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August 2017
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As the nation gets ready to become the fastest-growing aviation market, the first line to counter the challenges that will be thrown up emanating from the magnitude of growth will rest with the Air Navigation Services that will have to craft out and strategise long-term solutions.

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Readying for the future

India is among the fastest-growing aviation markets in the world and will be in the top three by 2020. Air traffic continues to grow at a rapid pace – airlines in the country have ordered 500-odd aircrafts in the next decade – and this trend is likely to continue in the future. The magnitude of growth that is expected will create significant pressures on air traffic management in the country to which ad hoc responses will not suffice. Long term solutions will require a new way of thinking with a fresh approach because the challenges will only multiply over the years.

As India enters a new growth phase, the issue of airspace and air traffic management infrastructure, a key component of the aviation value chain, requires a renewed focus. There is, then, a need for fresh thinking on how best to prepare the Air Navigation Services Provider (ANSP) to meet the challenges ahead. If India is to meet CANSO's Global Vision for the future of ANS, it will need to address basic issues such as:

- *Seamless and efficient airspace:* Increased cooperation and coordination with global ANS providers in order to create an efficient and seamless global airspace;
- *Managed Safety:* Implementation of a Safety Management System and deployment of appropriate equipment;
- *Regulation:* Effective regulation;
- *Civil-Military Airspace:* Increased cooperation to optimise use of limited airspace;
- *Skills:* Enhanced training and performance;
- *Optimised ATM Systems:* Implementation of productive technology that is interoperable with other ANSPs; and,
- *Security:* Tackling security issues effectively and fast.

Today, the challenges that Air Navigation Services (ANS) professionals face are also those that are faced by aviation in general. These constitute the proliferation of carriers in the domestic market (once the Regional Connectivity Scheme is on in full swing, there will be more entrants); Nagging capacity constraints because of insufficient infrastructure – particularly airports and air traffic control; Air connectivity (number and frequency of services) is unevenly distributed; and, lastly, environmental performance, especially in relation to noise and emissions.

It is a fresh approach that Air Traffic Management (ATM) professionals have been looking out for. First, any technological change in ATM usually develops at a slow pace and the reasons are not so difficult to understand: the high safety requirements and the coordination efforts needed to harmonize standards around the world. Even so, new potentially disruptive technologies have been emerging in ATM together with the need to boost productivity and innovation speed.

These and other important issues will be discussed in this first-ever seminar, **ANS: Challenges & Opportunities**. Air Navigation Services professionals from different fields of Air Traffic Management — the Air Traffic Control and Communication, Navigation and Surveillance departments — will come together to discuss the challenging issues holistically. The seminar will be particularly important in view of the need to agree and develop solutions that will be globally relevant and in keeping with the ICAO ATM Global Concept document that defines ATM as "the dynamic, integrated management of air traffic and airspace - safely, economically, and efficiently – through the provision of facilities and seamless services in collaboration with all parties".

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NAGENDER DUBEY

p48 A LOOK on the back stage players, the Air Traffic Controllers who forms the backbone of the aviation industry, a job that ensures safety of flights.

CNS OFFICERS' GUILD

Meeting to make Indian Airspace Safe

CNS Officers' Guild is a professional body of the communication, navigation, surveillance (CNS) engineers and technical executives of Airports Authority of India. As per ICAO and the global aviation industry these professionals in air traffic management (ATM) are known as *Air Traffic Safety Electronics Personnel* (ATSEP).

ATSEPs are persons with proven competency in the installation, operation and/or maintenance of communications, navigation, surveillance/air traffic management (CNS/ATM) systems. ATSEPs play a vital role of safety in air navigation services. They operate and maintain the state-of-the-art highly complicated ANS systems. The systems are made available 24x7x365 days to the users: the Pilots and ATCOs for safe flying of aircraft over airspace all across the globe.

CNS Officers' Guild is an affiliate member of *International Federation of Air Traffic Safety Electronics Association* (IFATSEA), a global voice of ATSEPs. IFATSEA represents the ATSEPs in ICAO, CANSO, EUROCONTROL and other international bodies.

Air Navigation Seminar – Challenges and Opportunities is being organised jointly with CRUISING HEIGHTS, one of the premier aviation magazine in India on August 25, 2017 at India Habitat Center, New Delhi.

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‘Strategic plan to enhance safety, efficiency and airspace capacity is in place’

Chairman Guruprasad Mohapatra has set a scorching pace at the Airports Authority of India (AAI) since the time he arrived last July. A career civil servant, he has plenty of clarity on what he expects the AAI to do. He offers ideas of the roadmap ahead for the Air Navigation Services. Excerpts from a conversation with him:

Is the aviation sector likely to see a major shake-up soon with Air Navigation Services (ANS), a critical source of revenue for airport operator Airports Authority of India (AAI), being made a separate entity following a recommendation by a government-appointed panel?

As far as present AAI setup is concerned, all the ANS functions are headed by a separate Board of Director, that is Member (ANS). ANS is a specialized stream and thus keeping this in mind the Board level officer was inducted to give due attention and autonomy to the ANS functions. Under AAI, there is separate strategic plan for the ANS road map and the latest state-of-art technology has been inducted in AAI at par globally. The roadmap is in line with the ICAO GANP and to implement the same, separate budget is allocated for development of ANS infrastructure. There is a lot more to gain by the current synergetic model of AAI, rather than separate discrete entities. Any further change in this scenario will be based on the deliberations and direction of the Government.

To enhance airspace capacity and increase safety, has upper airspace harmonization been implemented?

As the traffic growth in India has been forecast to double by 2018, the demand on CNS/ATM system infrastructure is going to be manifold. The efficiency in flight handling has to be enhanced by planning a better route structure, efficient sector planning and prudent use of the resources available. In order to achieve this entire

There is separate strategic plan for the ANS road map and the latest state-of-art technology has been inducted in AAI at par globally.

airspace has to be more adaptable from the user point of view as well as it has to be environment friendly. The solution for meeting the diversity of user requirements is the effective and dynamic management of the pre-designed airspace structures through a highly flexible and integrated Collaborative Decision Making (CDM) process at network, regional, national and local level. Faced with these realities, Airports Authority of India has taken the initiative to review the existing Indian airspace structure and develop a new Airspace Management Strategy to cope with the predicted impressive future growth of air traffic.

India has taken up Upper Airspace Harmonization [UAH] programmes within the Indian FIRs through integration of Surveillance Sensor data (Radar & ADS-B)

India has taken up Upper Airspace Harmonization [UAH] programmes within the Indian FIRs through integration of Surveillance Sensor data (Radar & ADS-B)

& ADS-B) along with an efficient and seamless VHF communication System network.

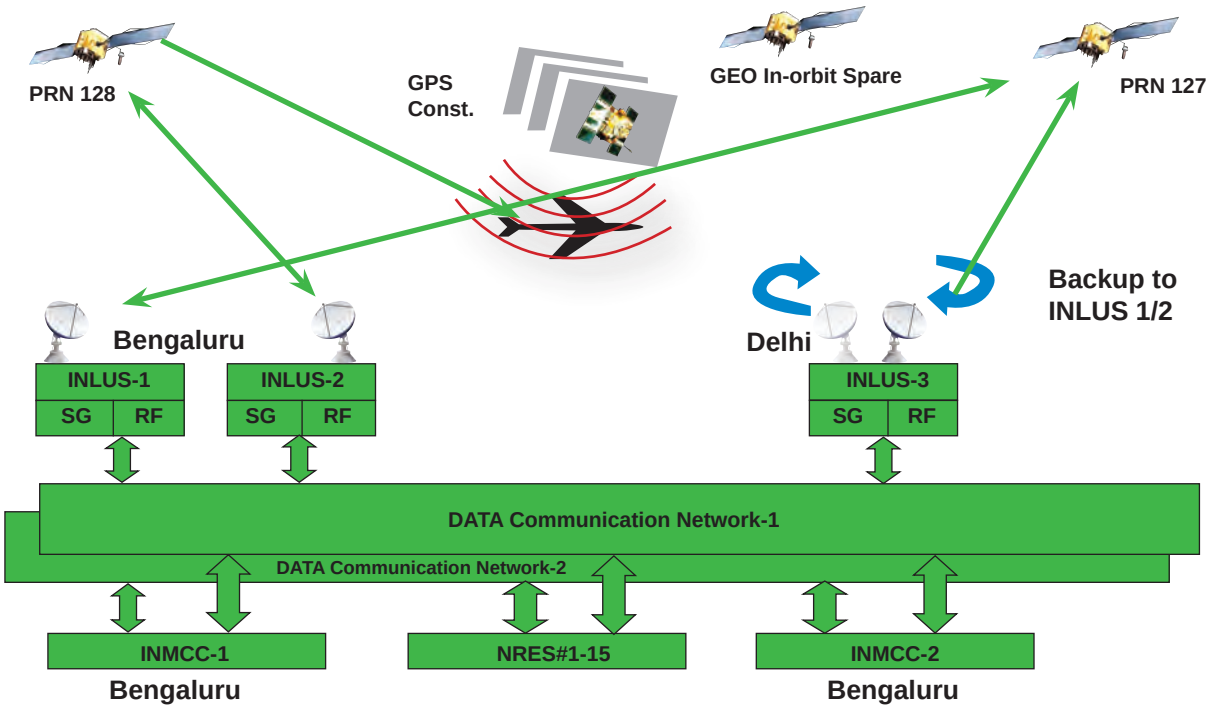
In view of complexity and magnitude, the task has been planned in a phased manner. First phase was completed with restructuring of Chennai FIR and the second phase has recently been completed with Upper Airspace Harmonization in Kolkata FIR. Subsequently restructuring shall also be taken up for Delhi and Mumbai FIRs. CNS/ATM Infrastructure for Delhi FIR UAH is being put in place and is planned to be implemented with the new ATS Complex facility at Delhi airport.

- **How is AAI keeping in tune with the latest technology in its operation and navigation services?**

AAI has put in place a strategic plan in line with ICAO Global Air Navigation Plan [GANP] and Aviation System Block Upgrades (ASBU) to enhance safety, efficiency and airspace capacity through systemic improvements in communication, surveillance, navigation and automation systems.

In the recent past, we have implemented various state-of-the-art technology, CNS-ATM systems and advance ATM procedures to enhance safety, efficiency and reduce congestion in airspace across various airports and the entire Indian airspace. The entire Indian Airspace has been brought under Radar/ADS-B surveillance. Radar/ADS-B sensors have been integrated to provide an integrated multi-Radar based situational awareness to the Controllers. Advanced ATM Automation system with safety alerts and decision making support tools have been implemented at various airports. To reduce delays on ground and in air AAI is also focusing on upgradation of Air navigation Services. Central Air Traffic Flow Management (CATFM) has been installed making India only the 7th country in the world to have the capability. GAGAN has been commissioned.

INDIA'S EYE IN THE SKY



Once mandated, GAGAN will be used nationwide for *en route* and terminal procedures. GAGAN will provide increased operational efficiency, reduced fuel burn and enhanced capacity.

Straightening and optimization of ATS routes and reduction in Aircraft separation standards both in the terminal and *en route* airspace to facilitate optimum flights levels and increased capacity have been implemented. Data Link Based departure clearance have been provided to reduce frequency congestion, enhance operational efficiency and to reduce cockpit workload of the pilots and controllers. D-ATIS, Data Link Based airport weather information have been provided through a common Server to ensure timely availability of weather conditions of 42 airports right in the cockpit.

ADS-C/CPDLC has been provided for situational awareness, surveillance and communication with the aircrafts in oceanic regions. For fog bound airports, CAT-III [B] ILS operation are available for suitably equipped aircrafts at IGIA [there are three of them], Lucknow and Jaipur Airports. AAI will be commissioning CAT-III [B] ILS at Kolkata and Amritsar before start of fog season 2018. The facility will be considered for other airports based on the requirement.

GAGAN will be used nationwide for en route and terminal procedures. GAGAN will provide increased operational efficiency, reduced fuel burn and enhanced capacity.

For improved ground movement, enhanced safety and to avoid runway incursions AAI has installed ASMGCS systems at several airports. Presently all our metros, Hyderabad and Bengaluru airports are having ASMGCS along with vehicle tracking facility. Recently the system has been extended to Jaipur, Lucknow and Amritsar. ASMGCS will be extended to Cochin and Bhubaneshwar airports also.

Futuristic telecom infrastructure (FTI) has been planned to provide networked connectivity across all the airports keeping in mind the future automated technologies required in the field of aviation to increase capacity and enhance the efficiency of the flight movement besides ensuring the safety and security of the aircraft.

- **Is GAGAN ready for full optimisation, to help India break free from the over dependence on the international**

tech regime led by the Global Positioning System (GPS) of the US and Global Navigator Satellite System of Russia?
GAGAN as the name suggests is "GPS Aided Geo Augmented System" and is basically a Satellite based augmentation system (SBAS) and augments the signals taken from core constellation of GPS to provide the additional accuracy, availability, and integrity necessary for all phases of flight, from en-route through approach for all qualified airports within the GAGAN service volume. The system is inter-operable with other international SBAS systems like US-WAAS, European EGNOS, and Japanese MSAS etc. At this point of time the system is not capable of taking information from any other constellation other than GPS, however, the technology is changing very fast and the other SBAS systems in the world are planning to move towards multi frequency, multi constellation setup for the augmentation system, accordingly India will also be adopting the technology suitable for its ionospheric conditions.

● **What are the advantages of GAGAN over the navigation systems? What are the challenges that you think it will face?**
The GAGAN system is the satellite based augmentation system of India which ensures the global seamless navigation for all phases of flight over Indian skies. As brought out above, GAGAN provides the additional accuracy, availability, and integrity. Besides this the vertical guidance improves safety, especially in adverse weather conditions, reduces the circling approaches, facilitate better energy and descent profile management during the final approach and allow direct routings, multiple approaches resulting in considerable fuel savings to airlines and provide for capacity enhancement of airports and airspace

GAGAN will reduce delays, diversion and cancellations due to non-availability of ground based navigation system, as flight is not dependent on series of navigational aids.

GAGAN though primarily meant for aviation, will provide benefits beyond aviation to many other user segments such as intelligent transportation, maritime, highways, railways, surveying, geodesy, security agencies, telecom industry, personal users of position location applications, etc.

India situated in the equatorial anomaly region, ionosphere is one of the major challenge for GAGAN. We will be upgrading our system in future to process dual frequency reception to overcome with ionospheric issues. Other challenge is making the airlines start using the GAGAN facility. In this regard the government is likely to come out with a notification shortly making it mandatory for Indian carriers to only induct aircraft which are compliant with the newly-developed GAGAN navigation system in their fleets from January 1, 2019.

GAGAN provides the additional accuracy, availability, and integrity. Besides this the vertical guidance improves safety, especially in adverse weather conditions.

● **The AAI has taken steps for sustainable development through green initiatives like the establishment of Central Air Traffic Flow Management (CATFM) and implementation of RNAV. How successful have the moves been?**
Airports Authority of India introduced Central-Air Traffic Flow Management in April 2017, after successful completion of trials in Delhi, Mumbai and Bengaluru, the Phase-I of implementation of C-ATFM involves six metro airports, and the Phase-II will involve all airports in India including defence airports. The C-ATFM system is primarily meant to address the balancing of capacity against the demand to achieve optimum utilization of the major resources, viz., Airport, Airspace and aircraft at every Indian airport where there is a capacity constraint. The benefits of C-ATFM will be immense in terms of fuel saving to the airlines and reduction of carbon footprint.

RNAV Standard Instrument Departures (SIDs), Standard Arrival Routes (STARs) and RNAV routes between busy city pair routes have been implemented at all international airports, which have enabled aircrafts to fly optimum profile like continuous climb and descent operations, which contribute immensely towards fuel savings to the airlines and

reduction of carbon footprint thus, sustained contribution towards the environment by Airports Authority of India

● Is AAI planning to look at markets outside India for ANS considering the pool of aviation experts who are professional and skilled?

With the vast pool of aviation infrastructure experts, professional and skilled manpower, we definitely intend to leverage this capability to venture into the international arena.

We have, in the past delivered assignments like procedure design and Flight calibration of Navigational facilities in quite a number of countries in field of ANS. We have also undertaken assignments related to calibration of navigational facilities in several countries. To strengthen this activity, AAI has created a dedicated Business Development Directorate to tap international markets.

