AIRSPACE MANAGEMENT: A SYNERGISED APPROACH

ATUL KUMAR SINGH

The growth of India's civil aviation industry is one of the shining stories of contemporary India. The accelerated globalisation in the 21st century and consequent economic expansion have propelled the phenomenal growth in the civil aviation sector. The sector has grown at the rate of 20 per cent in 2004 and 2005 and is expected to grow at the rate of 25 per cent for the next ten years. The annual report of the Ministry of Civil Aviation (MoCA) 2006-07, records a 41 per cent growth in passenger traffic, and forecasts a whopping 400 per cent growth in passenger traffic and 600 per cent growth in cargo traffic over a period of the next 20 years.[1]

The unprecedented growth of civil aviation in India has overwhelmed the aviation infrastructure in the country. The lack of an adequate number of airports, runways, radars, communication, navigation systems and control facilities have made this growth look more gigantic than it actually is. The crowding of airspace, prolonged holding periods and uneconomical methods of airspace management, owing to waste of fuel and time, are often quoted as the reasons for near miss incidents in the air. However, when compared to the air traffic over comparatively smaller nations in Europe and elsewhere, it would

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Wing Commander **Atul Kumar Singh** VSM, is a Research Fellow at the Centre for Air Power Studies, New Delhi.

1. "Civil Aviation in India: Surging Skies," *VAYU*, III /2007, p. 34.

emerge that countries like the UK, France Germany, Singapore and Hong Kong have higher traffic density in terms of take-off, landing and transit of domestic and international flights as compared to India, yet those countries seem to be managing their airspace in a much more organised manner, primarily because of better infrastructure, integration of air traffic control assets, centralised control of airspace and policy regulations that have kept pace with the rapidly changing nature of air space management.

Military aviation, and particularly the air force, is the other largest user of airspace, followed by private companies, state governments and owners of smaller jets and helicopter services. Military aviation is an imperative of national security and with the changing geo-strategic scenario and increasing dependence on aerospace power, the role of military aviation will expand in the years to come. Also, the armies and navies the world over are more inclined to expand their aviation assets, thus, enlarging the size of the military aviation inventory.

The responsibility of airspace management in India is divided between the Airports Authority of India (AAI) and Indian Air Force (IAF). The airspace is divided, regulated and controlled by the two agencies under different sets of policies and regulations. The IAF is responsible for the air defence of national airspace, and therefore, plays a vital role in airspace management and in safety and security of civil aviation. The demarcation of airspace for civil and military use, a number of controlling agencies and different sets of rules for identification of air traffic, climb and descent procedures, radio telephony (RT) communication procedures, air operations over restricted and prohibited areas under the control of different controlling agencies often lead to conflict of interest and priorities, and complicated coordination procedures result in air incidents and, occasionally, in air accidents.

Against this backdrop, this paper intends to analyse the growth of civil aviation and its impact on airspace management, the role and peculiarities of military aviation, the issues and problems that afflict the passage to more efficient airspace management and the ongoing coordination and cooperation between civil and military organisations. The paper briefly touches upon the

international norms and principles on which the most acceptable solutions should be based and how similar problems are being dealt with by the developed countries. The paper concludes with a pathway to better airspace management in India. It is restricted to airspace management by civil-military coordination and does not intend to deliberate on inter-Services airspace management in the tactical battle area.

THE FUTURE OF CIVIL AVIATION

The annual report of the MoCA (2006-07) forecasts the growth of passenger traffic by 400 per cent in the next 20 years. In 2006-07, airlines have carried nearly 86.76 million passengers as compared to 73.35 million in 2005-06. The domestic passenger traffic has witnessed a massive growth of 41 per cent in 2006-07.[2] This has resulted in an ever-increasing number of full-time airlines, low-cost carriers and regional airlines, and a rising demand for helicopter services and smaller jet services for the corporate sector.

The civil aviation sector is likely to grow at the rate of 25 per cent or more for the next 10 years.[3] It is expected that by 2020, the passenger air traffic, currently at 96.4 million, is likely to reach 280 million, and air cargo is likely to jump from the current 1.6 million metric tonnes to 9 million metric tonnes. The Civil Aviation Ministry has planned investment worth Rs. 41,000 crore over the next five years.[4] Meanwhile, the fleet sizes have also increased from 150 to 300 in the past two years, and in the next six years, more than 300 new aircraft are likely to fly in Indian skies. It is estimated that the fleet size of Indian carriers will increase by almost 200 per cent by 2012, reaching the figure of 700 aircraft. Boeing estimates an additional 856 new orders for all manufacturers over the next 20 years, while Airbus raises the figure to 1,100 aircraft.[5] Based on these figures from the MoCA and civil aviation experts, it could be assumed that by 2020, the Indian civil aviation industry will have a fleet of approximately 1,800 aircraft or more, and it will fly approximately 280 million passengers (domestic and international), and lift 8-9 million metric tonnes of cargo.

