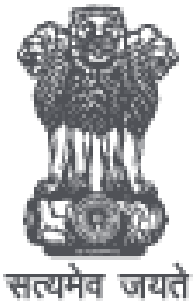

नागर विमानन मंत्रालय
MINISTRY OF
CIVIL AVIATION

Consultation Paper No. 02/2019-20 Dated 15.01.2020

Determination of Philosophy and Tariff for Air Navigation Services for the Control Period (1st April 2020 to 31st March 2030)

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Contents

1. Preface

1.1.1. The Ministry of Civil Aviation (MoCA / Ministry) is responsible for formulation of national policies and programmes for the development and regulation of the Civil Aviation sector in the country. It is responsible for the administration of the Aircraft Act, 1934, Aircraft Rules, 1937 and various other legislations pertaining to the Aviation Sector in the country. This Ministry exercises administrative control over attached and autonomous organizations including Airports Authority of India (AAI).

1.1.2. Airports Authority of India is a body corporate constituted under the Airports Authority of India Act, 1994 (No. 55 of 1994) as amended by the Airports Authority of India (Amendment) Act 2003 ("AAI Act"). The said Act provides for the constitution of the Airports Authority of India and for the transfer and vesting of the undertakings of the International Airports Authority of India and the National Airports Authority to and in the AAI so constituted for better administration and cohesive management of airports and civil enclaves whereat air transport services are operated or are intended to be operated and of all aeronautical communication stations for the purposes of establishing or assisting in the establishment of airports and for matters connected therewith or incidental thereto.

1.1.3. Tariff for providing air navigation and communication services through-out India (which includes Route Navigation Facility Charge (RNFC) and Terminal Navigation and Landing Charge (TNLC) is required to be approved by Central Government as per Section 22(b) of the AAI Act.

1.1.4. MoCA is evaluating request made by AAI to revise tariff for air navigation service provided by AAI in all airports in India. In order to ensure transparency and to consider the views of all the stakeholders in determining its tariff, this consultation paper has been prepared listing out its philosophy and approach to the tariff determination of air navigation service, and evaluation of the proposed tariff together with the relevant details and workings.

1.1.5. Objective of this consultation paper is to formulate a philosophy for tariff determination for the air navigation service and to provide transparency in the tariff determination process. This consultation paper is being issued to elicit comments from stakeholders.

1.1.6. In drafting this paper, due care is taken to represent the relevant, applicable laws and regulations, prevailing practices and as many variables as possible that go into tariff computations. This consultation paper has been prepared with the intention of eliciting responses from stakeholders. MoCA hopes that this paper will generate discussion and comments and welcomes written evidence-based feedback, comments and suggestions from

stakeholders on issues raised herein. Comments / submissions should be furnished, latest by 14th February 2020, at the following address:

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1.1.7. MoCA intends to take feedback, comments and suggestions received on this paper on board while finalizing the revision to its tariff for air navigation services.

2. Context

2.1. Legal and Regulatory Framework

2.1.1. Brief outline of the three major acts governing the civil aviation sector in India is given below:

2.1.2. The Aircraft Act, 1934 provides for the control of manufacture, possession, use, operation, sale, import and export of aircraft. This Act and the rules made thereunder by the Central Government inter-alia, govern the development, maintenance and operation of all airports, including greenfield airports. Under the Act, Government of India (GoI) has the sole right to grant a license for setting up an airport and the operations of the airport would be subject to its licensing conditions.

2.1.3. The Airports Economic Regulatory Authority of India Act, 2008 envisages the establishment of a statutory authority called the Airports Economic Regulatory Authority of India (AERA). This Authority is set up to regulate tariff for the aeronautical services for major airports, determine other airport charges for services rendered at major airports and to monitor the performance standards of such airports. By virtue of this Act, tariff for aeronautical services at all "Major" Airports is determined by AERA. Please refer 5.4 below for discussion on the authority for determination of tariff for air navigation services in India.

2.1.4. The Airports Authority of India (AAI) Act, 1994 provides for the constitution of AAI and the vesting of the airports in AAI.

2.1.5. Oversight of the various functions in Aviation sector in India are carried out by Director General of Civil Aviation (DGCA), Bureau of Civil Aviation Security (BCAS), AERA and AAI under MoCA.

2.1.6. The civil aviation sector in India is also currently governed, broadly, by four policies: – the Domestic Air Transport Policy, Policy on Airport Infrastructure, Greenfield Airports Policy and National Civil Aviation Policy 2016 (NCAP 2016). The Domestic Air Transport Policy enabled entry of private airlines in domestic air transport, the Policy on Airport Infrastructure relates to use and development of airports and the Greenfield Airports Policy provides a framework within which such airports are set up and must operate. NCAP 2016, issued by the GoI serves as the guiding policy framework for all key initiatives in the aviation sector in India.