● As you expand your activities, what is the skill gap and how are you addressing?

As per DGCA CAR on requirements of maintenance/inspection of Communication, Navigation, Landing and other equipment installed at Airports and en-route, all personnel entrusted with the maintenance/checks of a facility should have undergone necessary training. They should undergo periodical on the-job checks at least once in a year and refresher course at least once in three years.

To meet the above CAR Requirement, AAI has a strong training culture and a robust training policy for the CNS engineers. AAI has Civil Aviation training college (CATC) at Allahabad for imparting training in CNS/ATM facilities and maintenance management along with regional training centers (RTCs) located at Delhi, Mumbai, Chennai and Kolkata. CATC is a renowned Centre of Excellence and member of ICAO TRAINAIR PLUS, which is a cooperative network of training organisations and industry partners working together to develop and deliver ICAO-harmonized training packages. The CNS executives of AAI are trained on *'ab initio'* courses and subsequently trained in advanced courses and refresher courses as a part of continual training and skill upgradation.

All the CNS executives are required to attain proficiency through precise and continuous training plans. The officials are actually placed on the job on active equipment's after attaining proficiency on the specific equipment's. On an average, the training facilities including CATC conducts around 400 courses to impart training to CNS engineers.

AAI has further adopted the recently launched Competency Based Training and Assessment (CBT/A) curriculum by International Civil Aviation Organisation (ICAO) under Next Generation Aviation Professional (NGAP) programme. The above CBT/A curriculum is based on ICAO PANS Training DOC 9868 and ATSEP manual DOC 10057.

AAI has also entered into a MOU with French Civil Aviation Training College [ENAC] to conduct an ANSP Management course at Training Centre Hyderabad. This course is open to middle level executives of both CNS and ATM.

In addition to above to have continuous knowledge up gradation and further development in the ANS technology field, CNS executives regularly attends trainings conducted by OEM whenever a new technology/equipment/system

With the vast pool of aviation infrastructure experts, professional and skilled manpower, we definitely intend to leverage this capability to venture into the international arena.

is introduced or procured apart from training programmes/workshops conducted by ICAO, CANSO, professional bodies etc. at international level .

AAI have also set up an R&D centre at Hyderabad for research and development in ANS field.

● **What about technology upgradation matching international standards in ANS, what are AAI's plans in the pipeline?**

AAI follows ICAO Global Aviation Navigation Plan [GANP] for provision and up gradation of its CNS/ATM Infrastructure. To this effect AAI has available CNS/ATM infrastructure which meets the ICAO ASBU [Aviation System Block Upgrade] Block 0 requirements.

To meet block 0 requirements AAI has introduced ADS-B [installed at 21 locations and planned at 10 more locations] and ASMGCS [Installed at 09 locations, under installation at 02 locations and planned at 02 more locations].AAI has introduced UAH and ATFM. AAI is also examining for introduction of newly launched technology like space based ADS-B Surveillance programme and Remote virtual Tower.

AAI has envisaged to invest approximately `2716 crores in the next five years i.e. 2016 to 2021 for induction of new technology, replacement of existing ANS facilities, GAGAN expansion plan, new ATC tower and Technical Blocks and ANS facilities at green field/ brown field and regional airports.

AAI follows ICAO Global Aviation Navigation Plan [GANP] for provision and up gradation of its CNS/ATM Infrastructure. To this effect AAI has available CNS/ATM infrastructure which meets the ICAO ASBU [Aviation System Block Upgrade] Block 0 requirements.

● **What is AAI's plan for CNS manpower augmentation, recruitment and training for sustenance of the coming new systems being inducted?**

As you know, recruitment is a continuous process in any organisation. The same applies to CNS engineers in AAI. In the last few years we have tried to augment our manpower to cope up with the induction of new equipment's and cater to new airports. Management has taken decision to recruit CNS Engineers at induction level through the GATE [Graduate aptitude Test for Engineers] being conducted by IITs. There is of course some gap, however, AAI has firm recruitment plans to meet the challenge of smooth maintenance and operation of ANS infrastructures through provision of trained CNS manpower after imparting regular trainings.

● **Does AAI believe in outsourcing maintenance of safety critical ANS facilities?**

AAI has a vast pool of excellent trained CNS engineers who are capable to sustain the maintenance of its safety critical ANS facilities. We have dedicated facilities and setup for equipment repair facilities both at component level and at cards/module level for three quipment's through our specialised maintenance units and central maintenance unit.

Apart from this we also have software support facilities, however, wherever required software support services are also taken from the OEMs for upgradation of the system from time to time.

The core CNS/ATM facilities will continue to be maintained in-house. In fact, our CNS experts also provide support to other aviation users like IAF, Indian Navy, HAL, etc. for maintenance and management of similar system operational with them. However, maintenance of ancillary facilities such as UPS, EPABX, Lightning & Surge protection systems etc. are outsourced. ■

ANS IN THE NEXT DECADE
Challenges & opportunities

Air Traffic Management helps aviation to connect vast regions and thereby contributes economic and social benefits to the country while also providing global access to markets, emphasizes A K Dutta.

Aviation provides fast, safe and efficient connectivity across vast regions and contributes to significant economic and social benefits to the country and provides global access to markets. Air Traffic Management (ATM) plays a critical role in building this connectivity by ensuring the smooth and safe flow of traffic.

Since the beginning of this century, air traffic has grown at a tremendous rate across the world. Asia Pacific region continues to be one of the busiest regions in the world for air transport; China, India, Indonesia and Vietnam being excellent examples of this. Indeed, the Asia Pacific region accounts for more than 30 per cent of global air traffic, with over a billion passengers travelling by air annually.

The scenario in India is even more exciting. A growing economy, a sustained fall in ATF prices and an ever expanding middle class have significantly contributed to the Indias growth story, resulting in Indian aviation growing at a very high rate of over 20 per cent per annum over the last two years.Air traffic growth has accelerated further in FY2017, with India overtaking Japan this year to become the world's third largest domestic market behind the USA and China.

However the growth is primarily concentrated at the six metro airports, which account for about 65 per cent of the total domestic passenger traffic, leaving the rest to the remaining 73 airports. The Aviation advisory body, Center for Aviation (CAPA) estimates that the air traffic will sustain the rate of growth in the next two years.

A K DUTTA
Member (ANS)
AAI

Taking cognizance of the impact of air connectivity which has a catalystic impact on regional development, investments, and tourism and job creation significantly, Government of India has launched an ambitious Regional Connectivity Scheme-UDAN (acronym for *'UDE DESH KA AAM NAGRIK'*) for providing connectivity to un-served and under-served airports of the country.

This is a first-of its-kind scheme globally and will create affordable yet economically viable and profitable flights on regional routes so that flying becomes affordable to the common man even in small towns. This path-breaking initiative has the potential to enlarge the aviation grid of India; bring in additional traffic, revenue and profits; create direct and indirect employment; and facilitate economic development in the interiors of India.

> It is this changing operational environment that is to be addressed, while recognizing that the future will be very different from today.

Impact of Growth

However the sustained double-digit rate of air traffic growth has posed challenges for aviation infrastructure. It is well known that creating aviation infrastructure is a long term process which requires large resources. Even though much investment has been made over the last two decades in terms of Greenfield airports, airport terminals, ANS infrastructure, the burgeoning air traffic demand has put tremendous pressure on the capacity utilization, specifically at the metro airports. The mismatch between infrastructure capacity and ever increasing demand is responsible for congestion at major airports, leading to an increase in airline operating cost. Because of congestion, aircrafts are required to burn more fuel, with the fuel costs accounting for over 45 per

ENSURING SAFETY: Insides of remote ATC tracking the operation.

cent of the operating cost of the airline. Air route congestion requires flying the aircraft at non-economic heights.

Apart from resource capacity crunch, skilled manpower shortage is another critical area which needs immediate attention. The manpower shortage is being felt in areas of air traffic management, engineers and technicians, type rated pilots, cabin crew, flight planning and airport management. The government of India has established a dedicated aviation university with an aim to address the skill deficiency. It is envisaged that the newly established National Aviation University would help meet the requirements of skilled workforce in the longer run.

But as the economy continues to grow and air traffic increases there is more work to be done to ensure safe, sustainable growth and development. The overall economic progress of the nation, maturing of new technology and services are having an increasing impact on both global and regional air traffic management operations and the capacity to deliver efficient and effective air navigation services.

It is this changing operational environment that is to be addressed, while recognizing that the future will be very different from today.

This is a future where drones, remote tower services, artificial intelligence and data analytics with greater integration of systems and data between ground and airborne systems, will all become common place and these will have a significant influence on how capabilities are developed to provide effective and efficient air traffic management.

It is a future that will see increasing demand, greater congestion, tighter environmental constraints, and escalating demands on scarce resources, including airspace, land use around airports, and even aviation frequency spectrum.

Creating and operating a seamless global airspace through a safe, efficient, harmonized, and cost-effective air traffic management (ATM) system will play a vital role in meeting this challenge.

As the economy continues to grow and air traffic increases there is more work to be done to ensure safe, sustainable growth and development.

Embracing the technological Change

The focus of the Aviation System Block Upgrade methodology adopted by ICAO in the Global Air Navigation Plan is on adoption of mature and proven technological solutions and procedures by States, in a harmonized manner. Changes in technology and services are already having a huge

impact on air traffic management worldwide.

But adopting these capabilities is based on two things: first, understanding what are the challenges and benefits of these technology; how best to embrace new technologies and services on a practical level; and finally, working together to ensure transition seamlessly to the latest highly technological air traffic management systems. This process should be flexible and responsive enough in a period of rapid change and development.

New challenges in Aviation

The global aviation scenario is witnessing a number of developments and new technologies that are changing the industry's approach to air traffic management or ATM. These include: the rapid proliferation of unmanned aircraft systems, and their challenges; the impact of automation; the possibilities offered by artificial intelligence; space-based navigation and surveillance; digitization and remote air traffic control (ATC) towers. In addition, the existing techniques, technologies and processes, such as performance-based navigation, air traffic flow management and collaborative decision making are undergoing more refinement.

The UAV challenge

Unmanned aircraft vehicle (systems) or UAV(S) are one of the biggest game changers of modern times. UAV(S) are known by a number of different names including drones, RPAS, UAV etc. They operate in conventional airspace as well as below 500 feet, which is where the vast majority of recreational and commercial delivery systems will operate. UAS offer an exciting opportunity to change the way people, businesses and State organisations do things.

The challenge for conventional ATC is how can UAS safely operate without being a threat to civil aviation. It needs a rethink of traditional approaches to air traffic management. It is important to recognize that access to any airspace should be determined by capabilities. Hence any technological solution must ensure performance based approach. Also proposed systems should enhance existing ATM systems and technologies while ensuring safety, particularly appropriate safety at boundaries or buffer zones between what might be termed UAS airspace and the airspace controlled by ANSPs.

AUTOMATION SYSTEM: Integrated automation ATS system at Chennai to improve ATC efficiency, safety and capacity

The challenge for conventional ATC is how can UAS safely operate without being a threat to civil aviation. It needs a rethink of traditional approaches to air traffic management.

Automation and artificial intelligence

The ATM industry is increasingly using automation, bringing safety, operational and commercial benefits. Automation has enabled smooth integration of diverse pieces of data from surveillance sensors, flight plan data, and weather and provides ATC with decision supporting tools in the form of safety nets. It has enabled ATC to safely reduce separation between aircraft and to build

capacity by: driving efficiency through advanced flow management; and sequencing tools; and optimizing airport throughput (using arrival and departure management).

In the future, as envisaged in the concepts of FF-ICE (Flight Flow Information in Collaborative Exchange) and SWIM (System Wide Information Management), automation will provide global real time and predictive decision-making, accounting for a wider range of safety and efficiency needs. There will be greater exchange of information between ground and air borne systems, so as to fully utilize the capabilities of air borne technology, which is matched and harmonized with increasingly advanced ground-based automated systems. There will be increased efficiency through more complex decision-making, flow management and en-route and airport optimization in predictive and real time solutions.

AI (Artificial Intelligence) will be a key component in developing fully autonomous and agile systems as it progressively replaces today's unique human input in dynamic decision-making. In the near future, components of AI will be used in optimizing flow management and airport collaborative decision-making (CDM).

In the future, as envisaged in the concepts of FF-ICE and SWIM, automation will provide global real time and predictive decision-making, accounting for a wider range of safety and efficiency needs.

Many new Technologies

The introduction of space-based ADS-B (planned in 2018) will enable surveillance in oceanic and remote areas not presently covered. Digitization and network connected systems in remote towers will improve connectivity through the ability to cost-effectively manage traffic at remote and lesser used airports. All these game changers will enable harmonised systems, processes and traffic flows, regionally and at a later stage globally.

The future interconnected global ATM network is obviously increasing cyber risks. Threats to ATM systems accessible via data communications networks are becoming prevalent and sophisticated. Vulnerabilities inherent in almost all computer operating systems, many support services and, network and CNS applications can be exploited in a variety of ways. Civil aviation organisations rely on the interconnection of electronic communications networks even for critical parts of their operations, including safety-critical functions (e.g. surveillance data exchange, flight plan processing, etc). The protection of information systems from malicious attacks and the means of dealing with the consequences of such attacks are encompassed by cyber security. The future Aviation professionals will need to be trained in recognizing and dealing with cyber security aspects.

The challenge is to take full advantage of these opportunities and embrace change.

Our Approach to the challenges

It is of utmost importance that the human and the new technologies

need to work together, using the strengths of both and minimizing the weakness of both (for any new technology will have vulnerabilities too). The human and technology need to support each other in a synergistic manner.

The future ATCO will still be an active decision-maker in the system. The transition phase will be the key to the future successes. For those currently in the job transition to the future working environment and the challenges should be planned in an acceptable way.

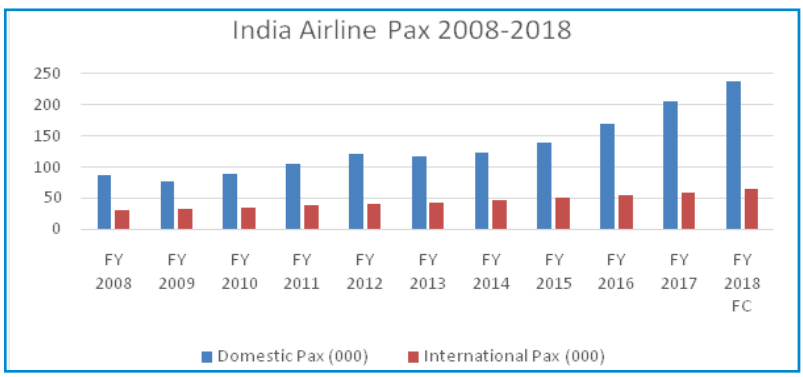
The new generation of ATM and ATSEP professionals will have to be trained in areas like big-data management and analytics, cyber security, network management. The ANSP management should initiate a process of change management and tools will have to be developed to make the new generation understand the processes they have embarked upon. The transition phase will happen gradually over many years. The ANSPs will need a structured project management approach to each issue with a focus on deliverables and defined timescales.

Future aviation professionals will have to work together, defining requirements, opportunities, recognizing constraints, obtaining knowledge of each other's roles, recognizing technological/ institutional developments as well as environmental and economic facts. The human contribution will be crucial to run the future aviation business in a safe and efficient way, because the human component is the most flexible and adaptive component in the aviation system. The key drivers in the future will be Safety and Performance–based ATM.

The assimilation and adoption of modern technology will only be successful, when the ANSP has a better insight into the new workforce generation, the culture they form and their needs. The technological changes will create the "Next Generation of ATM Professionals" who comprise the professions of ATSEPs, managers, procedure designers, regulators, approval organisation staff, and many others, of equal importance to the ATC profession. The ANSP management should ensure that ANSP professions are provided with attractive work choices, clearly define the new roles and responsibilities in the ANSP sector comprising the Controllers, ATSEP (engineers) and administrative professions and how they are linked to pilots, airline and airports tasks and responsibilities. It is imperative that the management promotes best practices, especially in the management of safety and in human-automation synergies.