2. Annual Report 2006-07, Ministry of Civil Aviation, available at http://civilaviation.nic.in, accessed on 16 Aug 2007, pp.7-49.
3. n.1 p.36.
4. "The Way to Go," *The Indian Express* (New Delhi), August 15, 2007.
5. n.1.

It is estimated that by the year 2030, the number of domestic and international passengers is likely to shoot up to 400-450 million.

These estimates are mainly about the major players and larger aircraft. Apart from primary aviation activity, secondary aviation activities will also swell, paramilitary and police forces will acquire their own fleets for organisational requirements, and a variety of smaller – from two to twenty-seater fixed wing – aircraft for private operators and chartered services, flying clubs and helicopter services, tourism, pilgrimage, sporting, adventure aviation activities and metro air taxi services from roof tops are like to saturate the air space from low-level to 1,5000 feet.

If the growth rate projected by the MoCA up to 2020 is extrapolated for the next ten years at the moderate growth rate of 6 to 8 per cent, it is estimated that by the year 2030, the number of domestic and international passengers is likely to shoot up to 400-450 million, further boosting the number of aircraft, airports, air traffic services and technologically advanced CNS/ATM systems required for efficient airspace management. If the presumed growth of civil aviation by the year 2030 was to be plotted on the Indian map, the emerging picture will indicate that the skies may not be saturated but a very large part of the Indian airspace will have a high density of aviation activity.

The AAI controls and manages 127 airports (all inclusive)[6] and the IAF controls and manages 61 (19 open for joint operations).[7] It is expected that the increasing demand of aerial connectivity and expansion of civil aviation activities over the period of the next 20 years would require 200 or more operational airports (including construction of new airports). The metro cities and international airports like Delhi, Mumbai, Kolkata, Chennai, Bangalore, Ahemdabad, Pune, Hyderabad, Amritsar, Thiruvananthpuram, Goa, Guwahati, Nagpur, etc will remain the primary hub centres. Cities like, Srinagar, Jammu, Ludhiana, Chandigarh, Agra, Jaipur, Jodhpur, Lucknow, Patna, Varanasi, Bagdogra,

6. Comptroller and Auditor General of India, "Review of Infrastructure & Operational facilities, Airports Authority of India" (Report-17 of 2007), pp. 38-41, available at www.cag.nic.in accessed on September 20, 2007 and Annual Report 2006-07 MoCA, n.2 p.45.
7. "Air Traffic Services: Indian Air Force," available at http://indianairforce.nic.in accessed on September 17, 2007.

Dibrugarh, Jorhat, Bhopal, Indore, Bhubneshwar, Vishakhapatnam, Port Blair, Coimbatore, Mangalore, Madurai, Trichy, Calicut, etc would emerge as secondary hub centres, and smaller airports at Pathankot, Shimla, Dehradun, Jaisalmer, Gwalior, Agartala, Belgaum, Bhuj, Dimapur, Kandla, Khajuraho, Imphal, Silchar, Pondichery, Ranchi, Raipur, Cochin, Vijayvada, Tirupati would emerge as feeders for primary and secondary airports.

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The network of primary, secondary and feeder airports would generate 8,000 or more flights every day. International arrivals/departures and transiting air traffic are likely to generate another 4,000 flights, thus, boosting the civil air traffic up to 12,000 flights from altitudes of 2,000 to 46,000 ft. Military fighters, transports, helicopters and unmanned aerial vehicles (UAVs) will generate approximately 3,000 operational and training flights that will operate within the web of civil flights. Therefore, we could safely assume that in a cycle of 24 hours, 12,000 to 15,000 aircraft will fly in the Indian airspace, thus, generating a volume of a minimum 43,80,000 (12,000 × 365) aircraft movements per annum, registering a growth of 450 per cent against the projected figure of 9,54,080 for year 2006-07.

The network of international, domestic and smaller regional airports and flow of traffic along these routes also indicates that states like Delhi, Punjab, Gujarat, Maharashtra, Uttar Pradesh, Karnataka, the northeastern states, the southern peninsula south of the Mangalore-Bangalore-Chennai axis, and the triangle formed by Kolkata-Patna-Bhubaneshwar would emerge as choke points, with high density and variety of air traffic. In such a scenario, military aviation will not be able to enjoy the freedom of operation over restricted areas that it enjoys today. A large portion of restricted areas will have to be released for free flow of air traffic. The air operations at a few air force bases in Punjab, Gujarat, and Maharashtra and Delhi would be impeded by air congestion

between 6,000 to 40,000 ft. And, in certain cases, the air force bases may have to be shifted to locations with less density of traffic, leaving only the assets which are operationally imperative for the security of the airspace. For example, the air traffic density would be lower between latitude 1800 N to 2500 N and 7800 E to 8500 E, along India's eastern coast line. This is also the area of India's strategic depth in central and southern India. The geographical area could be highlighted by a triangle formed by the Gwalior-Varanasi-Kolkata axis in the north, Kolkata-Vishakhapatnam-Chennai axis along the coast line and Chennai-Nagpur-Gwalior axis in the west. Within this area, the air traffic is likely to be at higher altitude and of transitory nature. Therefore, as a measure of long-term plans, military aviation needs to work out how the operational military aviation would function effectively in the continuum of the airspace shared equally by all users, with minimal conflict and maximum capacity management.

