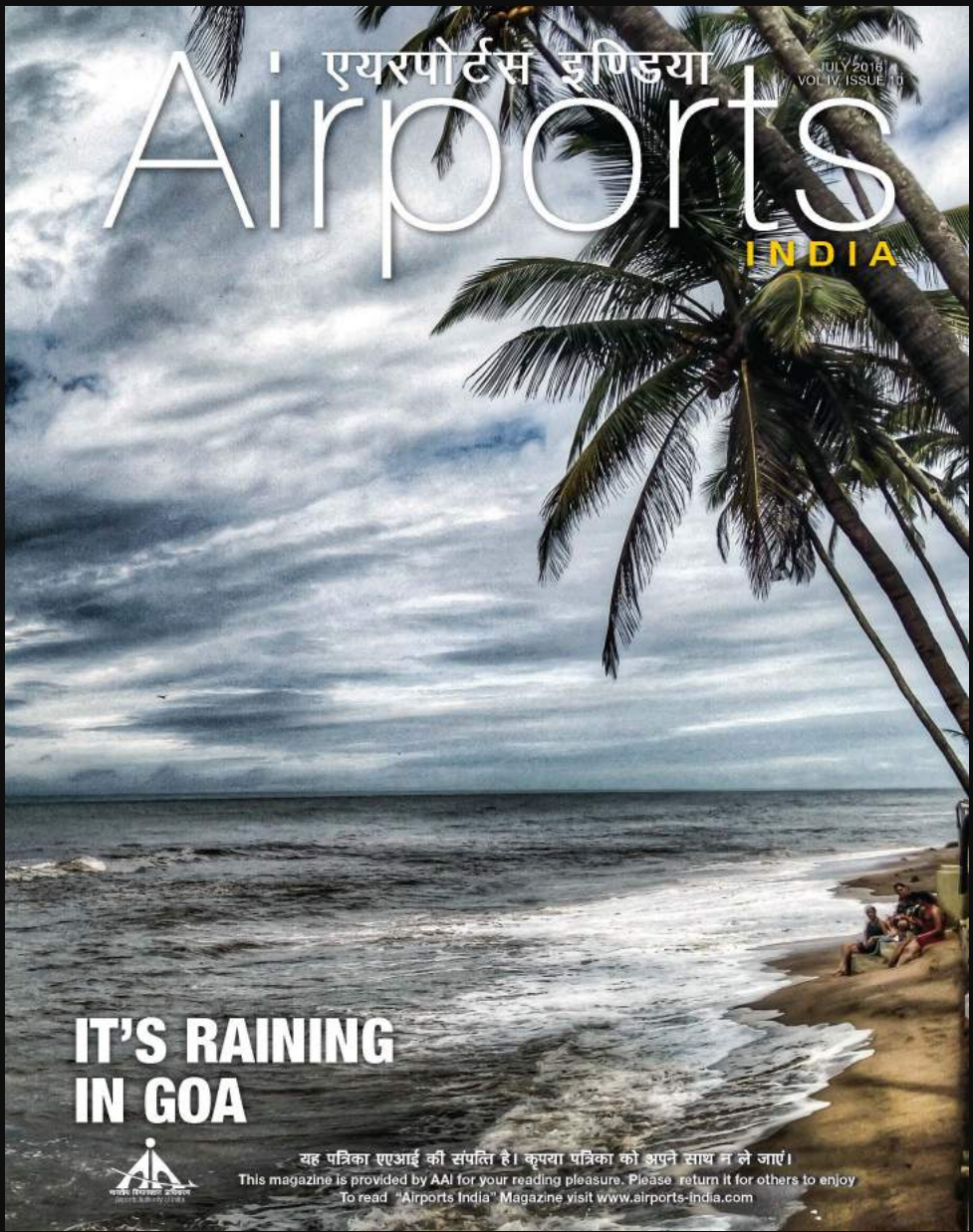


Enabling technologies of Upper Airspace Harmonization

The International Civil Aviation Organization (ICAO) the UN specialized agency, established by States in 1944 manages the administration and governance of the Convention on International Civil Aviation (Chicago Convention). ICAO works with the Convention's 191 Member States and industry groups to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector. These SARPs and policies are used by ICAO Member States to ensure that their local civil aviation operations and regulations conform to global norms, which in turn permits more than 100,000 daily flights in aviation's global network to operate safely and reliably in every region of the world.

In addition to its core work resolving consensus-driven international SARPs and policies among its Member States and industry, and among many other priorities and programmes, ICAO also coordinates assistance and capacity building for States in support of numerous aviation development objectives; produces global plans to coordinate multilateral strategic progress for safety and air navigation; monitors and reports on numerous air transport sector performance metrics; and audits States' civil aviation oversight capabilities in the areas of safety and security.

Having witnessed tremendous air traffic growth in the last decade and expected consistent growth of over 7% international as well as domestic traffic in the coming years, India has taken major steps in upgrading the air navigation services' ground infrastructures and airspace restructuring to enhance the safety, capacity and efficiency of airspace and airports. One of the major steps taken by India is "Upper Airspace Harmonization". Therefore, it is an attempt to provide a general overview on the airspace structure, enabling technologies behind the upper air space harmonization and benefits extended to stakeholders of aviation.