Traffic growth at Indian airports FY2016 to FY2018

	Domestic	International
FY2016	21.2%	7.7%
FY2017	22-23%	9-10%
FY2018F	20-25%	10-12%



India Airline Passengers FY2008-2018F (Source – Traffic News, AAI)

Conclusion

According to experts, the Indian aviation industry is heading towards a period of sustained growth. Furthermore, current policy reforms such as permitting FDI in aviation, allowing import of aviation fuel and increased emphasis on the development of airports in tier 2 and tier 3 cities would boost the sector's growth.

ANSPs have to anticipate and adapt to the changing face of aviation. Technology is already changing the role of ANSPs. Technology helps to harmonise systems, processes and traffic flows in a global way without reference to national borders or even land based equipment.

India has a great opportunity in terms of highly capable manpower who can be perfectly trained for harnessing the benefits of the cutting edge technology and processes.

The country is perfectly poised for a taking quantum leap in aviation by becoming the third largest aviation power in the world, by the time of centenary of scheduled civil aviation operations in the country, i.e,. in 2032. It is incumbent upon all the stakeholders in India to contribute to realizing the opportunity. ■

ICAO's plans for Global Air Navigation

Addressing the growth and realising the promise of twenty-first century Air Traffic Management (ATM), ICAO has chalked out a comprehensive 15-year plan.

ICAO's 15-year plan addressing Global Air Navigation (2016-2030) is designed to guide complementary and sector-wide air transport progress over the period. The draft document of the 15-year plan points out that air transport plays a major role in driving sustainable economic and social development. It directly and indirectly supports the employment of 58.1 million people, contributes over $2.4 trillion to global Gross Domestic Product (GDP), and carries over 3.3 billion passengers and $6.4 trillion worth of cargo annually.

The draft document says that aviation achieves its impressive level of macro-economic performance by serving communities and regions through clear cycles of investment and opportunity. Infrastructure development generates initial employment and the ensuing airport and airline operations generate new supplier networks, tourism influxes and access for local producers to distant markets. These burgeoning trade and tourism economies then continue to expand, fostering wider and more sustainable regional growth.

It is no mystery, the draft document points out, then why air traffic growth has so consistently defied recessionary cycles since the mid-1970s, expanding two-fold once every 15 years. It resisted these recessions precisely because it served as one of our most effective tools for ending them – an important consideration for governments at every level in a challenging economic environment.

But even as air transport's speed and efficiency significantly facilitate economic progress, its growth under certain circumstances can be a double-edged sword. Though a sure sign of increased living standards, social mobility and generalised prosperity on the one hand, unmanaged air traffic growth can also lead to increased safety risks in those circumstances when it outpaces the regulatory and infrastructure developments needed to support it.

To ensure that continuous safety improvement and air navigation modernisation continue to advance hand-in-hand, ICAO has developed a strategic approach linking progress in both areas. This will allow States and stakeholders to realize the safe, sustained growth, increased efficiency and responsible environmental stewardship that societies and economies globally now require.

This is aviation's core challenge as we progress into the ensuing decades, says the draft document. Fortunately, many of the procedures and technologies being proposed to address today's need for increased capacity and efficiency in our skies also enhance many positive factors from a safety standpoint. Additionally, the more efficient routes facilitated by performance-based procedures and advanced avionics serve to significantly reduce aviation emissions – a key factor supporting more fuel-efficient modern aircraft as aviation pursues its commitment to compre-

hensively reduce its environmental impacts.

New capabilities to serve the aviation community

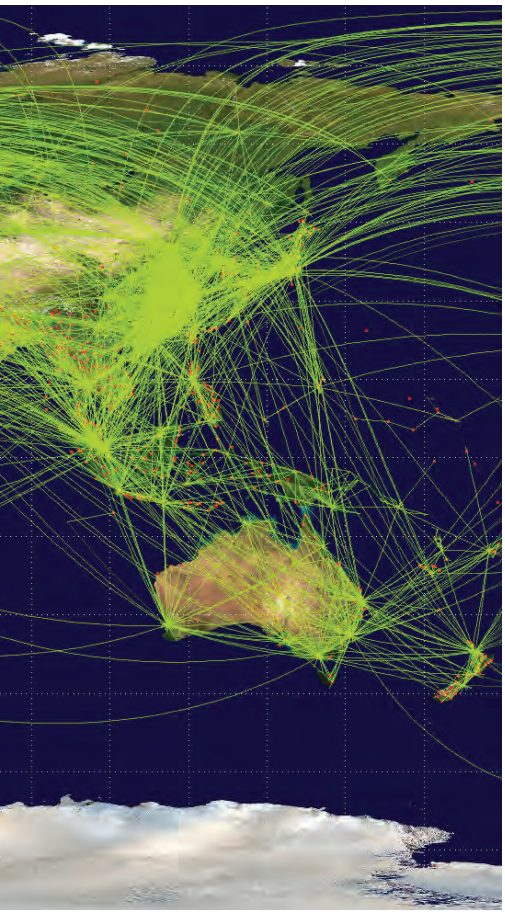
Air Navigation has witnessed some important improvements in recent decades, and yet, a considerable remainder of the global Air Navigation system is still limited by conceptual approaches that arose in the twentieth century. These legacy Air Navigation capabilities limit air traffic capacity and growth and are responsible for unnecessary gas emissions being deposited into our atmosphere.

A fully-harmonised global air navigation system built on modern performance-based procedures and technologies is a solution to these concerns. This goal has been on the minds of Communications, Navigation and Surveillance/ Air Traffic Management (CNS/ATM) planners for many years. Because technology never stands still, the realisation of a strategic path to such a globally harmonised system has proven elusive.

The solution to this impasse lies at the heart of ICAO's core mission and values. Only by bringing together the States and stakeholders from every corner of the aviation community can a viable solution to twenty-first century Air Navigation be determined.

The Aviation System Block Upgrades (ASBU) methodology and its Modules define a programmatic and flexible global systems engineering approach allowing all States to advance their Air Navigation capacities based on their specific operational requirements. This will permit all States and stakeholders to realise global harmonisation, increased capacity, and environmental efficiency that modern air traffic growth now demands in every region around the world.

If the air transport system is to continue to drive global economic prosperity and social development to the extent that the aviation community and the world have grown accustomed,



especially in the face of expected regional traffic growth projections and the pressing need for more determined and effective climate-related stewardship, States must fully embrace the new Block Upgrade process and follow a unified path to the future global Air Navigation system.

The Global Air Navigation Plan's Aviation System Block Upgrades methodology is a programmatic and flexible global systems engineering approach that allows all Member States to advance their Air Navigation capacities based on their specific operational requirements. The Block Upgrades will enable aviation to realize the global harmonisation, increased capacity, and improved environmental efficiency that modern air traffic growth now demands in every region around the world.

What does the Global Air Navigation Plan's strategic approach mean for my State?

The 2016–2030 ICAO Global Air Navigation Plan draft presents all States with a comprehensive planning tool supporting a harmonised global Air Navigation system. It identifies all potential performance improvements available today, details the next generation of ground and avionics technologies that will be deployed worldwide, and provides the investment certainty needed for States and Industry to make strategic decisions for their individual planning purposes.

Ongoing Air Navigation improvement programmes being undertaken by a number of ICAO Member States (SESAR in Europe; NextGen in the United States; CARATS in Japan; SIRIUS in Brazil, and others in Canada, China, India and the Russian Federation) are consistent with the ASBU Methodology. These States mapped their planning to respective Block Upgrade Modules in order to ensure the near- and longer-term global interoperability of their Air Navigation solutions.

The GANP's Block Upgrade planning approach also addresses user needs, regulatory requirements and the needs of Air Navigation Service Providers and Airports. This ensures a single source for comprehensive planning.

Basic Modules to implement as a minimum path to support global interoperability were discussed at the Twelfth Air Navigation Conference. They will be defined in the next triennium and be taken in account in the Regional Priorities agreed to by the Planning and Implementation Regional Groups (PIRGs), says the draft document. As the GANP progresses, Module implementation will be fine-tuned through regional agreements in the ICAO PIRG process.

The PIRG process will further ensure that all required supporting procedures, regulatory approvals and training capabilities are set in place. These supporting requirements will be reflected in regional online Air Navigation Plans (eANPs) developed by the PIRGs, ensuring strategic transparency, coordinated progress and certainty of investment. ■

THE 2016–2030 GLOBAL AIR NAVIGATION PLAN:

* Obliges States to map their national or regional programmes against the harmonised GANP, but provides them with far greater certainty of investment.
* Requires active collaboration among States through the PIRGs in order to coordinate initiatives within applicable regional Air Navigation Plans.
* Provides required tools for States and regions to develop comprehensive business case analyses as they seek to realise their specific operational improvements.
* Provides a vision of the evolution of the Global ATM system and the potential requirements to industry, for better anticipation in its products.

Are we ready for the FUTURE OF AVIATION?

Automation is the key driver to improve efficiency and to deliver the capacity for the expecting increase of traffic — specifically in Asia, comments Thorsten Wehe.

IFATSEA represents 60,000 ATSEPs around the Globe. Air Traffic Safety Electronics Personnel (ATSEP) are the authorised personnel who are proven competent to install, operate, maintain, release from, and return into operations communication, navigation, surveillance (CNS) and air traffic management (ATM) equipment. Evidently, States, Civil Aviation Authorities and Air Navigation Service Providers need to ensure they have trained, qualified and competent ATSEP to install, maintain and operate these globally interconnected and complex CNS and ATM systems. Ongoing Automation is the key driver to improve efficiency and to deliver the capacity for the expecting increase of traffic. In specific, in Asia, more and more people like to travel by air.

IFATSEA is recognised as an Observer by the International Civil Aviation Organisation, ICAO. One of the main objectives of IFATSEA is, to establish global standards for qualification, training and competencies to ensureSafety, Security and Complience in Aviation.

From IFATSEA point of view the global regulatory framework is behind the fast-ongoing implementation of new technology in Communication, Navigation, Surveillance and Air Traffic Management Systems. The uppermost priority in air traffic has safety. The retention and the rise of the safety in the aviation system justifies all available measures.

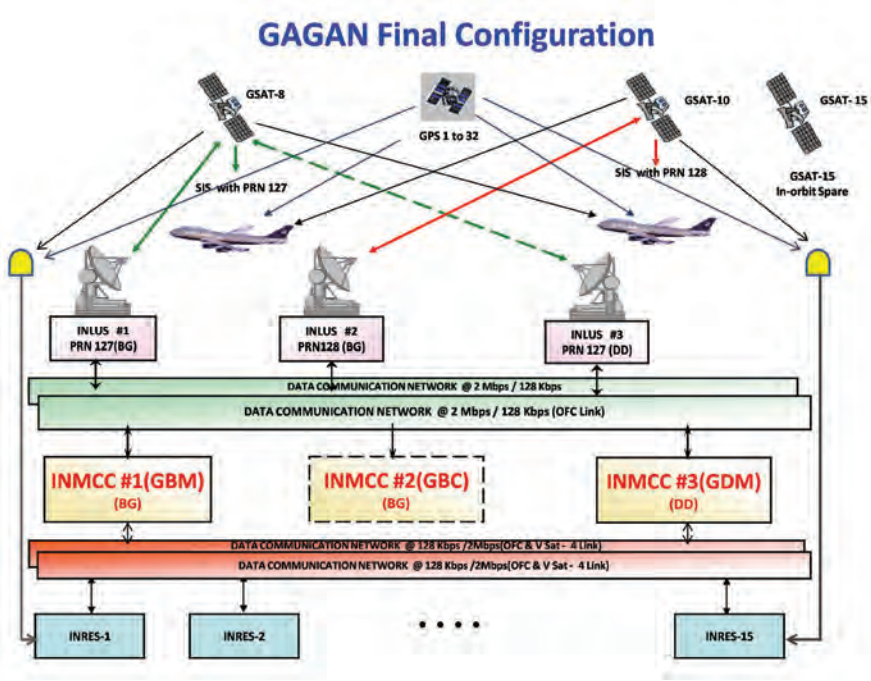
The air traffic control services are responsible for the safe and efficient flight realisation. Air Traffic Controllers are during a flight in the constant contact with the Cockpit Crews. They provide separation between the airplanes and support the Pilots in abnormal situations.

THORSTEN WEHE
IFATSEA
Executive Secretary

The air traffic control technical services are a firm component of the air-traffic control services. Air traffic control-technical services enclose the services of Communication (Air-Ground, Ground-Ground, Voice Recording), Navigation (Radio Beacon, Instrument Landing System for safe landing in bad weather conditions), Surveillance (Radar systems to detect targets in the air), Radar-Data-Processing Systems (Display airplanes in real time processing), (Flight Plan-Data-Processing Systems: Information for Flight Routing). The air traffic control technical services are provided by Air Traffic Safety Electronics Personnel (ATSEP). ATSEP are the authorised staff, who supervise and release air traffic control equipment for the operational use. ATSEP are a firm component of the aviation safety chain.

For the rise of the flight security a strict regulation, supervision and certification is necessary for the air traffic control technical services and their staff. It is important from the safety and security point of view to ensure that individuals show continuously that they are qualified, competent, show medical fitness; physically and mentally, eligibility and appropriateness and access.

IFATSEA was involved in improving the ICAO PANS-TRG Doc. Procedures for Air Navigation Services — Training (PANS-TRG, Doc 9868) include now competencies for Pilots, ATCOs and ATSEPs to establish Competence Based Training. IFATSEA introduced the ICAO Doc 7192-AN_857 Part E-2 - ATSEP



THE FUTURE OF AVIATION: How GAGAN will work for Indian aviation

Training Manual. The update of the ICAO ATSEP Training Manual is completed. The new ICAO Doc 10057 "Manual on Air Traffic Safety Electronics Personnel Competency-based Training and Assessment" is published. This will expand mobility but most importantly increase internationally collaboration, coordination and partnership.

New Technology, e.g.: Data-Link, Network Manager, Gate to Gate Concepts, also for Long Haul Flights, System Wide Information Management (SWIM), 4D-Trajectory, Arrival and Departure Manager, VoIP, Remote Tower, RPAS, Remotely Piloted Aircraft Systems, Client/Server Technology, will be implemented by ATSEPs. One big challenge here will be Cyber Security.

We see the change of job pictures in aviation for a long time. The Flight Engineer disappeared due to evolving technology in aircraft cockpits. Studies are on the way to fly an aircraft with only one pilot. Only Technology can encourage such developments. An ATCO will need more knowledge about Technology. A change from active control to observing will take place. Active Control for separation of aircrafts will be executed by Software. Sector less Control is a new project on the screen. ATSEP will need more knowledge about procedures.

Training for "Expect the Unexpected" is a must. This does not mean a main system is switching to a back-up system due to failure. Emergency Training means be aware of Tsunami, Earthquake, Fire, Floods, etc. Resilience of Systems is a major issue. Innovation cycles decrease from 15 years to 8 years; on demand high qualified and competent resources for maintaining Systems in operation and implementation of new systems must be available.

Always forgotten the human aspects. Fatigue, Risk and Stress Management is a well-known objective for ATCOs and Pilots. What about ATSEPs working in the safety critical aviation chain?

High Availability, Accuracy, Continuity and Resilience of service are very important factors in aviation business. Unreliable service provision leads to high delays and increased Pilot and Air Traffic Controller workload. Beyond you provoke frustrated passengers who trust in the function of an often-unknown system. Thus, besides the imperative Safety element, the Availability and Continuity of ATM/CNS services impacts efficiency and cost elements of operations.The new CNS/ATM environment will consist of interoperable systems of high complexity with new failure modes (e.g. cascade system failures), thus requires highly competent ATSEP being able to ensure resilience of the whole system worldwide in a standardised manner.

Always forgotten the human aspects. Fatigue, Risk and Stress Management is a well-known objective for ATCOs and Pilots. What about ATSEPs working in the safety critical aviation chain? Where are studies measuring the exposure on our colleagues' working day by day in High Voltage and high density of electromagnetic Radiation environment? Did we measure the burden of long working hours in shift mode in carrying out our duties? IFATSEA identified all these subjects and will enforce the aviation community to find solutions for Human Factors.

Do you think flying is dangerous? For sure flying is dangerous, but we undertake every effort to make flying as safe as possible. ■

Human factors and performance of ATSEPs

Air Navigation Services (ANS) is defined as services provided to air traffic during all phases of operations including air traffic management, communication, navigation and surveillance, meteorological services for air navigation, search and rescue and aeronautical information services.