The technologies in the 21st century will allow the next-generation supersonic passenger jet that would fly 300 passengers at more than 1,500 miles per hour. The high speed civil transportation (HSCT) is expected to cross the Pacific or Atlantic in less than half the time of modern subsonic jets. The air travellers of the future may step onto a double-deck jetliner that resembles a flying wing, capable of carrying up to 800 passengers over 7,000 miles at a cruise speed of approximately 560 miles per hour (mph). The blended wing body (BWB) design will maximise the overall efficiency of the aircraft by integrating the engines, wings and body into a single lifting surface. The BWB will also provide new technologies for many future aircraft, and some applications of BWB technology include commercial transports and very-long-range military cargo aircraft. On the other hand, military aviation may see introduction of hypersonic aircraft (hypersonic speed is defined as speed above Mach 5 or above five times the speed of sound). Hyper-X is an experimental hypersonic flight research programme at the National Aeronautics and Space Administration (NASA). The purpose of the programme is to develop a hypersonic air vehicle powered by an air-breathing engine. The hypersonic propulsion systems will allow the development of very high-speed strike aircraft, manned or unmanned, capable of attack at great distances deep in

hostile territory in a very short time.[8] By the middle of this century, unmanned airliners may become a reality. The advent of such technologies in the civil aviation industry would mean very high speed aircraft, less reaction time, fully automated global CNS systems. Such technologies require minimal human interface and may not require any active controlling, thus, demanding extensive prior coordination, with no margin of error.

The future air navigation systems (FANS) were first conceptualised in the mid-Eighties. The International Civil Aviation Organisation (ICAO) first developed the high level concept of FANS in 1984, and FANS as we know them today, had their beginning in 1991 with Pacific engineering trials (PET). The FANS concept was developed to improve the safety and efficiency of airplanes operating under procedural control. This method uses time-based procedures to keep aircraft separated. The separation standard is determined by the accuracy of the reported positions, frequency of position reports, and timeliness of communication with respect to intervention. The continuous process of development and upgrades on FANS has resulted in seamless navigation, communication and surveillance services. The benefits of FANS include fuel economy, reduced flight time through direct routing, increased payload capability for flight limited by take-off weight, and reduced lateral and longitudinal separations and selection of optimum altitude for a combination of distance, route and fuel consumption. Automatic dependent surveillance (ADS), satellite navigation systems (GPS, GLOSSNAS, GALILEO), controller-pilot data link communications (CPDLC), required navigational performance (RNP) and required time of arrival (RTA) are the main features of FANS. Approximately, 15 airlines are operating aircraft with integral FANS upgrades. Larger civil aircraft manufacturers have already introduced FANS on their modern fleets. In India, AAI is in the process of installing a dedicated satellite communication network (DSCN), the global positioning system (GPS) aided geo-augmented navigation (GAGAN) is likely to be operational in 2008, ADS and CPDLC that have been installed and operationalised at Mumbai and Delhi airports, have been under trail since December 2006.[9]

8. NASA, "Air Transportation in the 21st Century and X-43A Hypersonic Aircraft," available at www.nasa.gov and www.aerospace-technology.com, accessed on August 23, 2007.
9. n.6.

SECURITY OF AIRSPACE AND SAFETY OF CIVIL AVIATION

The security of the airspace from unwanted intrusion/violation or activities that jeopardise the national security and aviation safety is an important task of the IAF which has been the largest occupant and user of airspace hitherto. In July 9, 2004, Minister of State for Civil Aviation Praful Patel informed the Lok Sabha that "airspace available to military and civil aircraft is 35 per cent and 65 per cent of the total of the Indian airspace respectively."[10] The IAF occupied and controlled the major portion of the segregated Indian airspace, primarily for two reasons. Firstly, the responsibility of the air defence of the Indian airspace, including the territorial waters, island territories and littorals lies with the IAF which, therefore, needs to have a control mechanism to execute this responsibility. Secondly, the nature and peculiarities of operational and training activities of the IAF require segregated airspace to avoid interference with civil aircraft and enhance safety of civil aviation.

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In pursuance of this responsibility to defend the national airspace, the entire Indian airspace is divided into five air defence identification zones (ADIZs), which extend well into the ocean to cover island territories and economic assets like oil rigs, etc. It is the responsibility of the IAF to scrutinise flight, plans, issue air defence clearance and identify each and every flight, civil or military, entering, transiting or originating from an ADIZ. Prompt identification, initiation of appropriate tactical action to identify the aircraft or initiate other necessary actions, as specified in standard operating procedures to deal with the situation, require round-the-clock surveillance of the airspace, flow of information, real-time coordination and constant monitoring of traffic in a defined airspace by both civil and military control organisations and often in a

10. Shri Praful Patel, MoS for Civil Aviation, while answering an Unstarred Question 572, in the Lok Sabha on July 9, 2004, available at http://civilaviation.nic.in.

time critical and stressful environment. The current air traffic management system, based on ground-based navigational aids, voice communication and radars, will eventually be unable to cope up with the predicted growth of air traffic, further complicating the task of air defence.