Airspace is divided scientifically into different regions by International Civil Aviation organization [ICAO]. They are divided into multiple Flight Information Regions [FIR]. India has four major FIRs with the control centers at Chennai, Kolkata, Delhi and Mumbai. Each one of these FIRs has four layers: Tower, Approach, Lower area control centre [ACC] and Upper area control centre [ACC] with vertical jurisdiction. Each layer will have multiple sectors with lateral jurisdiction.

Any restructuring efforts on civil aviation air space over an individual's state could be viewed as a part of a global air space plan, as capacity changes at one part of the globe, it certainly influences the movement and capacity at another part of the globe. By restructuring the air space and air routes, saving of fuel and time, reduction in emission, enhancement in safety and increased airline on time performance is being achieved significantly. So, upper airspace harmonization has become very essential.

Two major challenges are addressed in harmonizing the upper airspace to enable the air traffic management of different sectors from one control centre. First challenge is, extending the air situation pictures of different sectors to a single upper airspace control centre. Second, enabling the communication between pilot and controllers; during the entire flight duration within the upper airspace irrespective of the distance between them.

This fused information is further correlated with electronic flight plan information for enhancing the safety nets, which includes short time conflict alert, danger-zone proximity warning and minimum safe altitude warning system etc. This fused data are made available to controllers' working position as per the requirement along with electronic flight information. In this way, the consolidation and deconsolidation of sectors is made feasible to handle the traffic based on the density of the traffic and human resource availability.

In case of communication between pilots and controllers, very high frequency [VHF] voice communication is widely used because of voice quality. However, the range of VHF is limited to line of sight. Even though High frequency [HF] voice communication can provide better range, it is not preferred over continental airspace due to poor voice quality. Satellite based Controller Pilot Data Link Communication

[CPDLC] is preferred only over oceanic region as ground based VHF will not meet the required coverage. So for cost effective measure VHF communication facilities are extended to the limit possible with the additional coverage with CPDLC and HF.

Chennai FIR: Upper Airspace of Chennai FIR above 26000 was restructured as a single continuum of airspace with the introduction of advanced ATS automation system along with integration of radar data from Chennai, Bellary, Vizag, Mangalore, Trivandrum, Bangalore, Cochin and Hyderabad. Enhancement of surveillance data is made with ADS-B data from Port Blair.

Kolkata FIR: Similar to Chennai FIR, surveillance data from radars installed at Kolkata, Guwahati, Katiahar, Varanasi, Jharsaguda, Nagpur, Vizag, Berhampur and ADS-B sensors located at Agartala, Guwahati, Varanasi and Nagpur, being extended to the control centre. The Kolkata VHF network is employing IP Radio and IP based VCS system for the first time in the country. VHF IP radios installed at thirteen remote network stations have been networked to provide seamless coverage to the routes operating in the FIR.

Delhi FIR: Radar data from Delhi, Bhopal, Udaipur, Amritsar along with the ADS-B sensors located at Jaipur,Amritsar&Lucknow are being extended to the control centre.

Mumbai FIR: All similar efforts are in progress for harmonizing the upper airspace of Mumbai.

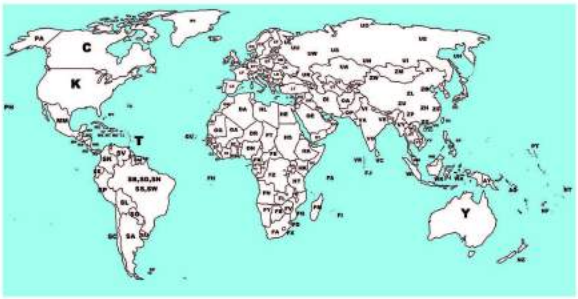
Surveillance data provided to all these FIRs will be enhanced with ADS-B and additional radar data in the coming days so that the entire Indian continental and critical oceanic airspace is covered fully with overlapping coverage with adjacent FIRs. All the FIRs automation facilities are connected with application level ATS Inter Facility Data Communication (AIDC), which would permit automatic exchange of aeronautical data among ATC units and thereby increasing the time for surveillance activities. AAI is installing over 400 number of VHF transmitters/receivers across India to meet the VHF requirement and will become one of the ANSPs having the largest IP based VHF systems in the world.

With implementation of IP based VCCS and Radio at major ACCs, it will be possible to share Radio resources between these centers for optimum utilization apart from seamless operation from single ACC in case of operational requirement like emergency or contingency.

The benefits of this major step taken by the Indian Air Navigation service provider [ANSP] i.e., AAI are

1. Reduction in separation between aircraft resulting in increased airspace capacity utilization.
2. User Preferred Flight Profile.
3. Increased automatic coordination and reduced manual coordination or Substantial reduction in voice coordination between units.
4. Effective utilization of Manpower by consolidating and deconsolidating Sectors dynamically depending on traffic density.
5. Redundant and enhanced coverage of seamless surveillance data provide means for creation of closely spaced air routes.
6. Added safety tools.
7. Harmonized ATM procedures.
8. Saving fuel and reducing carbon emission by facilitating efficient climbing and descending.

Results observed on airlines getting their preferred route, flight levels and carbon emission control after the installation of automation system and surveillance sensors integration, are very positive. These major steps taken by AAI being one of the fastest growing ANSP in the world, would certainly contribute in making India as one of the best air transportation service provider in the world.



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