Air Traffic Management (ATM) is an aviation term encompassing all systems that assist aircraft to depart from an aerodrome, transit airspace, and land at a destination aerodrome, including air traffic control (ATC), air traffic safety electronics personnel (ATSEP), aeronautical meteorology, air navigation systems (aids to navigation), Air Space Management (ASM) and Air Traffic Flow Management (ATFM), or Air Traffic Flow and Capacity Management (ATFCM). The increasing emphasis of modern ATM is on interoperable and harmonised systems that allow an aircraft to operate with the minimum of performance change from one airspace to another. ATC systems have traditionally been developed by individual States that concentrated on their own requirements, creating different levels of service and capability around the world.

Air Traffic Safety Electronics Personnel ATSEPs: As per ICAO and globally accepted terminology for Communication Navigation Surveillance (CNS) Engineers/ personnel have been used in this article for better understanding of the role of ATSEPs in Air Navigation Services (ANS).

ATSEPs' tasks are continuously increasing and becoming more complex with the introduction of new technology and new concepts in the Air Navigation Services (ANS) all over the world. In addition to ensuring the safety in the air traffic, ATSEPs are playing significant role in increasing the capacity of the traffic handling both in the air and on the ground.

SUBIT KOBIRAJ
IFATSEA, Regional Director – Asia Pacific

> The role of the ATSEPs have been becoming more complex with the introduction of new technology and new concepts in the Air Navigation Services (ANS) all over the world. It is time to address the human factors that cause them to underperform.

Scientific analysis on their job profile and on the human factors causing them to underperform including stress and fatigue would certainly give new findings. Addressing on those findings will assure the safest air traffic services across the globe in future. Since no such studies have been carried out till date, it is necessary to initiate scientific studies at the earliest specifically focused on ATSEPs.

Growing complexity and increasing demand in the ATSEPs role

In a capacity-driven air space management, complex Communication Navigation Surveillance & Air Traffic Management (CNS-ATM) systems are playing a very significant role from Gate to Gate to increase the capacity and efficiency in addition to safety. As ATSEPs are responsible for all the stages of life of these critical CNS-ATM systems, their role becomes more demanding and complex.

Their areas of expertise are becoming complex as more and more new technologies and concepts are being brought into ANS. In the present scenario, ATSEPs' technological expertise is required in all the following areas: (1) Electronic devices (2) Network theory (3) Signals and systems (4) Analog and digital electronics (5) Power electronics (6) Communication systems (7) Electromagnetic theory (8) Electronic measurement and instrumentation (9) Antenna and wave propagation (10) Computer HW and S/W (11) Microprocessor and interfacing (12) Microwave and radar engineering (13) Control systems and engineering (14) Data communication (15) Embedded systems (16) Optical communication (17) Digital signal processing (18) Wireless communication (19) Tele communication, and (20) Satellite communication.

ATSEPs are professionals who are expected to act immediately on demand

by applying their knowledge from a wide spectrum of fields as mentioned above. Apart from all the 20 fields mentioned above if new technologies are introduced, ATSEPs are expected to learn quickly and initiate procurement action on new technology applications, identify suitable sites, install, customise and adapt the facility to the particular site, identify the suitable maintenance philosophies and carryout the maintenance. In other words all the CNS-ATM systems are being taken care by the ATSEPs from the induction stages to till the life expansion programmes of the same.

For ensuring the required standard of operational life of the CNS-ATM systems, ATSEPs are carrying out wide range of tasks which not only require managerial skills but also need technological skills which are of very wide range than that of IT professionals', telecommunication professionals', microwave engineers', power electronics professionals' and many other well recognized technical professionals.

Scientific studies have been carried out on most of the recognized technical professions mentioned above even though their area of expertise is limited. So, similar analyses on ATSEPs are very essential and overdue.

ATSEPs' safety critical contribution in the aviation – Overlooked safety issue

For ensuring the required standard of operational life of the CNS-ATM systems, ATSEPs are carrying out a wide range of tasks which not only require managerial skills but also technological skills.

In aviation industries, several researches have been carried out on pilots, ATCOs and ground aircraft maintenance engineers. However, the role played by ATSEPs for the air safety is overlooked and not given any priority.

CNS-ATM systems failure could result into huge financial loss, significant property damage, damage to the environment and even loss of life. System degradation of safety critical CNS-ATM systems is unacceptable as global air traffic services are depending on them.

New integrated CNS-ATM systems which mainly work on information technology networks have the potential for very high consequences on failure or degradation. Future air traffic systems will be far more automated and far more dependent on safety critical computers than today's systems. The result is that serious consequences of failure arise for entirely new application domains and new failure modes are evolving such as denial of service attacks against networked information systems.

Maintenance tasks or jobs are in direct response to the air traffic services' safety. Good quality maintenance work leads to good

results or elimination of unexpected failures, lower costs, and better safety to the passengers. In other words ATSEP role is inevitable and they must perform well to meet the required level of performance under any circumstances. Unless otherwise this inevitable role is played properly safety in the air traffic services cannot be taken for granted. Safety is of paramount importance, thus it must be ensured at all the levels and components of CNS/ATM.

So, it is essential that comprehensive approaches to the total CNS-ATM systems and the professionals behind these systems are needed so that critical role of ATSEPs and human factors associated with them are not overlooked.

Human factors that lead to degrade ATSEPs ability to perform

Transport Canada identified 12 human factors that degrade people's ability to perform effectively and safely, which could lead to maintenance errors. These twelve factors, known as the "dirty dozen," can be viewed from the ATSEPs' point of view.

The twelve factors are: *Lack of Communication, Complacency, Lack of knowledge, Distraction, Lack of team work, Fatigue, Lack of resources, Pressure, Lack of assertiveness, Stress, Lack of awareness* and *Norms.*

Need for studying the human factors in the ATSEPs' job profile

The impact of the above factors in the maintenance errors is very significant and we cannot overlook the potential safety threats these maintenance errors can cause. Though we have many research findings in the area of maintenance in general we need to focus to initiate a specific study in line with the ATSEPs job profile.

ATSEPs are exposed to work in high raised towers or even under cable trench. They work in the remote sites exposed in the hot sun and in the same day come back to main data processing equipment room where the temperature is different.

ATSEPs are expected to work in a remote sites with very few or no people around and at the same time they need to work in a major ACC where many human interactions are required.

ATSEPs are expected to perform a wide variety of tasks like a very simple daily reading recording to specialised site adaptations. Most of the work ATSEPs are carrying out are not well defined and supported with state authority documents. These contrasting nature of job profiles cannot be ignored further. We cannot address the human factor issues by referring general management techniques. In particular stress, pressure and fatigue factors need to be studied in detail.

A case study can be immediately started with identified samples like, busy airport to remote en-route site, human intensive places to remote site where one or two ATSEPs are posted and younger to old generations.

The need for scientific study on ATSEPs human factors and their effects in the performance are very justified. We need to take the first small step towards this study. In the era of information, the collection of research data won't be difficult. We may initiate a case study to begin with. After reviewing and reworking on the type of data we need to collect for addressing the objective we can move forward for widescale collection of research data. Such studies will not only bring us wonderful findings but also make us define the role of ATSEPs to match with the growing technology intensive ANS.■

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Cybersecurity in ANS

TECHNICAL FAILURE OR CYBER-ATTACK?

The technical and operational environment of Air Navigation Services, which was till recently, a secluded area has changed. Now, possibilities of intrusions have arisen, as Theodore Kiritsis points out.

Until recently the technical and operational environment of Air Navigation Services was a secluded area with its proprietary technologies specifically made for purpose, such as CNS/ATM systems, disconnected from the information flow of the rest of the aviation and other industries. Only recently we have moved towards a more distributed/networked environment. In any case the 'legacy or existing ' networks used so be disconnected from outside users. Thus the possibilities of intrusions were minimal by architectural design and only randomly there were cases of malware.

However, it is worth noting that very little, if any, data exists on potential intrusions or cyber-attacks as no cyber-incident collection has been done in an organised fashion so far.

Under the current culture, the CNS/ATM environment of an Area Control Center (ACC) or an Airport that is subjected to an attack will be addressed as a technical failure and be attributed to hardware or software failures by the operational technical personnel, the ATSEP (Air Traffic Safety Electronics Personnel).

It is worth noting that if for a moment we confine our focus on the ACC or the Airport Tower areas and imagine an example of a cyber-attack such as denial of a service, the air traffic controller on duty will be deprived of critical data. The controller on duty will alert the ACC room supervisor who in turn, will communicate the failure or degradation from the Operations room to the Technical SMC (Systems monitoring and Control room). There the ATSEP on duty will try to detect, through symptomatic detection (as today there are no tools to detect or identify a cyber-attack) whether it is a failure or intrusion.

Therefore, an Air Navigations Service Provider, the ATSEP on duty will be requested to deal with the impact/symptom of a cyber-attack, basically acting on best practice and under the current maintenance culture. There are also cases where the local systems supervision tools may identify some abnormal behaviour through the monitoring of specific critical or crucial technical parameters, or intrusion in remote CNS installations which are simpler to interpret but again there are no tools to detect or identify a cyber-attack nor whether the event is a failure or intrusion.

Given that usually the distances of remote CNS facilities, on mountain tops, for example, the response or mitigation time is unknown. The impact on the system resources has to be diagnosed as the response has to be able to mitigate the failure or the cyber-attack. Of course, if the intrusion is not detected, many security and consequently safety issues, can arise.

It is expected that an advanced local SMC supervision

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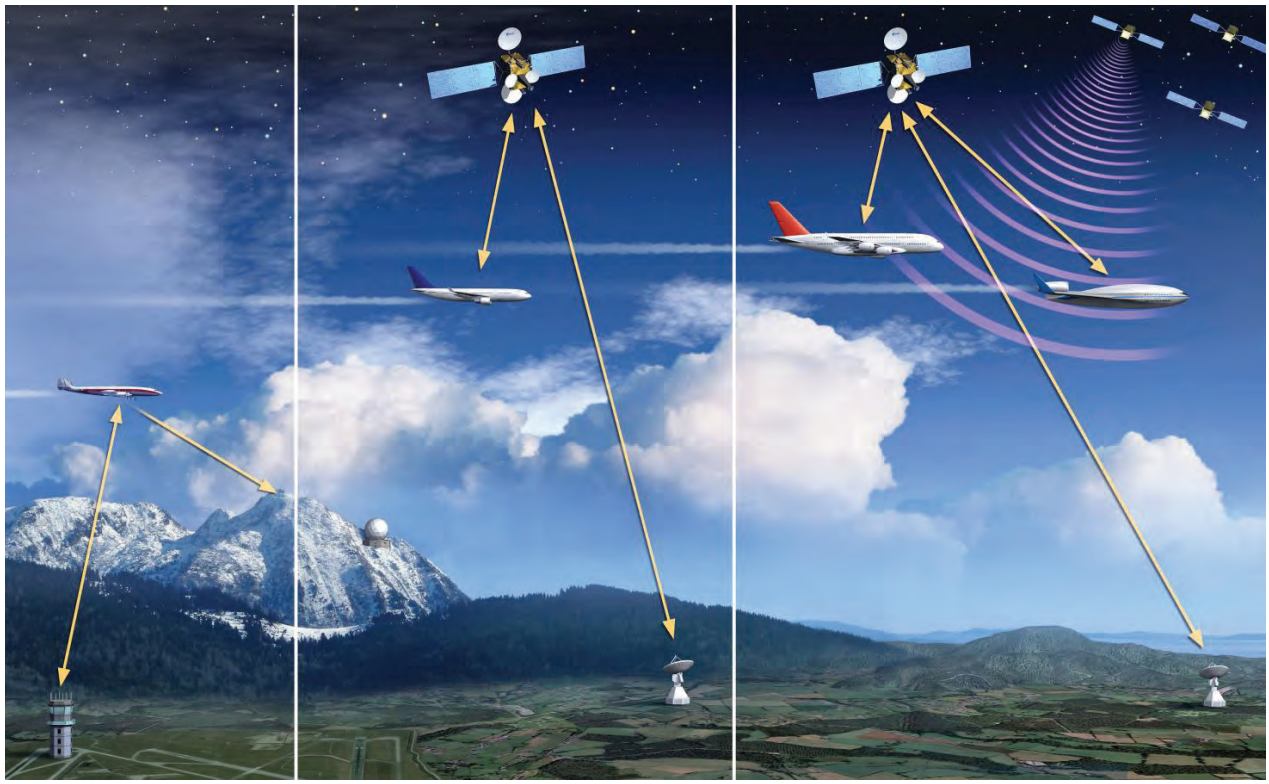
IFATSEA Vice President
Editor Navaire



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with systems, health management and cyber security tools will be researched, so that the future concepts implemented through tomorrow's elements of the Service oriented Architecture (SoA) and its distributed socio-technical systems, gain the capability of 'sniffing' and proactively identifying abnormal system behaviours whether they are of technical or of cybersecurity nature (or both!).

This new anticipated technical environment will give the ATSEP of the future the ability to counter the potential threats and thus avoid service degradation at system level and even the propagation of the threat. After 9/11 it was decided to think 'out of the box', so we must do now in the ANS domain.

It must be noted here that the resilience of the ANS technical and operational system to withstand external 'perturbations' being security breaches/attacks but also to overcome and recover from them, will have be enabled by the above tools and, of course, the necessary competence levels of both ATSEP and ATCO on the ground and pilots in the air. This may even expand further to cooperation with competent authorities on the boundary of the ANS domain.

The new anticipated technical environment will give the ATSEP of the future the ability to counter the potential threats and thus avoid service degradation at system level and even the propagation of the threat.

It must be noted that today the ACC and the Airport systems are fed with data from Sensors that are open with no encryption whatsoever (e.g ADS-B transmissions). The same goes for the communications which are still VHF with AM modulation and datalink modes that are also open with no encryption.

Therefore, trying to identify if the failure is a malfunction or an attack is very demanding. In order to think out of the box, studies must be made in order to strengthen the CNS/ATM system and increase its Resilience to cyber attacks. This would be a new element/approach as today the Research on System Resilience focuses not on the technical side but on the ATC service provision.

Coming now to the SESAR and NextGen technologies that rely mainly on networking (through SWIM), it is easily realised (and it has been) that everything from the system design to the business model have to be scrutinised for creating inherent security gaps. Sometimes this is even connected to proposed changes in the Business model.

I will explain with a small example.

"The SESAR2020 concept is investigating the splitting up of the Data Processing model in an ACC to individual Services that may be fed to the controller screen from potentially different data providers. Thus, the final picture that will be presented to a controller will be a product of synthesis of data from different originators or Data providers. Assuming that a 'false' or 'suspicious' indication appears on the screen, the ATSEP that will be called to identify the cause of the problem and restore it, will have to identify the root cause and on top of that to identify whether it is a cyber-attack or not!. "

In other words while the Controller is facing a real time demanding safety critical situation, the ATSEP has to trace back the causal analysis to the said data providers and/or potential interference with the unencrypted sensor data. Now, if we include in the system a new concept such as RPAS (Drones) with their own sensors and failure modes for which no experience exists yet, then the cybersecurity equation becomes more and more complex. Remember a RPAS flying in non-segregated airspace is just another target for the system.

The new proposed business model for CNS provision and/or even a centralised critical functionality like a Central Tracker, inherently creates single points of failure. Just imagine for a moment the case of a false alarm on the Centralised tracker and the impact it would have on the clients/ANSPs having to revert to their backup systems. Similar, clearly technical failures in ANSPs have created havoc for several hours in the European skies.

If you want to elaborate a little more, include the Pilot in the awareness loop in this time critical situation!

So, it is the ATSEP and the ATCO (if the failure reaches their screen) and the Pilot in the air and that is all. This incident I described above will be a battle against time!

Moreover, the cyber issue needs to be resolved because Safety, security and even performance are threatened especially in the case of false alarms. The issue of False alarms and Probability of detection is a well-known problem for detecting potential threats especially in the Airport Security metrics.

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if we include in the system a new concept such as RPAS(Drones) with their own sensors and failure modes for which no experience exists yet, then the cybersecurity equation becomes more and more complex

Addressing the Cybersecurity issues, directly links to the CNS/ATM system resilience and the failure propagation to other interconnected systems as now in the SESAR and NextGen era most, if not all, systems communicate through SWIM.