In addition, there are other restrictions on the use of airspace, for example, prohibited, danger and restricted zones for the security of strategic political, civil and military assets and areas earmarked for safety of civil aviation, like air-to-ground and artillery firing ranges. The new technologies have led to expansion of military aviation and the number of airspace users have also been increasing; new aircraft induction, unmanned aerial vehicles (UAVs), aerial refuellers (ARs), airborne warning and control system (AWACS), increasing number of missiles and expansion of army and naval aviation demand segregated airspace and impede unrestricted use of airspace. The other peculiarities of military aviation and particularly of the air force that demand segregation of the airspace are:

- Unrestricted aerial combat manoeuvring in the horizontal and vertical planes.
- Very large band of vertical airspace for combat training and exercises.
- Quick reaction high priority missions like air defence missions that demand highest priority for take-off and landing. Time critical no communication missions, search and rescue missions and intelligence missions require exclusive use of airspace.
- The classified nature of some of the military missions precludes the possibility of placing all military movements on the open flight plan network.
- Operational and training flying of UAVs has added to the complexity and demand for additional airspace.
- Separate communication, navigation and air traffic control procedures.
- Short duration of flights, with frequent take-off and landing and low endurance as compared to civil aircraft.
- Weather conditions, like poor visibility, low clouds, precipitation, thunder, lightning, etc adversely affect military aviation as compared to civil aviation. The operational objectives, flight safety considerations, training and experience of pilots play a vital role in the decision to fly in marginal weather conditions.

- The operational and training flying cannot be segregated, for the combat pilot training is a continuous and never ending process. Different aircraft, military avionics, procedures, peculiarities of operations over different terrain, ability to accomplish missions by day and night in all weather conditions require constant practice, and keeping abreast of evolving tactics makes training a routine task. Therefore, the combat squadrons deployed at forward airfields are required to fly regular training missions to maintain high operational readiness.

The aforementioned and a variety of other peculiarities demand that military aviation is segregated from civil aviation primarily for reasons of safety, divergent operational environments, organisational requirements and ease of control. However, this situation is rapidly changing. During, the mid and late Nineties, civil aviation in India comprised a small segment of airspace users and civil air traffic could be easily managed within the confines of existing air traffic services (ATS) routes and marshalling areas in the vicinity of airfields. The unprecedented growth of civil aviation witnessed in the last decade has put extreme pressures on air traffic services and there is a constant requirement of additional airspace for safe, efficient and economical flow of traffic. The segregation of airspace for specific airspace users puts restriction on other airspace users which, in turn, leads to uneconomical routing, excessive fuel and time consumption and impediments to smooth flow of traffic. This situation causes the conflict of requirement between civil and military aviation.

CIVIL-MILITARY COORDINATION: STUMBLING BLOCKS

In last three to four years, there have been numerous instances of flight safety incidents where civil and military aircraft have had a close shave, causing safety concerns for both civil and military aircraft. A recent media report cited 21 near miss reports in 2005, and 26 in 2006, and out of 26 incidents in 2006, the IAF and civil aviation aircraft were involved in seven incidents.[11] Lack of coordination, poor communication leading to blockages in flow of information, different control agencies controlling air traffic in the same airspace and procedural lapses

11. Manju V., "Air Scare: 2 Near Misses Every Month" *The Times of India*, April 2, 2007.

are some of the main reasons. However, now the government has set up an Inter-Ministerial Coordination Committee to discuss various issues pertaining to the management and security of the Indian airspace in accordance with recommended practices laid down by the ICAO. The terms of reference for the Inter-Ministerial Coordination Committee are: [12]

- Civil-military coordination and cooperation in managing airspace and airspace security in India.
- Suggesting measures for flexible use of airspace while keeping in view the international changes and commitments.
- Integration of civil-military radars and related infrastructure.
- Optimum human resource utilisation for effective airspace management.
- Creation of a Joint Control and Analysis Centre at all airports in India.
- Any other issue vital to airspace management and security in India.

The Inter-Ministerial Coordination Committee has suggested a roadmap for civil aviation and various issues pertaining to civil-military coordination have been discussed with the Ministry of Defence (MoD) but the civil-military coordination has not taken off. The main concerns of civil aviation are:[13]

- Large parts of the Indian airspace are reserved for defence use, thereby restricting the choice of optimal routes for commercial aircraft.
- In order to meet the expanding requirements of civil air traffic, there is an urgent need to widen the existing air corridors, provide them uni-directional air corridors, to provide smooth flow of air traffic and, thus, enhance air safety.
- Restrictions on civil aviation movements in terms of choice of altitudes, timings and routing of the aircraft which is uneconomical.
- The airspace management model of developed countries like the USA should be followed to make the airspace permanently available for civil aviation and ensure that segments of airspace are re-vested and made available to defence on request.
- To optimise the utilisation of restricted airspace, by networking of radar and data systems, which should be acquired on the basis of mutual compatibility.

