to engage targets at such altitudes and beyond. If a HAPS is detected and enters defended enemy airspace during wartime, its survivability becomes a serious concern. Its very characteristics can work against it. A fixed-wing solar HAPS is slow. It is lightly constructed. It has limited ability to manoeuvre aggressively. Its normal mission requires it to remain within a predictable geographic area. The U.S. Naval Institute assessment of HAPS concludes that their altitude reduces exposure to many air-defence systems but does not make them immune to advanced kinetic weapons, directed-energy systems, electronic attack or cyber operations.[12] This suggests an important operational principle for India. HAPS would be most valuable when

positioned intelligently, often inside friendly or protected airspace, using altitude and long-range sensors to observe contested areas without unnecessarily placing the aircraft directly over heavily defended territory. Their survivability would also increase if several relatively affordable HAPS were available rather than treating each aircraft as an irreplaceable strategic asset.

India has already begun building the technology base

The IAF's interest does not begin with the July 2026 DAC approval. Indian organisations have been experimenting with stratospheric platforms for several years. CSIR-NAL has developed and flown a sub-scale solar and battery-powered high-altitude platform and is working towards a full-scale system capable of operating around 20 kilometres.[13] Bengaluru-based NewSpace Research and Technologies has also developed HAPS prototypes with support from India's defence innovation ecosystem. Its sub-scale solar-powered demonstrator achieved endurance exceeding 24 hours during testing at the Aeronautical Test Range at Chitradurga, according to the company. The programme has involved support from iDEX, the IAF, HAL and DRDO organisations. This domestic ecosystem matters because a HAPS is more than an airframe. India will need lightweight composite structures, high-efficiency solar cells, advanced batteries, electric propulsion, autonomous flight-control systems, secure data links, high-resolution sensors and eventually sophisticated payload integration. Developing those technologies indigenously has applications well beyond HAPS itself.

Why does the IAF need HAPS?

Because the modern battlespace increasingly punishes gaps. A fighter aircraft can strike a target only if the target has been found. A surface-to-air missile battery can engage only if somebody provides an accurate track. A commander can respond to an enemy buildup only if intelligence reaches the command chain in time. Modern warfare therefore depends on maintaining what might be called an unbroken chain of awareness. Satellites provide one part of that chain. AWACS aircraft provide another. Ground radars, aerostats, UAVs, reconnaissance aircraft, electronic intelligence systems and human intelligence provide others. HAPS adds persistence. Its real value is not that it performs a mission no other platform can perform. Its value lies in performing several familiar missions from a position where very few existing platforms can remain for long periods. It can watch. It can listen. It can relay. And, perhaps most importantly, it can stay. That is why the July 2026 approval deserves more attention than the strange name of the aircraft might initially suggest. The Indian Air Force is not simply buying another drone. It is moving towards occupying the stratosphere.

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