The IFATSEA SESAR team in Europe has developed a Concept of operations to address Cybersecurity architecture and submitted it to SESARJU and also presented it in several fora. This work was also presented to ICAO Assembly in 2016 (A39-WP/370) Agenda Item 36: Aviation safety and air navigation implementation support: A CYBERSECURITY ARHCITECTURAL APPROACH FOR LEGACY- AND SWIM-BASED CNS/ATM SYSTEMS and can be downloaded from *https://www.icao.int/Meetings/a39/Documents/WP/wp_370_en.pdf.*

Interesting info can also be found on a European research website of GAMMA *(http://www.gamma-project.eu/)* of which IFATSEA is included in the User forum. ■

Theodore Kiritsis
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Challenges bring Opportunities — AN ATSEP PERSPECTIVE

While it is well-recognised that Air Traffic Management (ATM) is one of the fundamental ingredients for air transport, it is also a profitable business. Costas Christoforou points out that the profession of Air Traffic Managers is changing and it is time to counter challenges by working globally.

Nowadays, nobody can deny that Air Traffic Management (ATM) is one of the fundamental ingredients for air transport and aviation in Europe as well as the globe. It is not only the easy access and transferring of people and goods across the world but it is also a profitable business. It is estimated that in aviation industry is working around 1.5 million people. With a contribution of 110 billion Euros to the EU's GDP, it is really a boost to the European economy.

The passengers everywhere are looking for safe, reliable and economy transport for their movements without paying a lot of attention behind the scenes. The ATM has as primary roles to maintain safety, capacity and performance in aviation and at the same to take care as much as possible the environment by reducing the impact associated to each flight.

The expected traffic growth in Europe between now and 2035 is almost double as it is expected around the globe. The existing (legacy systems) Europe's ATM infrastructure and technology are not the latest one. Also, procedures followed needs updating. In order to face these big challenges back in 2004 the Single European Sky ATM Research (SESAR) project was launched. It is considered as the technological pillar of the Single European Sky (SES). Along with the public-private partnership, the SESAR Joint Undertaking (SESAR JU) they have as a mission through research and innovation, the modernisation of the European air traffic management (ATM) system. This will be succeeded with the deployment of all SESAR solutions contributing to the increase of ATM performance.

COSTAS CHRISTOFOROU
IFATSEA DIRECTOR EUROPE

Up to now the results of this project were very promising offering 63 Air Traffic Management (ATM) solutions. Our federation, IFATSEA is contributing from the very beginning in this effort. Our experts across Europe participated in all the phases of this project and

now are ready to continue their effort through SESAR 2020, the new project.

SESAR 2020 case, is to integrate all relevant constituent parts, it is mandatory since it has key benefit enablers the improvement in Surface management systems, CDM processes on airports, extended AMAN (Arrival Manager), full 4D trajectory and so many other performance areas.The new technologies have a significant impact on the safety, efficiency, capability, capacity and also on environmental and financial performance of the Air Transportation System.

IFATSEA with its involvement in the validation and deployment operation of SESAR 1 for these new implemented technologies has proved that the Air Traffic Safety Electronics Personnel (ATSEPs) are a key enabler for the future innovation in the ATM/ANS sector. ATSEPs are the proven experts in implementing and ensuring the operational quality of all these new innovative technological solutions in ATM.

Inevitably, during this process we are going to face several new burning issues like Cyber-security. This is one big challenge we need to address, a price we have to pay, as we are moving in all these revolutionary technological changes in aviation. As the number of digital applications and data networks increases, the same goes for the risk for exploitation.

IFATSEA with its involvement in the validation and deployment operation of SESAR 1 for these new implemented technologies has proved that the Air Traffic Safety Electronics Personnel (ATSEPs) are a key enabler for the future innovation in the ATM/ANS sector.

In all these new concepts of operation the availability, the accuracy, the integrity and security of critical information as well as the continuity of service is of vital importance. With Cyber security we focus on solid proactive measures in order to protect computers, networks, programmes and data from intended or unintended as well as unauthorised access, change or destruction.

ATSEP's job is not going to be easy. They will have to maintain all existing (legacy) systems and at the same time trained and be competent to run the new systems with the complexity and the added need for cybersecurity resilience.

Surely, this will require new scientific expertise for ATSEP. Thus, we have to plan well ahead in order to avoid a shortage of highly qualified electronics professional experts (ATSEP) in the forthcoming new automation era.

To safeguard the new systems will be a real challenge for all of us. It is pity that we lost so much time in designing the cutting edge of technology in aviation systems and in some cases we did not take the appropriate security measures to secure these systems from Cyber attacks. Even

the Technical supervision concept has yet to be formalised and researched in depth while being cyber secure.

Additionally, the new regulation on ATM/ANS common requirements from the European Aviation Safety Agency (EASA) in combination with ICAO ATSEP competency framework and ICAO ATSEP Training manual (DOC 10057) will bring for a very first time a stronger regulation for our profession. It is with our active participation in the regulatory domain (EASA mostly) we are trying to clarify issues like "Accountability" of ATSEP in this new ERA of changes.

We can clearly state that we are going through huge changes and we more than ever convinced that we have to set our targets for a European as well as for a global licensing scheme for ATSEPs, which will ensure the harmonisation of ATSEP competences around the globe. It is disappointing and totally unacceptable that the ATSEP profession is not included in ICAO Annex 1 and while everything will be relying on CNS/ATM technology.

IFATSEA has emphasized a lot and in many occasions, its determination to promote a Pan-European ATSEP license scheme, as well as a Global one, and to explore further the new ATSEP training domains and ATSEP competency schemes as derived by all these changes. I would like to stress again that ANSPswork towards a meaningful and productive training and competence scheme for ATSEP. This is a very serious mission for us.

We are going through huge changes and we more than ever convinced that we have to set our targets for a European as well as for a global licensing scheme for ATSEPs, which will ensure the harmonization of ATSEP competences around the globe.

Our concerns should also extent on topics like the ATM efficiency, interoperability, Human Factors, Safety Management System, the Functional Airspace Block (FAB) developments and a lot more. As ATSEP we work patiently to promote SAFETY, efficiency and performance in the ATM/ANS world striving at the same time for a "JUST CULTURE" society in Aviation.

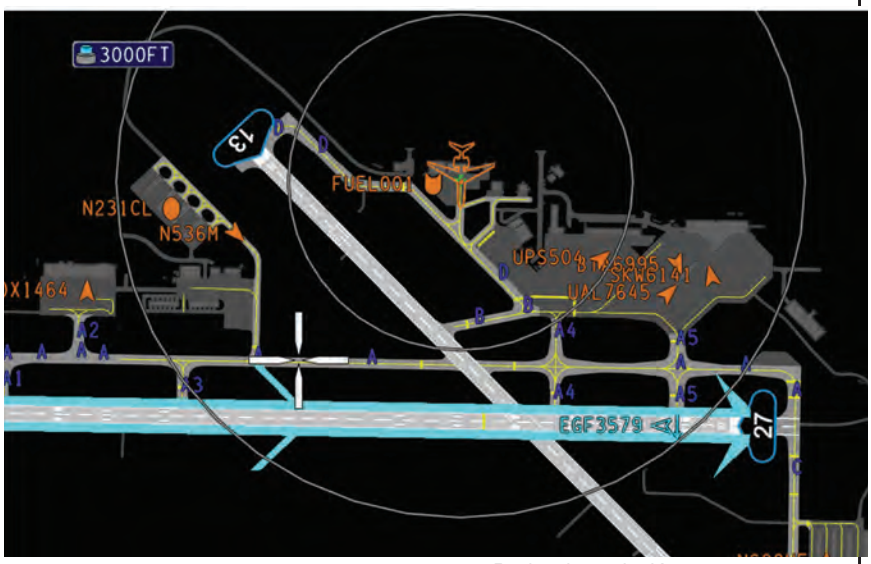
We consider that Challenges bring Opportunities

Our Job, our profession is changing bringing challenges and opportunities. Our duty, our goal as professional entities is to help our members to overcome the challenges by giving them the knowledge and the skills and on the other hand to encourage them to take advantage of the new professional opportunities.

During this technological evolution, I can assure you that we will face new challenges. Let us all work globally, in the forthcoming years, to prepare us for this. ■

Costas Christoforou works for Cyta (Cyprus Telecommunication Authority). Currently working as a Supervisor of ATSEP at Nicosia ACC and Quality Manager of the unit.
Involved in SESAR Joint Undertaking (SJU) and recently signed the MoC with SESAR JU, on behalf of IFATSEA, related to active participation of region Europe at the SESAR 2020 industrial research projects.

Future of Indian ATM AND ITS ECOSYSTEM



ATM Challenges

Today India is moving towards "sky is the limit". Our Indian air space density has increased 20-fold compared to the last few decades. Our government has initiated to extend air travel to every citizen as well as point-to-point air connectivity. In the coming years, it will be tough challenge for Airports Authority of India (AAI) to handle large number of aircraft in the air space, especially in the hubs (like Mumbai or Delhi).

Associated are a few challenges:

- Airport capacity challenge
- Operating in a congested network challenge
- Environmental challenges carbon footprint
- Seamless, more coordinated air navigation system and services
- Increasing number of International air traffic due to globalisation
- Reduce separation to accommodate more aircraft in airspace and increase safety
- Traffic situational awareness on airport surface
- Sudden change in flight Level or routing due to bad weather
- Continuous descent and trajectory based routing
- Civil and military aircraft flying restrictions and collaboration
- Frequent position report to FIR, not traditional 30 minutes reporting mandate

Existing ATM systems and trends

The existing ATM systems are completely dependent on Primary Surveillance Radar (PSR), Secondary Surveillance Radar (SSR) and Surface Movement Radar (SMR). The paradigm shift of ATM is:

- Procedural: Estimate both current and future position
- Radar-based: Know current location and estimates future position
- Trajectory-based: Know both current and future position

In terminal control centre, Ground Based Radar Data Processing and Display System plots the aircraft on runway based on sensor data (placed at certain interval on runway). Also aircraft on surface are plotted based on SMR data.

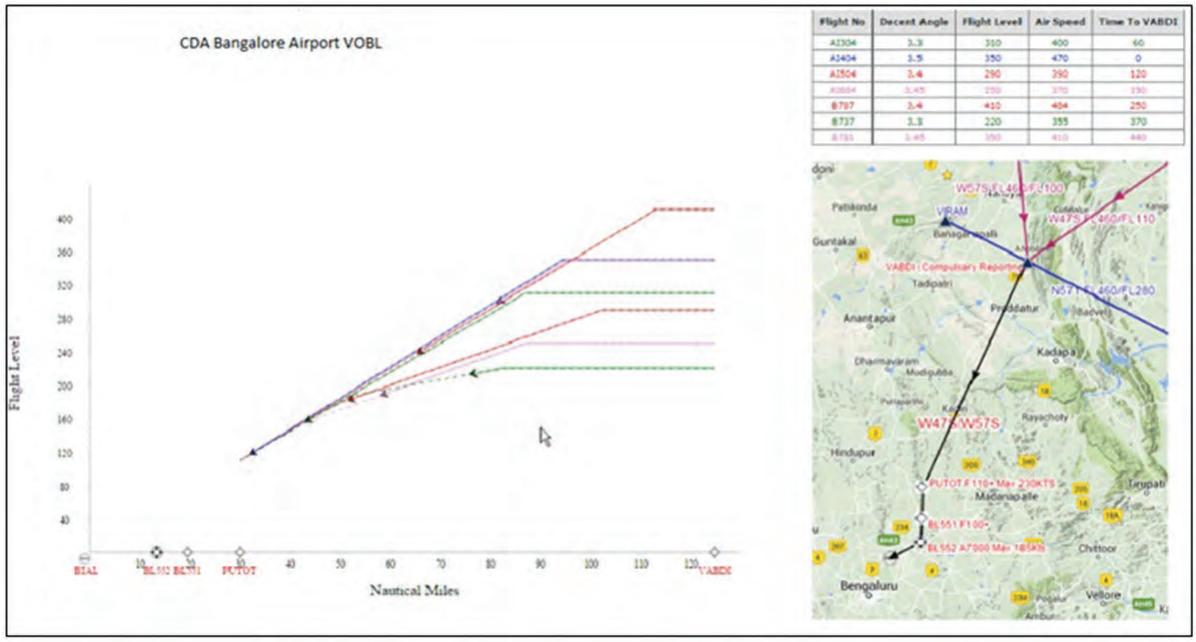
Estimated arrival time to compulsory reporting points along routes are never accurate. Naturally the workload on air-traffic controller is huge.

> India is ranked top in air travel growth among global big seven markets, which leads tremendous growth in air traffic. We need a very robust, flexible and functional next generation air traffic management. To address similar business needs European Union is moving towards SESAR and United States towards NextGen system.

Next Generation ATM systems across the globe

Currently very well-known ATM systems at implementation phase are:

SESAR - Single European Sky ATM Research — SESAR is the European air traffic control infrastructure modernisation program.



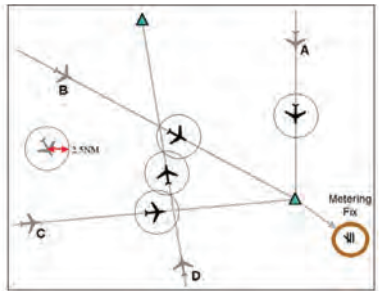
NextGen - Next Generation Air Transportation System: NextGen is the next generation air navigation system by FAA. The main goal of NextGen is to improve the ground based air traffic management system to satellite based air traffic management system.

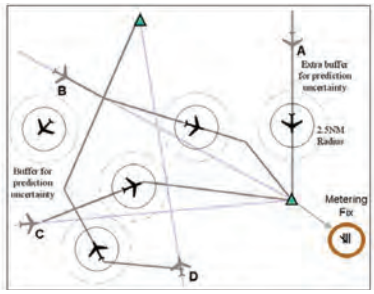
Some of the other initiatives are:

- CAAS agreement with SESAR-JU, MITRE, FAA and Airbus
- Air Navigation System (ANS), Russia
- Air Traffic Management Bureau of Civil Aviation Administration
- CNS/ATM, Japan

Key enablers for trajectory-based operation

1. RNP/RNV: Very high accuracy navigation required i.e. (for Approach 0.1-0.3NM, RNP1 / RNP2 for no radar low density terminal airspace etc.), integrated SATCOM/GPS system.
2. ADS-B: Automatic dependent surveillance - broadcast - Aircraft to broadcast the own ship position information.
3. Air Ground datalink: CPDLC (Controller-pilot data link communications) and ADS-C
4. Ground to Ground communication and interoperability and SWIM (System Wide Information Management)





5. Advanced avionics interactive system available to pilot i.e. cockpit application

Advanced concepts of ATM systems required for Indian Air Space

Satellite based aircraft tracking and information sharing system: To get continuous coverage for real time entities of ATMs,to integrate large number of aircraft in control zone in domestic and international routes satellite based tracking is more appropriate compared to radar based tracking. It provides better call admission control, better resource management, reduced adverse weather effect and surveillance effects. It also improves search and rescue operation. Our nation has remarkable GPS-aided navigation and capable ecosystem, so we can leverage GAGAN for accuracy in navigation.

Multipath enabled ATM data communication: Today we are seeing huge amount of data exchanged by each ATM control centre. Multipath enabled ATM ecosystem needs to be implemented due to its reliability, robustness and fail proof connection mechanism. Instead of single channel communication over Ethernet, Wireless, power line or SATCOM, we can utilize simultaneous use of all channels to exchange data between different stakeholders of ATM (crew, air traffic controllers, operational control centres, etc.) ■

Jayaramakrishnan Sundararaj,
Sourav Dey
HCL Technologies, India

Transforming AIR TRAFFIC MANAGEMENT

Saab's offsite air traffic management could prove to be a game-changer for India as it goes for regional connectivity.

VARUN VIJAY SINGH
Marketing Director
Air Defence and ATM
SAAB India Technologies

Saab's revolutionary Remote Tower concept promises a completely new approach to Air Traffic Management at airports. While not changing the proven routines and procedures of Air Traffic Control itself, it uses the latest high-technology digital sensors and visual display systems to both increase traffic capacity and to enhance safety- and efficiency by improving the controllers' situational awareness. This could act as a force multiplier for India's regional airports, enabling multiple low-cost, no-frills airports to be controlled from regional hubs.