12. Shri Rajiv Pratap Rudy, MoS for Civil Aviation, while answering an Unstarred Question 922, in the Lok Sabha, December 8, 2003, available and downloaded from http://civilaviation.nic.in.
13. Naresh Chandra Committee report, MoCA, *A Roadmap for the Civil Aviation Sector* (2003). Available on http://civilaviation.nic.in/moca/nccommittereport.pdf on August 17, 2007 and AAI, Policy on Airport Infrastructure downloaded from http://aai.aero/misc/policy on August 17, 2007.

- Additional land is to be provided at civilian enclaves in military airports.
- Additional slots should be made available for civilian flights at military airports.
- To facilitate effective coordination and cost sharing, civil and defence air traffic controllers (ATCs) may be co-located where feasible.

There is no formal organisational structure to coordinate the airspace between civil and military aviation except air force liaison units at the four metropolitan airports, therefore, there is no platform to discuss and formulate a national level strategic airspace management mechanism, and the existing mechanism for tactical or routine liaison has proved grossly inadequate. However, there is a general understanding between the AAI and IAF that "flexible use of airspace" is the way forward and formal discussions and official interactions have resulted in a better understanding of each other's requirement, and as a result:

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- All IAF aerodromes are made available for civil aviation. At present, 19 of these airfields are being used by civil aviation.
- The airspace above Hindon airfield near Delhi has been has been made available above 3,600 ft, to decongest the airspace above Delhi.
- Five ATS routes have been allowed to be routed through restricted IAF airspace to save time and fuel.[14]
- Use of restricted IAF airspace above FL 280 in Hyderabad area.
- Extension of watch hours at IAF airfields to accommodate civil flights.
- Acceptance of international flights at IAF bases and acceptance of civil flights at strategic IAF airfields where civil enclaves do not exist.
- Releasing IAF ATCs on deputation to AAI for cross-training and utilisation of IAF controllers in times of crisis.

In line with the "open sky policy," Chief of Air Staff, Air Chief Marshal F. H. Major has assured, "We do understand that expansion of the civil aviation sector is

14. Press Trust of India, "IAF Opens up 5 Routes for Civil Air Traffic," *Hindustan Times*, July 24 2007, downloaded from http://www.hindustantimes.com on August 07, 2007.

a must for our nation's progress and we are extending all assistance in this regard." The flexibility demonstrated by the IAF notwithstanding, a lot more needs to be done to achieve an efficient, if not ideal, airspace management mechanism to meet the burgeoning civil aviation and operational requirements of military aviation. The concerns of both the IAF and AAI need to be addressed at the highest level to resolve the apprehensions and find a mutually agreeable path of accelerated progress. The draft civil aviation policy of the MoCA envisages that management of the entire Indian airspace be vested with civil aviation and released for use by the defence Services as per requirement projected, which impinges upon the IAF's right to utilisation of airspace and does not identify it as an equal partner in policy formulation. The IAF, therefore, would like the issue to be resolved by a Joint Working Group comprising representatives of all relevant agencies like the MoCA, MoD, IAF, DGCA and AAI.

Unlike the smaller European and Southeast Asia countries, India has a large landmass, larger number of airfields and enormous airspace which can accommodate both the growing civil aviation and military aviation. It is more a question of management of national resources in a manner that would meet the requirements of growth in civil aviation, national airspace security and also accommodate the operational imperatives of military aviation. There is an inescapable requirement of integrating civil and military radars to share a common air picture; secondly, the CNS/ATM system should also be on a common grid, and the military aircraft are to be upgraded to meet the requirements of future air navigation systems; thirdly, we need to have a common cadre of civil and military air traffic controllers who are familiar with each other's controlling procedures and operational requirements. The common pool of controllers could be developed by sharing resources and sending controllers on cross-training or deputations. Fourthly, civil and military aviation organisations need to share real-time communication and data links to share flight plan information, deviations, delays to handle contingencies more efficiently. The existing system of liaison units needs to be reviewed in terms of its capability to handle increasing traffic, communications and procedural methods all of which need to be restructured to meet the futuristic requirements.

In the overall interest of the growth of the national economy and expansion of safety requirements in airspace, there is necessity for a clear-cut policy on the *modus operandi* for sharing of airspace.

And, most importantly, sharing of airspace through flexible use need to be formalised. In the overall interest of the growth of the national economy and expansion of safety requirements in airspace, there is necessity for a clear-cut policy on the *modus operandi* for sharing of airspace. There are bound to be inherent organisational interests that would cause apprehensions and inertia; however, these could be resolved through institutionalised structures and legislative provisions.

INTERNATIONAL NORMS

The conflict between the growth of civil aviation and the requirements of military aviation is not new to the world of aviation – the more developed and larger nations across the world have faced similar dilemmas in the process of economic growth and security concerns. In the USA, the Federal Aviation Act of 1958 gave the Federal Aviation Administration (FAA) the sole responsibility for a common civil-military system of air navigation and air traffic control. The European Civil Aviation Conference (ECAC) states in Europe are managing civil-military coordination through mechanisms of Euro-control which adopted flexible use of airspace (FUA) in 1996. The global principles of air traffic management are governed by the guidelines and regulations of the International Civil Aviation Organisation (ICAO) issued in the form of Standard and Recommended Practices (SARPS). The ICAO lays down the fundamental communication, navigation, and surveillance procedures, and regulations for air traffic management. The guiding principles of ICAO's global ATM concept are[15]:

- **Safety**. Highest priority in air traffic management.
- **Humans.** Responsible for managing, monitoring and intervening when necessary.

15. Arthur Bradshaw, chairman, Air Traffic Management, in a presentation on, "Global Air Traffic Management Concept," Cairo, December, 2005.

- **Technology.** Technology for integrated and interoperable ground-based and airborne systems.
- **Information.** Sharing of timely, relevant, accurate, accredited information on a system-wide network.
- **Collaboration.** Strategic and tactical collaboration with airspace users and ATM community.
- **Continuity.** Maximum continuity in the face of major outages, major disasters, security threat, etc.

Within the framework of the aforementioned guiding principles, the global concept of airspace management is expected to provide equal access, improved traffic handling capacity, cost-effectiveness, global interoperability, aviation safety and security, efficiency, and meet the environmental guidelines.[16]

The problem of airspace management needs to be resolved within the framework of ICAO regulations and guiding principles because safety, interoperability and cost-effectiveness can be achieved only when there is global uniformity in air traffic control and airspace management. The requirements of air defence and military operational flying would have to be given precedence over general aviation whenever the situation demands; however, it should preferably be pre-planned and with the exception of time critical contingencies (air defence missions, casualty evacuation and search and rescue (SAR) missions, etc). There are bound to be certain geographical areas that would have to be decongested depending upon the density of flying activity – civil, military or private. Both the civil and military aviation authorities have identified and addressed some of the critical areas although a clear–cut policy on FUA has not been formalised owing to organisational apprehensions. The concept of FUA is briefly explained below.

FLEXIBLE USE OF AIRSPACE (FUA)

The basis of the FUA concept is that airspace should no longer be designated as either military or civil airspace but should be considered as one continuum and used flexibly on a day-to-day basis. Therefore, any airspace restriction or

16. Bradshaw,Ibid.

Effective application of the FUA concept requires the establishment of a high level national airspace body tasked with reassessment of the national air space, the progressive establishment of new flexible airspace structures and introduction of procedures for the allocation of these air-space structures.

segregation should be of temporary nature. One of the major objectives of FUA is the more efficient use of airspace by civil and military users. It increases the flexibility of airspace use and provides air traffic management (ATM) with increased capacity management. FUA allows the joint use of air space by appropriate civil-military coordination to achieve separation between general and operational flying. The segregation of airspace is based on real usage within a specified time-frame. The advantages of FUA are:[17]

- Increase in air traffic control capacity.
- Decongestion of the airspace reduces delays to general air traffic, civil or military
- Enhanced real-time civil-military coordination, resulting in enhanced safety.
- Increase in flight economy by reduction in distance, time and fuel.
- Reduction in airspace segregation needs.

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- **Strategic ASM.** National and international airspace policy.

17. Euro-control Handbook on Airspace Management, *The Concept of the Flexible Use of Airspace Management* (Edition 2.0, October 22, 2003) pp. 2.1-2.3, available on http://www.eurocontrol.int, accessed on September 20, 2007.
18. Ibid.

- **Pre- Tactical ASM**. Day -to-day allocation of airspace.
- **Tactical ASM.** Real-time use of airspace.

The strategic ASM consists of a joint civil-military process established by the "high level national body for airspace policy" which formulates the National Airspace Management Policy. The strategic objectives of the high level national body for airspace policy are:[19]

- To maintain safe and effective management of airspace and its supporting infrastructure.
- To carry out fair and effective regulation of that airspace system.
- To build confidence and respect between the airspace regulators and airspace users through consultations and cooperation.
- To maintain and improve the standards of service through effective planning and monitoring of the high level body's activities and key processes.
- To accommodate shared use of the airspace by all user groups.
- Harmonise airspace management procedures.