The most striking feature of the Remote Tower is that it can eliminate the requirement at every airport of a traditional control tower, whose prime purpose is to provide direct line of-sight views of the whole airport area through its windows. Instead, the Air Traffic Control centre can be sited wherever is most convenient: at ground level, underground, even off the airport completely and tens or hundreds of kilome-

tres away. With modern communications systems, distance is not a problem. And the space saved releases valuable airport real estate.

The primary visual information needed by the Air Traffic Control officers is provided not by human eyes, but by fixed high-definition video cameras mounted on one or more masts. In combination, these give a complete 360° overview of the airport, whatever its size. Infra red cameras can provide excellent images in darkness and fog, and the system remains functional in the worst of rainstorms and sandstorms. The fixed cameras are complemented by magnifying pan/tilt/zoom cameras which the controller can direct to any object of interest.

"Saab is redefining the future of Air Traffic Management. Currently our products and services serve 18 of the 20 busiest airports in the world, including JFK, Dublin, London, Frankfurt, Paris, Amsterdam, Copenhagen and Stockholm. Our Digital Tower Solutions represent the next revolution in air traffic control, enabling air traffic services to be provided more efficiently for any airport, from any remote location. In March 2016 year, we received the prestigious IHS Jane's Air Traffic Control Award for delivering the first operational and approved Remote Tower in the world", says Varun Vijay Singh, Marketing Director of Saab India.

In the control centre, the camera pictures are displayed panoramically on a semi-circular wall of TV screens in front of the controller's desk. Other sensors transmit radar data, meteorological data and surface-movement information. The controller's work position incorporates data screens displaying integrated flight data and electronic flight strips, and provides air and ground radio links. At larger airports, separate role-based camera views can be supplied for air and ground traffic.

In the control centre, the camera pictures are displayed panoramically on a semi-circular wall of TV screens in front of the controller's desk.

Ten years of development

The Remote Tower Services system has been developed jointly by Saab and the Swedish Air Navigation Service Provider, LFV, since 2005; then tested at Swedish airports since 2008 in parallel with conventional systems.

Remote tower services and digital solutions are a breakthrough within air traffic control. In 2015, the airports in Örnsköldsvik and Sundsvall became the first in the world to be controlled via Remote Tower Centre (RTC) in Sundsvall. And Linköping Airport will follow suit and become the third remotely-controlled airport in 2017. In December 2016, a letter of intent was signed with Scandinavian Mountains Airport AB to provide services for remote air traffic control to the first airport in the world built without a conventional control tower.

London City Airport and NATS have chosen Saab as the technology provider for a test installation to remotely control London City Airport. Successful test installations have also been implemented in Australia, the USA, the Netherlands, Norway and Ireland in diverse environments and at various distances.

At a time when the very rapid growth of air travel is placing ever-greater pressure on an air traffic environment that is already extremely complex, the Remote Tower concept offers a path to higher traffic capacity and higher standards of safety. Saab's Remote Tower Services (RTS) system is the only certified solution meeting ICAO Regulations. And the important part is that this remote air traffic control system complies with the same existing rules and regulations as applicable to conventional towers. It is also a fully scalable system, equally suitable for major international airports, single regional airports or local airport clusters — and could help transform India's aviation landscape in the coming years, by supporting quick and efficient development of India's many regional airports.

The important part is that this remote air traffic control system complies with the same existing rules and regulations as applicable to conventional towers.

Saab and the Swedish Air Navigation Service provider (LFV) offer remote air traffic control throughout the world. The successful technology lays the foundations for the smart airport, where various digital solutions are combined to streamline logistics and traffic flows both on the ground and in the air.

Remote air traffic control systems are marketed by Saab Digital Air Traffic Solutions, which was formed in September 2016 and is jointly owned by Saab and LFV. But this is only part of the offering. By combining LFV's unique operational experience with Saab's world class technology solutions we can drive the whole process from planning to commissioning remote air traffic control. We offer smart digital solutions so that data can be used in several locations to streamline traffic flows around an airport, both in the air and on the ground.

With more and more airports coming up within India, Saab's Remote Tower Solution fits perfectly to boost India's regional connectivity scheme (UDAN) by providing smarter, cost effective solutions by digitizing and integrating airport functions. Whether that airport is an international hub, a small regional airport or a new airport, Saab offers cost effective solutions that improves safety and enables high operational efficiency. ■

UDAN will need more ATCs, CNS engineers and more...

The regional connectivity scheme will require infrastructure and more manpower. The present 40 per cent shortage in the CNS and with the CNS-ATM existing systems to be maintained and made available for operations, the ANS is over burdened with additional responsibilities to maintain airport systems like security equipment, IT systems, etc.

With UDAN (Ude Desh Ka Aam Nagarik) well under way, a major problem that air services to small towns will face is air traffic control. As the situation stands today, there is a shortage of Air Traffic Controllers - Delhi airport, according to a Bloomberg report, needs 600 for stable operations, but employs only 360 - and finding someone willing to go to airports in 'Little India' would be a difficult task indeed.

The Airports Authority of India (AAI) could have found a way out. According to reports, the authority is seriously considering to monitor air traffic at these 'underserved' airports and airstrips through mobile ATCs to handle a couple of flights in the short span of two or three hours of operations that these airports would see every day. AAI has, in fact, tendered for remote ATCs.

What is important to note is that while ATCOs only run Air Navigation Services/Air Traffic Management/Air Traffic Services - and they do have a very vital role in Air Traffic Control, but they are the end-users and will have nothing to do if the infrastructure/ CNS-ATM system is not in place whether it is the Remote Tower or Remote Controller.

The unsung heroes - the ANS -- play a very important role for sustenance of ANS/ATM/ATS. There is, therefore, a need to focus also the need for CNS engineers for RCS/Remote Tower or the whole ANS.

What is important to note is that while ATCOs only run Air Navigation Services/Air Traffic Management/Air Traffic Services - and they do have a very vital role in Air Traffic Control, but they are the end-users and will have nothing to do if the infrastructure/ CNS-ATM system is not in place whether it is the Remote Tower or Remote Controller.

The situation today is that there is around 40 per cent shortage in the CNS and with the CNS-ATM existing systems to be maintained and made available for operation, they are over-burdened with additional responsibilities to maintain airport systems like security equipment, IT systems, etc. at all operational airports.

With the Remote Tower in operation, perhaps an ATCO may not be positioned but a number of CNS engineers need to be positioned to operate and maintain the state-of-the-art systems that will be required to make remote air traffic control possible.

Simply put, a Remote Tower is a concept that enables Air Traffic Controllers (ATCs) to control airport traffic from a remote location using a 360-degree presentation being constantly fed with live traffic video, weather conditions and all other data one would have in the tower. That, in effect, means an ATC controlling flight take-offs and landings not from the control tower but from a room which may be many miles away from the airport or even in another city.

Exciting as it may sound from a technology point of view, the Remote Tower concept is still undergoing trials. Prompted by the rising cost of aviation and related infrastructure, the Swedish airport authorities tried to find out whether it was possible to have efficient air traffic management at lower financial outlays. It was in 2006 that Saab

FUTURE SCENARIO: A Remote ATC in operation in Sweden. In India where aviation infrastructure is in the process of being created, Remote Tower could be used by airports that see a handful of flights a day.

started its research to develop the Remote Tower.

In the initial stages, it was like groping in the dark. There were a lot of hurdles. Chapters in the ATC manual had to be rewritten because it was the first time that 'control' was being done from a remote location. But when the early concept proved to be successful, the Swedish Air Navigation Service Provider, LFV, ordered a remote tower platform for two airports and a Remote Tower Centre (RTC).

Remote towers use technology where real-time video feeds from cameras at the airport are streamed to the remotely located centre via a high speed digital datalink. The airport tower has a number of cameras that together provide a 360-degree view for the controller in the RTC. In addition, the controller is given a dose of 'atmosphere' created by the meteorological feeds and sounds from the airport. In fact, so advanced is the system that the controller can even control the amount of visible light from the airport and zoom in and out from particular areas, almost like seeing through high-powered binoculars. Saab has also enhanced the technology to aid visibility in fog conditions, such as the one that envelopes Delhi in winter.

According to Saab, ANSPs (Air Navigation Service Providers) worldwide were trying to reduce the cost of providing air traffic services (ATS) without affecting safety or operational availability. The Saab Remote Tower Solution (r-TWR) would not only help this happen but would also introduce a 'never before seen' level of flexibility, allowing service levels to be enhanced. This may result in smaller airports remaining open for longer, or even keep some regional airports open that otherwise would have been forced to close, due to high cost levels.

Instead of a remote ATC, the ideal would be to appoint a retired Air Traffic Controller to handle a couple of flights for a few hours in a day. However, finding a retired ATC in a small town or city would be difficult. For that, the government will have to change the rules.

Termed an ideal concept for regional airports – that will struggle with limited traffic levels and shrinking revenue streams – such Remote Tower solutions with its unique modular design would allow operators to tailor their solution based on local requirements and operational needs.

Saab has developed the r-TWR solution, or ATS on-demand, that allows the operator to move to the location where the demand is, by simply pressing a button. While simultaneously, maintaining control of up to three airports, this creates economies of scale, and adding the dimension of operational flexibility, a true game changer for the ATM industry.

While the Remote ATC tower would reduce costs since there is little construction and maintenance that airport control towers need, would they be feasible in India? CRUISING HEIGHTS talked to an air navigation expert who emphasised the fact that with the present infrastructure, remote ATCs would not be feasible for the simple reason that the supporting infrastructure in the underserved cities or towns cannot be relied upon. The power supply, for instance, in smaller cities is neither constant nor of even voltage. Imagine an ATC without power and the plight of a plane landing or taking off in bad weather. While communication links are still suspect, there has to be failsafe backups. AAI's Dutta said that there would be backups. The Mobile ATC Tower "will have the provision of DG Sets and UPS and all the connectivity through public telecom network", he said. ■

Space-based ADS-B will be A GAME CHANGER

Space-based ADS-B systems put up by NAV CANADA over four million square kilometres has brought in considerable fuel savings for air carriers and even led to a reduction in greenhouse gas emissions.

The field of air traffic management and surveillance technology in many parts of the world has undergone a number of improvements in recent years. The industry's quest for innovation is spurred on by the combined pressures of economic constraints, the need to reduce fuel costs, and growing environmental concerns.

Advancements such as the expansion of Automatic Dependent Surveillance-Broadcast (ADS-B) have made a difference but surveillance over the oceans has been limited.

NAV CANADA is among the first few air navigation service providers (ANSPs) to deploy ADS-B. The company's expansion in its use of ADS-B from Hudson Bay to the coast of Greenland was chronicled in the article, "NAV CANADA Improves Flight Efficiency with 4 Million Square Kilometres of Operational ADS-B" *(Journal of Air Traffic Control*, Summer 2012).

Adding ADS-B surveillance to over four million square kilometres – including 1.3 million square kilometres of oceanic airspace over the North Atlantic – has reaped considerable fuel savings for air carriers and led to a reduction in greenhouse gas (GHG) emissions. But the benefits, especially considering the total size of the North Atlantic, represent an incremental improvement.

A New Era

While the term "game changer" has lost much of its impact due to overuse, its true meaning is restored when referring to Aireon LLC, a newly formed company set up as a joint venture between Iridium Communications Inc. and NAV CANADA.

Aireon will expand existing air traffic surveillance ten-fold, extending ADS-B coverage throughout the entire globe including the oceans – which make up 71 per cent of the Earth's surface – as well as remote and mountainous areas of the world that are currently not covered by either radar or ADS-B.

Aireon will achieve worldwide air traffic surveillance by installing ADS-B receivers on a constellation of 66 low-Earth orbit (LEO) satellites. The receivers will be part of the payload on Iridium NEXT, Iridium's second generation constellation of LEO satellites that are scheduled to be launched between 2015 and 2017.

For all its benefits, terrestrial ADS-B is still limited by the need for ground-based receiving units. With a range of approximately 250 nautical miles, this means the vast majority of oceanic airspace could not be served by ADS-B. Further limitations to the system exist in remote areas and polar regions where ground units are difficult and expensive to install. Aireon's space-based ADS-B system eliminates the need for ground installations, resulting in global coverage.

Currently, air traffic controllers must use procedural separation standards of 10 minutes, or approximately 80 nautical miles in almost 90 percent of the world's airspace which has no radar or ADS-B surveillance. This severely limits the number of aircraft that could fly on the most efficient routes and at the most favourable altitudes.

NAV CANADA estimates that customers on the North Atlantic alone will save more than $100 million per year in fuel costs with Aireon's additional sur-

Aside from the benefits for ANSPs that control traffic over the world's oceans, there are also advantages for countries that have surveillance gaps in domestic airspace, often over remote regions with difficult terrain.

veillance, also translating to a reduction of GHG emissions of over 260,000 metric tonnes annually.

The Partnership

The initial agreement establishing Aireon LLC was announced in June 2012. The agreement finalizing the terms of the joint venture between NAV CANADA and Iridium was reached in November.

"We are very excited to be working with Iridium and pleased that NAV CANADA is part of this new and exciting venture that will be a quantum leap in air traffic surveillance, improving safety and reducing the industry's environmental impact," said John Crichton, President and CEO. "The anticipated fuel savings to airlines and aircraft operators in the North Atlantic alone makes a strong business case for our involvement."

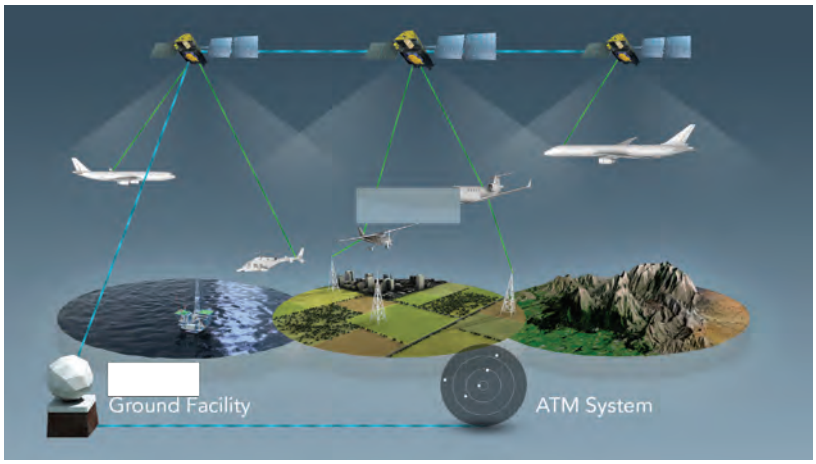
"Aireon truly is a revolutionary advancement and I am excited about the opportunities it will present for Iridium, NAV CANADA and other air navigation service providers who may choose to collaborate with us," said Matt Desch, CEO of Iridium. "The joint venture agreement we completed was a very important step towards bringing this critical innovation to market, and providing the benefits of faster, safer, more efficient air travel to consumers and businesses around the world."

NAV CANADA will acquire up to a majority interest in Aireon with an aggregate total investment of up to US $150 million.

This investment will be made in phases between now and late 2017 with each phase dependent on the achievement of performance milestones. Currently, the NAV CANADA investment is equivalent to 5.1 per cent of the fully diluted equity of Aireon following the first payment of US $15 million.

Leading Aireon is Don Thoma, who was named President and CEO of the newly formed company. Prior to this role, Thoma was Executive Vice President of Marketing at Iridium Communications Inc., joining the company in 2001 where he held various senior leadership positions during his tenure.

"I am very excited to be taking on this new challenge at Aireon," said Thoma. "It is a once in a lifetime opportunity to do something that can make a long lasting, meaningful difference to global aviation.



Iridium NEXT Satellites

66 low-Earth orbiting (LEO) cross-linked satellites,
six in-orbit spares, and nine ground spares
Launch Mass: 800 kg (1,764 lb.)
Solar Array: 2,000 W
Orbital Altitude: 780 km (485 mi)
Stabilisation: 2-axis

Hosted Payload

Weight – 50 kg
Dimensions – 30 x 40 x 70 cm
Power – 50 W average (200 W peak)
Data Rate - ←1 Mbps, Orbit average ~100Kbps

"I have learned a lot about NAV CANADA in the past year and knowing what I know about Iridium, I can say that the two companies share the same culture of innovation, each within their own expertise. Aireon is a perfect partnership for this project because it brings together a world-leading air traffic control provider that has been a pioneer in the use of ADS-B in remote areas and over a part of the Atlantic, with the industry leader in global satellite communications that operates the world's largest commercial constellation of LEO satellites," Thoma said.