The national body for airspace management formulates the national airspace policy and reassesses the national airspace structure for flexible use of airspace; and publishers the national airspace structure and ATS routes in AIP. The body also coordinates the planned major events like large scale military exercises and notifies these events. The guiding principles for the national body are similar to the ICAO principles of airspace management such as safety, consultations, cooperation and environment, etc. The national body is charged with reconciling civil and military operational needs, without affording preferential treatment to either, and ensuring that airspace planning takes into account the interest of all airspace users.[20]

The pretactical airspace management consists of the day-to-day management and temporary allocation of airspace through national and regional airspace management cells. The allocation of airspace, setting up of approved agencies (AA) to coordinate and approve use of airspace and airspace management cells,

19. Ibid., pp. 3.1-3.3.
20. Ibid.

central airspace data function (CADF) and integrated flight plan processing system (IFPLS) are all controlled and coordinated at the pre-tactical level. Setting up of temporary restricted areas (TRAs), temporary segregated areas (TSAs) and conditional routes (CDRs), notification on reduced flying activity, overflying of restricted areas or danger areas are the functions of approved agencies and airspace management cells at the pre-tactical level of airspace management.[21]

The tactical airspace management at level-3 consists of the real-time activation, deactivation or real-time reallocation of the airspace allocation made at level-2 and resolution of specific airspace problems or traffic situation between civil and military ATS units or controllers. (This task is presently done by air force movement liaison units and FIC). The real-time civil-military coordination capability enhances the flexibility in the use of airspace. The civil-military coordination includes the prompt exchange of information relevant to safe and expeditious conduct of civil and military flights which could be done in either active or passive mode. The active mode of coordination relates to the coordination of traffic situations requiring controller(s) action and is usually done by verbal or speech methods, whereas the passive mode of coordination relates mainly to communication of information (transmission of data) without any action by the controller. Silent coordination is used in situations which require prior coordination, for example, crossing of airspace and/or route structures. Crossing of ATS routes, controlled airspace, transfer of control responsibilities, transit through TRA or TSA and routine exchange of traffic information are executed at the tactical level or level-3 of airspace management.[22]

THE PATHWAY AHEAD

Airspace management is a set of complex issues and every aspect has to be dealt with separately, whilst issues pertaining to communications, and navigation are addressed on priority by civil as well as military organisations; even though it may take a few more years to have a common interoperable platform, plans are underway to have satellite-based capability for seamless navigation and

21. Ibid., pp. 4.1-4.6.
22. Ibid., pp. 5.1-5.7.

communication facilities over the entire continent and beyond. However, in view of the rapidly increasing traffic and safety concerns, one of the main challenges for aviation over the two decades is the creation of a continuum of the Indian airspace for air traffic management. Some of the important milestones for such a roadmap are enumerated as under:

The national airspace policy should define the vision for use of airspace by all airspace users as a national asset. Access and equity should remain the basic premise for use of airspace.

National Airspace Strategy

The national airspace policy should define the vision for use of airspace by all airspace users as a national asset. Access and equity should remain the basic premise for use of airspace. The main objective of managing the Indian airspace and enhancing civil-military coordination is to provide a common approach to airspace policy, planning and management issues, and formulate a national airspace strategy. The national airspace strategy will have to be implemented by enacting relevant legislative provisions which are obligatory upon all players with time-bound feedback accountability procedures.

The Civil-Military Coordination Group

Responsibility to implement the National Airspace Strategy should flow from top to bottom in the respective organisations. A joint working group (JWG) or a central coordination committee, comprising members from the MoCA, MoD, DGCA, IAF, AAI and navy needs to be set up to oversee the implementation of the national airspace strategy, reassess the requirements of actual airspace use, formulation of airspace structures, and execute the strategic level functions for flexible use of airspace. This group will jointly formalise the airspace management procedures for all three levels of control for flexible use of airspace.

Designation of Approved Agencies and Airspace Management Cells

The civil-military coordination group may designate appropriate agencies as approved agencies for centralised airspace requirements and regional airspace

management cells for level-2 or pre-tactical ASM functions. These cells may be set up at Flight Information Centres with military representatives for larger areas with high density traffic or at military air defence units in security sensitive areas.

Integration of Radars

The policies and procedures would require the requisite infrastructure on the ground that would support the integrated airspace management programme. Even in the era of space-based global navigation systems and communication satellites, radars and V/UHF communications will remain the primary tools of air traffic control and air defence. The 12[23] existing civil air surveillance radars (ASRs) and monopulse secondary surveillance radars (MSSRs) are grossly inadequate to cover the entire Indian airspace. The air force has a much larger number and variety of radars; however, these radars are deployed based on threat perception and air force surveillance requirements. There is an urgent necessity for integration of civil and military radars to enhance the radar cover over the entire landmass and extending over the sea as far as possible. The main problems of integration are different make, different vintage, different countries of origin, different data sharing protocols and eventually the issue of intellectual property rights. The radar procurement policies of the MoD and MoCA need to be rationalised with an aim to share the radar picture and work on a composite air picture to share traffic information.

Communication and Navigation

Similarly, civil and military aviation controlling agencies need to be connected on real-time data link for sharing of relevant flight plans and flight data to reduce the verbal communication and consequent delays. As mentioned earlier in the paper, the AAI is in the process of installing a Dedicated Satellite Communication Network (DSCN) comprising the very small aperture terminal (VSAT) at 80 airports with full redundancy, including the space segment for highly reliable communications. The Space-Based Augmentation System (SBAS) more popularly

23. Air Traffic Services, "Airport Equipped with Primary and Secondary Radar," available on www.civilaviation.nic.in, accessed on September 20, 2007.

known as GAGAN would include hardware for eight reference stations, master control centre and a part of the uplink station. GAGAN will provide en-route navigation for the entire landmass of India and precision approaches to aircraft at all airports.[24] The automatic dependent surveillance / controller pilot data link (ADS/CPDLC) has also been installed at Delhi and Mumbai airports to reduce RT congestion, remove drawbacks of HF communication and enhance the area of surveillance.[25] On the other hand, the air force is also in the process of modernising its communication, and navigation facilities. What is more important is that any modernisation or upgrade in civil or military aviation communication navigation systems must cater to the interoperability between the systems.

Technological Interoperability

The implementation of FANS, installation of GAGAN, ADS, CPDL and voice communication system are all integrated technological upgrades of ground-based, airborne and space-based systems. The advanced technology in communication, navigation, meteorology and surveillance system is the only way to handle the growing air traffic situation. In airspace which is shared by multiple users, all the users need to be at the same plane as far as technological upgrades are concerned or there will be interoperability problems that would lead to safety hazards, an absolutely unacceptable condition in the 21st century. The military aviation also needs to upgrade the existing systems to match the requirements of international norms of communication and navigation. It starts from the basic requirements of fitting RVSM compliant altimeters in non-combat aircraft. The deficiency of IFF mode C (automatic altitude transmission) in some of the aircraft often creates an air traffic situation. IFF mode S has been a long outstanding deficiency in military aviation, though induction of new generation of fighters, transports and helicopters may have IFF mode S. However, the military ground stations would have to be upgraded to utilise the system. The liaison and coordination procedures between military and civil control agencies need to be reviewed and upgraded with the latest technology to meet the challenges. The air force network of various radars and

24. n.2, p.11.
25. Ibid., p.50.

sensors to create a composite air picture needs to take into the account the requirement of selectively integrating civil aviation radars and communications to provide a seamless, surveillance, navigation and control facility. The IACCS, ODL and Indian Regional Navigation Satellite System are different aspects of an emerging net-centric environment, which should not only be fully integrated with the civil aviation environment but also meet the international norms of aviation technology and safety norms.

Air Traffic Control Capacity

The shortage in the number of air traffic controllers is a global phenomenon and this needs to be addressed by creating a common cadre of controllers who could handle both civil and military aviation. The organisational structures like joint working groups, airspace management cells and airspace management approving authorities should have adequate representations from civil and military air traffic controllers. Regular joint training programmes, and cross attachment for controlling duties would help understand each other's rules regulations, controlling constraints and the working environment, and create better understanding amongst the controlling community. The joint cadre of air traffic controllers should not be viewed as prospective loss of turf – rather, it should be treated as reinforcement that would assist and cooperate to achieve larger organisational goals.

CONCLUSION

The objective of sustained economic growth and national development remains the primary one for the country. The civil aviation sector is the driving force for economic growth and military aviation is the powerful instrument of ensuring enduring peace, thus, creating the suitable environment for such a development. Instead of being independent, both are interdependent and complementary. Any policy on management of airspace, therefore, should identify and work on this fundamental premise.

Flexible use of airspace is the inescapable necessity of the times to come and the fundamental need of FUA is cooperation and coordination. Both the civil and

Both the civil and military aviation authorities have accepted the necessity of, and initiated, measures that would eventually pave the path for FUA.

military aviation authorities have accepted the necessity of, and initiated, measures that would eventually pave the path for FUA. Nonetheless, urgent steps need to taken to resolve the issues of mistrust and apprehensions pertaining to encroachment in each other's organisational independence. While the process of installing or acquiring enabling prerequisite technologies, integrated CNS/ATM system, integration of radars, development of space-based capabilities and ground infrastructure (larger numbers of runways) is underway, the interim period needs to be utilised to formulate the national airspace policy, define airspace structures and generate an environment of trust and cooperation. The AAI, DGCA and IAF need to intensify efforts to find mutually acceptable solutions which would address:

- The requirements of increasing civil aviation activity.
- Prioritise the role of military aviation in the national airspace security.
- Identification of all airspace users.
- Equitable access to airspace for all airspace users.
- Airspace structures to meet the national and regional requirements
- Enacting new legislative provisions for enforcement of the airspace management policy in consonance with established international norms set by the ICAO.
- Establish an appropriate organisation, a joint working group (JWG) or a central coordination committee for planning and monitoring the implementation of all three levels of FUA

Military aviation would have to lead the way and accommodate the requirements of civil aviation by sharing its assets, be it airfields, human resource or airspace, as far as possible. Eventually, as a measure of long-term planning, some of the air force assets would have to be relocated to minimise the conflict and enhance air safety.