Aireon's Advisory Board includes Chairman, Norm Mineta, former U.S. Transportation Secretary and Russ Chew, whose long career as a leader in the air transportation industry includes four years as Chief Operating Officer for the FAA.

The System

Scheduled to begin launching in 2015, Iridium NEXT will include a total of 81 advanced communications satellites consisting of:

- 66 operational LEO satellites,
- 6 in-orbit spare satellites, and
- 9 ground spares

Iridium NEXT will recreate the existing Iridium constellation of LEO satellites deploying the cross-linked architecture that provides continuous coverage over the entire Earth's surface. Having 15 satellites as backups helps ensure the system's resiliency and

redundancy — both in space and on the ground.

The satellite constellation operates in near-circular low-Earth orbit approximately 780 kilometres above the Earth's surface. There are 11 satellites in each of six orbital planes, creating a cross-linked mesh network that provides coverage pole-to-pole. The low-flying satellites travel at approximately 27,000 kilometres per hour, completing an orbit of the Earth every 100 minutes.

"A key advantage with Aireon is that the system will use the same ADS-B onboard equipage currently in use by airlines around the world," said Sid Koslow, NAV CANADA Vice President and Chief Technology Officer. "There is no costly retrofit to be done which can be an impediment to implementing any new technology. That's the objective; to have one system that provides benefits in many places without requiring changes to the aircraft."

Many aircraft are already ADS-B equipped and the FAA has issued a rule which requires all planes operating in airspace where a transponder is mandatory, to be ADS-B ready by 2020. Currently, 85 per cent of the flights transiting the North Atlantic are flown by ADS-B equipped aircraft.

The ADS-B receiving units for Aireon will be modified from the current ground installations. "The ADS-B antennae and amplifiers are being designed specifically for the satellite application," noted Koslow. "But the work in terms of processing the signal once it is received will be very similar."

Another advantage to a space-based system is the avoidance of costs related to the installation, maintenance and operation of ground stations in remote locations notes Kim Troutman, NAV CANADA Vice President, Engineering. "The installation of ADS-B ground stations in remote regions is difficult and the operating costs are high.

"Most of our installations are located in isolated areas with limited infrastructure. The monthly cost of dedicated telecommunication lines and power can be thousands of dollars," Troutman said. "And when you have multiple locations, it starts to add up."

The satellite constellation operates in near-circular low-Earth orbit approximately 780 kilometres above the Earth's surface. There are 11 satellites in each of six orbital planes.

Troutman also noted that NAV CANADA air traffic management software such as GAATS (Gander Automated Air Traffic System) and CAATS (Canadian Automated Air Traffic System) have already been adapted for ADS-B. "There will be some further modifications required for the satellite system, but these will be relatively minor."

Benefits for ANSPs

At the announcement in June, NAV CANADA said that it would not only be a partner in Aireon, it would also be its first customer.

"As an ANSP that is focused on improving service and saving money for our own customers, we see the big advantages in having global ADS-B, especially when you consider that we manage part of the busiest oceanic airspace" said Crichton. "We are in discussions with other ANSPs on the ways they can benefit from the service, enabling them to extend to their airline customers significant fuel savings and avoided GHG emissions in vast reaches of airspace which today are confined to inefficient procedural separation."

Aside from the benefits for ANSPs that control traffic over the world's oceans, there are also advantages for countries that have surveillance gaps in domestic airspace, often over remote regions with difficult terrain. With Aireon, they can improve service and save on the infrastructure costs associated with radar or ADS-B ground stations.

It is anticipated that Aireon will provide ADS-B surveillance data to ANSPs around the world beginning in 2017. ■

Avoiding conflicts, detecting terrorist activities

As the world's political landscape undergoes a change, the increasing diversity of wireless communications and the presence of asymmetric threats are making it more difficult to detect and pursue organised crime and terrorists. What then is the way out?

Strategic intelligence systems, early information gathering and preventive crisis management help to avoid conflicts and detect terrorist activities. The manufacturers need to develop, produce and supply innovative solutions that allow governments to enhance their national security and increase their citizens' safety.

A changing world-political landscape, the increasing diversity of wireless communications and the presence of asymmetric threats are making it more difficult to detect and pursue organised crime and terrorists. Modular concepts and custom-built solutions are required in order to precisely adapt existing monitoring systems to the ever-growing number of new communications standards and equipment. Using a wide range of systems and instruments, government agencies and armed forces can speed up the process of gathering information and detecting emitters in the context of crisis management and peacekeeping missions. The users in the fields of homeland and external security, spectrum monitoring, frequency management, customers in defence and security, should have state-art-the-art solutions for radio reconnaissance, intelligence, surveillance, security scanning and cybersecurity. To ensure that they can adequately respond to the challenges they face, need complete signals intelligence (SIGINT) and electronic warfare (EW) systems ranging from sensor technology (antennas, receivers, direction finders, analysis equipment) to software that supports technical and operational evaluation.

In an age of growing threats, information superiority is a key factor for decision makers in governmental and military organisations.

In an age of growing threats, information superiority is a key factor for decision makers in governmental and military organisations. In order to gather reliable information, organisations usually exploit more than one information source. Overlapping, correlating and combining data from the different origins confirms results and reduces ambiguities. This improves assessments of situations, delivers more details and allows more targeted responses to situations. The reconnaissance systems convert intercepted signals to valuable facts. These systems should be modular and can be integrated into existing C4I network structures, they include recon-

naissance in different frequency bands, Satellite monitoring, Mobile phone monitoring, Network intelligence and lawful interception.

Discovering occurrences in the world with their related background information is a vital basis for making political and military decisions. Satellite-based as well as HF and strategic COMINT (Communications Intelligence) systems play an important role in worldwide intelligence. They allow non-escalating information gathering without geographical limitations, since their deployment does not entail penetration into foreign airspace or territory.

Far-reaching intelligence lays the foundation for considering action in different fields

- Early recognition of possible threats
- Conflict avoidance
- Political decisions
- Combating terrorism
- Efficient conflict management

Organisations that are a threat to our security are making increasing use of the full scope of modern radio data transmission technologies ranging from HF, VHF/UHF, SHF and SatCom to GSM/UMTS/LTE. Therefore, automated, highly integrated and adaptable multisensor systems must be deployed to ensure interception of valuable data and corresponding provisions.

Satellite intelligence

Obtaining basic reference data from satellite communications involves interception and automatic filtering of all voice, fax and data channels from visible satellites.

Worldwide HF intelligence

Despite increasingly powerful alternatives, HF communications links continue to play an important role due to their wide range of coverage. Typical HF communications problems such as fading and other types of interference can be largely compensated using advanced communications systems, thereby increasing the data rate and security of the transmissions. Airborne platforms offer a major benefit: a wide detection range that is not attainable with other types of systems. Special mission aircraft are able to detect radio traffic in areas not accessible by land-based or sea-based systems. Such systems always require a highly customized, sophisticated design, since they must be tailored for use in different types of aircraft, integrating the full range of hardware components (antennas, receivers, direction finders and process controllers) presents a major challenge.

Modern radar systems use new technologies. These demand a new generation of ELINT systems in order to gain situational awareness on the battlefield and protect own forces. Today's platforms operate with multifunction radars that simultaneously operate in different modes. Many modern radars apply low probability of intercept (LPI) technologies, such as frequency-modulated continuous wave (FMCW) radars. Intercepting and analyzing them requires new capabilities and features. Solid-state radars operate at very low power levels and require high system sensitivity for detecting and processing them. Hence the modern ELINT systems have to provide comprehensive intelligence gathering capability for such modern radar signals. Cutting-edge sensitivity and digital wideband recording preserves all signal properties such as instantaneous amplitude, frequency and phase. This enables in-depth analysis of even complex signals that can be used to regenerate true replicas of the signals and ultimately update reference databases. The compact sensors can be integrated into airborne, naval and land-based platforms. They not only feature the latest technological advances but incorporate the operational requirements in the supporting work flow. The digital design should preserve the frequency and phase characteristics of the recordings to provide lossless post-processing

Modern radar systems use new technologies. These demand a new generation of ELINT systems in order to gain situational awareness on the battlefield and protect own forces.

and high-quality results. The scalable design should be possible for single operators as well as nationwide systems, and allow remote control of unattended or detached collection sites. Thanks to the open interfaces that it can be integrated into existing signal intelligence systems.

Many nations put high priority on security against terrorist attacks and other threats. To protect their population and infrastructure, they have to count on state-of-the-art communications surveillance and intelligence systems. These systems provide law enforcement authorities with valuable information about illegal activities. Border surveillance, at international boundaries radio surveillance systems can find and track suspects, provide indications of forthcoming illegal activities and detect and locate specific targets. By exploiting the electromagnetic environment, the automated radio monitoring systems help to secure borders and coastlines. Mobile phone monitoring system used by law enforcement authorities allow surveillance tasks, data collection and target-oriented operations. They work actively or passively, and include features that even detect abnormalities in cellular phone networks. Commercially available drones have become widely used, sometimes also abusively. The drone defense systems reliably detect, identify and counter these threats without interfering other radio services in the neighborhoods. Worldwide communications increasingly run via the Internet, this is why authorities gather targets' cyber data. The network intelligence solutions recognize different types of IP traffic analyze protocols and extract metadata as well as content.

When organising large-scale events, responsible bodies minimize the risk of unwanted incidents caused by electromagnetic interferences. To do so, they search for abnormal emissions in the vicinity before and during the event. ATC and VTS Air traffic direction finders not only secure the aircraft activities around airfields but also allow traffic to be safely routed. They locate aircraft while their pilots send radio messages. Vessel traffic direction finders can locate emitters on all maritime radio channels, including the distress channel in parallel. Search and rescue (SAR) Vessel traffic direction finders locate mariners in distress, thus reducing the need for time-consuming search maneuvers and increasing survivability. Also on land, in remote or disaster areas, the modern systems support SAR missions by detecting and locating mobile phones. Interference hunting offers a comprehensive portfolio of devices and systems for mitigating interference. Fixed, mobile, transportable and portable radio monitoring and direction finding tools are the basis for reliable wireless communications.

Commercially available drones have become widely used, sometimes also abusively. The drone defence systems reliably detect, identify and counter these threats without interfering other radio services in the neighborhoods.

Security scanning

Deployed at security checkpoints in airports and other public locations or events with high threat potential, it increases safety dramatically. They detect unauthorized objects and prevent them from being taken on board an aircraft or other location behind the checkpoint.

Protection and threat prevention

Security in any country is subject to diverse threats and hazards. Hence the components and the systems have to be built for users' specific needs. ■

Revolutionising Global Air Traffic Management

Space-based ADS-B technology will be more effective for air traffic surveillance since it will include mountainous terrains, remote areas and oceans – presently without any real-time air traffic coverage.

Ground-based radar and Automatic Dependent Surveillance-Broadcast (ADS-B) technology are very effective tools for air traffic surveillance. However, they have inherent limitations due to line-of-sight and multipath radio signal propagation that leave mountainous terrains, remote areas and oceans without any real-time air traffic coverage. Many of these regions, including the poles, remain unsurveilled. These regions account for more than 70 per cent of the globe. Major traffic flows through large oceanic airspaces like the Bay of Bengal, Arabian Sea, Indian, Atlantic and Pacific Oceans are still being controlled and monitored procedurally based on periodic position reports. Larger separation between aircraft and wider spacing between routes result in inefficient use of airspace with reduced capacity, and operational deficiencies due to aircraft operating at uneconomical flight levels.

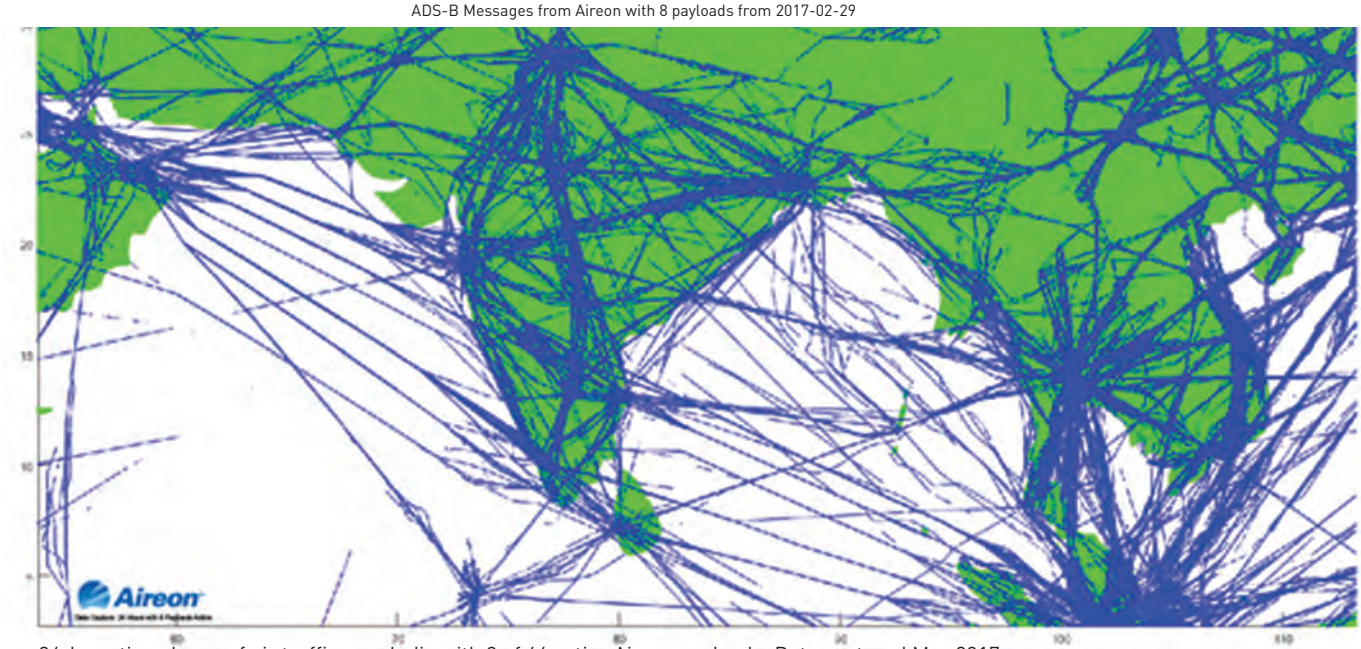
CYRIEL KRONENBURG
VP, Aireon LLC

This environment is not ideal for achieving seamless Air Traffic Management (ATM) and uniform application of separation standards across the globe.

Space-Based ADS-B: Disruptive Technology for Seamless Air Traffic Surveillance

In partnership with leading Air Navigation Service Providers (ANSPs) from around the world, like NAV CANADA,

ADS-B Messages from Aireon with 8 payloads from 2017-02-29



24-hour time-lapse of air traffic over India with 8 of 66 active Aireon payloads. Data captured May 2017.

the Irish Aviation Authority (IAA), Enav and Naviair, as well as Iridium Communications, Aireon is scheduled to have an operational, global, space-based air traffic surveillance system in mid-2018. The backbone of Aireon's space-based ADS-B system is the Iridium NEXT constellation of satellites, scheduled for eight launches through 2018. Aireon's space-based ADS-B system will relay signals from all ADS-B equipped aircraft to controllers worldwide, allowing 100 percent global air traffic surveillance, regardless of location or terrain, without requiring additional ANSP infrastructure or airline equipage.

The Space-Based ADS-B System

Even though the operational concept remains the same as ground-based ADS-B, space-based ADS-B will mitigate the limitations of ground-based surveillance. No additional equipage is needed for aircraft to be monitored by space-based ADS-B, as it functions off existing and currently mandated 1090ES ADS-B transponders.

ADS-B information is broadcasted from the aircraft and received by the Aireon payload, which transfers aircraft data from satellite to satellite down to Iridium's ground-based Teleport Network (TPN) and then to the Aireon Processing and Distribution (APD) system. The APD decodes and verifies the data, and delivers the data to the appropriate stakeholder facilities that have subscribed to the Aireon service.

Unlike traditional en-route radars, which rotate once every 12 seconds, Aireon's space-based satellites can provide position updates up to twice per second, with an expected Update Interval (UI) performance of eight seconds, which would meet the five-nautical mile (5 NM) application needs of en-route separation services, according to EUROCAE ED-129B and EUROCONTROLGEN SUR specifications.

Flight Safety Foundation Study: Safety Benefits of Space-Based ADS-B

US-based Flight Safety Foundation conducted a study on the safety benefits of deploying space-based ADS-B. This new system has the potential to significantly improve flight safety, efficiency and the health of the industry overall, according to the report, "Benefits Analysis of Space-Based ADS-B." Conducted over several months, the study identifies benefits of space-based ADS-B, and the integral role it can play in meeting both existing and future challenges facing the aviation industry.

According to the report, space-based ADS-B can immediately eliminate:

- Oceanic and remote airspace lack of surveillance – Space-based ADS-B will provide a critical real-time surveillance enhancement while also enabling reduced oceanic separation.
- Aircraft position errors that occur on or near the boundaries of two different Flight Information Regions (FIRs) are still relatively common – The integrity and accuracy of space-based ADS-B should introduce significant safety benefits to avoid positional errors for aircraft within adjacent FIRs. Also, handoff between Controllers at FIR boundaries should be more precise due to real-time situational awareness, reducing controller and pilot workload.
- Current flight trajectory monitoring is generally limited to every 30 minutes in oceanic and remote airspace, which can result in significant off-track errors – With an anticipated data-update rate of once every 8 seconds, space-based ADS-B will introduce real-time detection of aircraft not conforming with its intended and planned flight path, as opposed to the current standard of 30-minute updates.
- Controller and pilot work-

Even though the operational concept remains the same as ground-based ADS-B, space-based ADS-B will mitigate the limitations of ground-based surveillance.

loads are hampered by inefficient traffic management strategies over oceanic and remote airspace – Space-based ADS-B is expected to reduce controller and pilot workload, due to ADS-B's ability to display an accurate and near-real-time picture for controllers.

- Insufficient surveillance capabilities and lack of redundancy over designated conflict zones and volcanic ash clouds – In contested or obscured airspace where reliable surveillance is not available, space-based ADS-B should enhance strategic planning, contingency management and operational situational awareness.

Air Traffic in India: A Current Snapshot and Future Outlook

The International Air Transport Association (IATA) 20-Year Air Passenger Forecast states that India is the third fastest-growing market, in terms of additional passengers per year, over the next twenty years. The forecast indicates an additional 322 million new passengers for a total of 442 million.

Through a Memorandum of Understanding (MOU), Airports Authority of India (AAI) and Aireon have been working to develop applicable regulations, standards and procedures for ADS-B in its airspace, identify specific requirements for the use of space-based ADS-B and demonstrate how space-based ADS-B can improve aviation operations and safety in Indian airspace.

IATA 20-Year Air Passenger Forecast states that India is the third fastest-growing market, in terms of additional passengers per year, over the next twenty years.

Aireon and AAI continue to work together on developing a concept of operations for real-time aircraft position updates in their airspace. Don Thoma, CEO, Aireon states regarding the MOU, that "AAI's commitment to implementing leading-edge surveillance infrastructure to further India's aviation industry is pivotal in bringing space-based ADS-B to this region. As we develop and deploy Aireon, our close partnership with them will help bring a much-needed surveillance technology to remote and oceanic areas within AAI's airspace that are currently underserved."

With two Iridium NEXT launches already completed and the third scheduled for 30 September 2017, that will bring Aireon up to 30 payloads in orbit, with another 45 prepared for space operation in a series of 5 additional launches, planned over the next year. Aireon plans to provide the first opportunity for global air traffic surveillance in mid-2018 and is well on its way to providing real-time global air traffic surveillance to the world's aviation community. ■

HUMAN FACTORS IN AIR TRAFFIC CONTROL

Humans will always be at centrestage as decision makers and human performance will remain the key driver of ATM performance, writes S C Badola, Joint GM (ATM), Branch Secretary, ATC Guild (India)

Through this article I am sharing my experience of 13 years of active ATC duty at Indira Gandhi International (IGI) Airport as a procedural as well as radar controller and On Job Training Instructor. IGI airport is the busiest airport of the country. With multiple runway operations in different modes, it has to deal with frequent VVIP movements — that demand additional separation minima than the prescribed limit — prohibited airspace especially to the north of the airfield, ambulance flights i.e. aircraft carrying seriously sick/injured person on board and frequent changes in Standard Operating procedures (SOPs) to enhance capacity. The above-mentioned complexities and constraints demand proactive Air Traffic Controllers at IGI airport and other airports having similar complexities/constraints.

Growing traffic and airline demands are challenges to meet performance targets on safety, cost-efficiency, capacity and environment. To fulfil these targets, new ATM concepts are continuously being developed, building on enabling technologies.

When a controller is involved in a near-miss incident, there are many potential impacts and a few are as under:

- The first is that it represents a safety-related event.
- The second is that it can affect the controller concerned like financial loss, in more serious cases leading to post traumatic stress disorder, loss of sleep and an inability to continue functioning as an active controller.
- The third downside is that the organisation loses a trained controller for a considerable period, at times couple of months.
- The fourth downside is an impact on personal confidence level.

Mental workload

The mental workload experienced by a controller depends on many factors:

- The number of aircraft on his/her frequency.
- The traffic complexity, and fatigue factors, such as time on duty, time of day, etc.
- Some unavoidable social commitment which he/she is unable to fulfill because of the nature of H24 duties.
- Non-congenial work atmosphere.
- An apprehension of loss of rating i.e. an authorisation to work on a particular work station and the delay in investigation procedure.

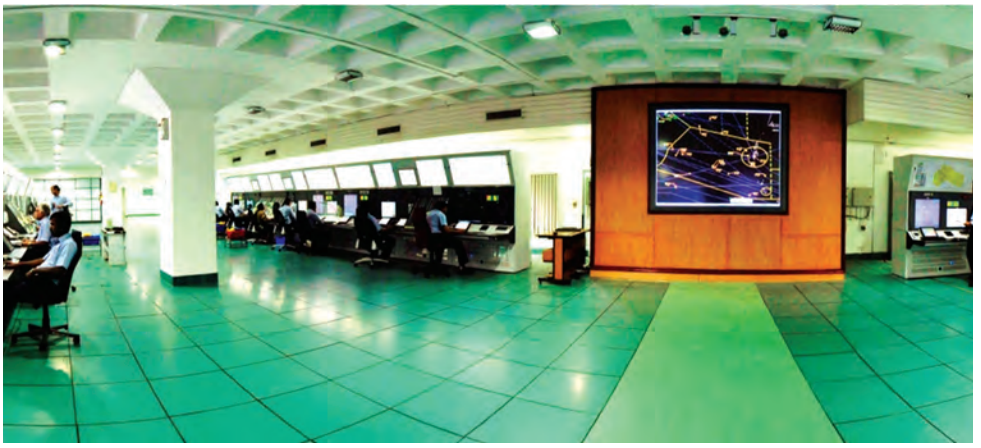
AN ATC MUST NOT FORGET:

- To unclutter his/her radar screen.
- That the pilots should not be given more than three pieces of information in a single transmission.
- That when issuing a clearance which is different from what the pilot was told to expect, he/she should emphasize the difference. (For example, **Controller to Pilot:** Expect radar vectors for Runway 28. **Pilot to Controller:** Roger, Radar vectors Runway 28. After sometime due to change in wind direction and speed the runway is changed to Rwy10. The controller should emphasize the change as Runway 28 may be somewhere in the mind of the Pilot.)
- That negative commands should never be issued (e.g. "Don't climb") and he/she always have to be sure that the action word in his/her instruction is what he/she wants the pilot to do.
- That he/she should never assume that a pilot will follow the clearance that was issued. Keep up his/her scan and check.
- To recognize his/her own personal signs of stress and those of their colleagues. Personal signs of stress may include: talking too fast or too loud, moving close up to the scope, sweating, increased heart rate, or other signals.
- That air traffic control is a team work. He/she should call for help before the situation gets out of control.
- That every controller should be treated as a resource. He/she should encourage and appreciate their feedback.
- That we are all set to hear what we expect to hear, therefor catching read-back errors is too difficult a job.
- To leave his /her worries aside till he/she is on duty or at a relief break during the duty.

The human-machine coordination process must be clearly defined so that the transmission of information between different parties are always clearly acted upon without any interference or ambiguity. ■

Job WITH A VIEW

They spend most of their working hours perched above runways, physically cut off from the world yet completely connected. Their job: ensuring the safety of planes and fliers in the sky and on the ground. We would point fingers at them if they did a bad job. In fact, the better they are the more invisible they become



"Air India... Tower, Touchdown at one three, vacate runway via Romeo continue to gate Four Three via Papa November Charlie."

As the plane docks in the bay at Delhi's Indira Gandhi International Airport and the passengers start moving out, it is the end of a journey. But, at the AAI's (Airports Authority of India) Air Traffic Control (ATC) — virtually a stone's throw from the airport — the Air India flight was only one of the 80-odd flights that the controllers safely guide in and out in an hour.

From the time the door of the aircraft are closed, till the last passenger goes out of the plane at his destination, the movement of the aircraft is continuously monitored by the Air Traffic Controllers (ATCs) who ensure that there is no threat to the safety of the flight.

It is a strenuous job — not only in India but all over the world — but one that the controllers look forward to everyday. Perhaps, it is the high that the 5000-odd Air Navigation System (ANS) officials of the country get every time they step into the more than 125 ATC centres around the country that keeps them glued to their posts. It takes a certain kind of personality to handle the job and it is one that you or I would not touch with a bargepole. These people take on long hours and work on holidays and perform at 110 per cent efficiency, paying attention to the minutest detail.

In a virtually windowless room, almost dark as night, these controllers sit with their headsets barking orders while

watching moving figures on glowing monitors. They make sure that million-dollar planes are at a safe distance from each other on the ground and in the air. These men and women are choreographers, always with an eye on the big-picture. Like the pilots up in the sky, they make split-second decisions based on "physics, geometry, aerodynamics" and intuition.

It is a responsibility like no other. Aviation enthusiasts often refer to ATC personnel as those with a God-complex — after all, they hold millions of lives in their hands even if it is for a few minutes — but, maybe it is more than that.

The work came in for praise from Ken McLean, Regional Director, International Air Transport Association (IATA), who lauded the AAI "for the significant progress made in transforming the ATM systems to meet the challenges of aviation growth in India. Through the concept of Operational Safety and Capacity Enhancement Teams (OSCET) and through the collaborative efforts of airport users and air traffic control, we have achieved a on-time performance of more than 80 per cent aircraft movements in Delhi with movements per hour increasing to a recent high of 73. Similarly, on-time performance at Mumbai airport has gone up to 80 per cent and the movements per hour have risen to 45".

Sustaining the high growth will only be possible with trained manpower. As Chairman Guruprasad Mohapatra pointed out *(see interview elsewhere in this publication)* "recruitment is a continuous process in any organisation. The same applies to CNS engineers in AAI. In the last few years we have tried to augment our manpower to cope up with the induction of new equipment's and cater to new airports. Management has taken decision to recruit CNS Engineers at induction level through the GATE (Graduate Aptitude Test for Engineers) being conducted by IITs. There is, of course, some gap, however, AAI has firm recruitment plans to meet the challenge of smooth maintenance and operation of ANS infrastructures through provision of trained CNS manpower after imparting regular training". That will ensure 99.999998 per cent availability of the communication backbone. That is the high level of benchmark that the AAI has set for itself.

And with each passing day, the responsibilities keep multiplying. While the number of aircraft is expected to rise from the 320+ today to a whopping 1000 in the next ten years, the growth rate of passengers could touch 15 per cent per annum. It is a virtual cat-and-mouse game: infrastructure and technology has to keep not one step ahead but race ahead to be on top of the game.

That race has transformed the AAI into a quietly efficient organisation — quite unlike the archetypal government bodies that move at their own pace — keen to modernise, innovate and upgrade ANS and airport infrastructure. Chairman Mohapatra was forthright when he said sometime ago to Cruising Heights magazine that "if I (the AAI) do not operate financially well, I will lose the whole purpose for which I was created. I cannot undertake new projects. The Government of India created an Airports Authority of India...to essentially finance by itself these projects. If the Airports Authority cannot even run and give salaries, then why the body in the first place?"

As for passenger experience, the Chairman mentioned, "We have appointed a very good globally famous consultancy agency to improve passenger amenities and customer satisfaction in AAI airports and we have given them a mandate for 10 airports – all the 10 major airports other than Ahmedabad and Jaipur – and within one year of the consultancy project having started we have improved significantly in all these areas in all these airports... At the same time, we are now starting the concept of handing over of O&M (Operation and Maintenance) of major AAI airports. Plus, we are constantly benchmarking ourselves giving a lot of emphasis on basic issues..."

The importance of investments in order to prepare the air-

Tall tower

The new air-traffic control tower at IGI Airport could start operations shortly. The tallest tower in India —102.9 metres — it is way over the present 60m-high tower that was built in 1999. The new tower will help the Delhi airport to increase the hourly flight handling capacity of its runways. According to AAI, the operations from the new tower will be part of a strategy that will include simultaneous operations from both old and new towers and finally switching over to the new tower which will allow ATC controllers to keep an eye on the three runways as well as the fourth one that is scheduled to be ready by 2021.

ports for the passenger growth of tomorrow is paying off. Over the years, the transformation has brought in results: enhanced safety and operational efficiency. Of course, international recognition has come as well — proof enough to declare to the world that we are not only good but the very best: in 2012, for example, there was the Janes' ATC Award and later, two ATC Excellence Awards in the category of Excellence in ANSP (Air Navigation Service Provider) Management (outside Europe and North America) and another award in the category of Strategic Advancement in Air Transport. These awards were won after contesting with multiple global ANSP leaders.

The jewel in the ANS crown is GAGAN (GPS Aided Geo Augmented Navigation) that is scheduled to start operations sometime in the middle of this year. GAGAN is part of the giant technological leap that the country has taken to redefine air navigation by transitioning from ground-based to satellite-based navigation. The project jointly undertaken by AAI and Indian Space Research Organisation (ISRO) in accordance with International Civil Aviation Organisation's (ICAO) plan to achieve smooth transition to satellite based navigation and seamless air traffic management across continents, GAGAN is designed to provide improve accuracy, availability, and integrity necessary to enable users to rely on GPS for all phases of flight.

Incidentally, India is the fourth country in the world after the US, Japan and Europe, to develop regional SBAS that will redefine navigation in India and neighbouring countries. GAGAN will cover a huge area beyond the Indian landmass, Africa and even Australia. The GAGAN configuration includes 15 Indian Reference Stations (INRES), two Indian Master Control Centres (INMCC), three Indian Land Uplink Stations (INLUS) and two GEO satellites (GSAT-8 and GSAT-10).

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The first step in a major move that aimed to save fuel, reduce pollution and bring down delays for fliers were taken a couple of years ago. A breakthrough had been achieved in the Flexible Use of Airspace (FUA). Simply put, the move has seen civil and military aircraft sharing airspace. The military controlled 65 per cent of the airspace leaving only 35 per cent for civil aircraft often leading to much wrangling between the civil aviation authorities and the Indian Air Force. The National High Level Airspace Policy Body (NHLAPB) has been created for FUA and it will lead to a fuel saving of 20,29,380 kg per annum and reduction of carbon dioxide emission by 63,93,600 kg per annum with the direct routing between seven city pairs of Delhi-Mumbai, Delhi-Kolkata, Delhi-Chennai, Delhi-Hyderabad, Delhi-Bengaluru, Kolkata-Chennai and Chennai-Mumbai. ■

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International Airports (3 Civil Enclaves & 3 Joint Venture Airports)

+

08 कस्टम हवाई अड्डे (4 सिविल एन्कलेव)
Custom Airports (4 Civil Enclaves)

+

77 अन्तर्देशीय हवाई अड्डे
Domestic Airports

+

19 अन्य सिविल एन्कलेव
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=

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