2.2. Air Navigation Services (ANS)

2.2.1. The function of navigation systems is to support en-route, terminal, approach, landing operations and surface movements.

2.2.2. ICAO Manual 9161 defines air navigation services as thus – "*This term includes air traffic management (ATM), communications, navigation and surveillance systems (CNS), meteorological services for air navigation (MET), search and rescue (SAR) and aeronautical information services/aeronautical information management (AIS/AIM). These services are provided to air traffic during all phases of operations (approach, aerodrome and en route)*."

2.3. Airports Authority of India (AAI) and ANS

2.3.1. AAI was constituted by an Act of Parliament and came into being on 1st April 1995 by merging erstwhile National Airports Authority and International Airports Authority of India. The merger brought into existence a single organization entrusted with the responsibility of creating, upgrading, maintaining and managing civil aviation infrastructure.

2.3.2. AAI manages several Airports, which include International Airports, Customs Airports, Domestic Airports and Civil Enclaves at Defence Airfields.

2.3.3. Functions of AAI are detailed in the AAI Act under Section 12. Clauses of this section which are relevant in the context of ANS is given below:

"Section 12(2) - It shall be the duty of the Authority to provide air traffic service and air transport service at any airport and civil enclaves.

Section 12(3(b)) - (b) plan, procure, install and maintain navigational aids, communication equipment, beacons and ground aids at the airports and at such locations as may be considered necessary for safe navigation and operation of aircrafts"

2.3.4. The mission of AAI for ANS is *"To achieve highest standards of safety and quality in air traffic services by providing state of-the-art infrastructure for total customer satisfaction"*.

2.3.5. AAI is responsible for providing Air Navigation Services (ANS) over the Indian airspace and the Indian Ocean region covering around 9.6 million sq. km. The Indian air space is nearly thrice of India's land area of 3.3 million sq. km.

2.3.6. AAI's coverage for provision of air navigation services includes all civilian airports in India including:

2.3.6.1. Joint venture airports (e.g., Delhi, Mumbai, Nagpur)

2.3.6.2. Public airports

2.3.6.3. Greenfield airports (e.g., Bengaluru, Shamshabad, Cochin, etc.)

2.3.6.4. State government airports (e.g., Lengpui), and

2.3.6.5. Private airports (e.g., Mundra, Durgapur etc.).

2.3.7. The current navigation infrastructure in India comprises primarily of ground-based navigation aids such as Non-Directional Beacon (NDB), Very High Frequency Omni Directional Range (VOR), Distance Measuring Equipment (DME) and Instrument Landing System (ILS) radio aids, which are standard International Civil Aviation Organization (ICAO) based navigational and precision landing aids.

3. The Industry

3.1. Specialized Services

3.1.1. Aviation is an integral part of society. This industry connects people and transports goods worldwide. It is an important driver of economic growth and sustainable development. It improves the standard of living of people around the world through safe and reliable operation of flights every day. Forecasts confirm robust air traffic growth within the next 20 years owing to positive economic, political and societal changes.

3.1.2. The achievement of sustainable growth within the international air transport system strongly relies on a high-performing and seamless global air navigation system. The global air navigation system supports the safe and orderly development of international civil aviation through the collaborative integration of humans, information, technology, facilities and services.

3.1.3. **Scope of air navigation services:**

3.1.3.1. Within the technical scope, the system comprises aerodrome operations, air traffic management, meteorology, aeronautical information and search and rescue services supported by air, ground and space-based communications, navigation and surveillance (CNS) capabilities.

3.1.3.2. Within the operational scope, the system encompasses en-route operations to integrate airport operations and flight turnaround.

3.1.3.3. Within the community scope, the system comprises all stakeholders involved in the provision of, or requiring the use of, air navigation resources.

3.1.4. A performance-driven, service-oriented and technologically advanced global air navigation system is therefore critical to achieve greater connectivity of passengers and goods and ensuring the sustainability of the growing aviation sector worldwide. In addition to the fundamental aviation performance principles of safety, security and environmental and economic sustainability, there are several other performance requirements that must be satisfied to meet the needs of society. As such, the need for performance should drive the evolution of air navigation system.

3.2. ANS - Global Market

3.2.1. **Global Air Navigation Plan (GANP)**

3.2.1.1. International Civil Aviation Organization's (ICAO) objective is to achieve sustainable growth of the global civil aviation system. To this end, ICAO sets the necessary standards

and policies to ensure the safe and orderly development of international civil aviation by serving as a global forum among its 193 Member States. With the GANP, ICAO brings the aviation community together to achieve an agile, safe, secure, sustainable, high-performing and interoperable global air navigation system.

3.2.1.2. The GANP drives the evolution of the global air navigation system to meet the ever-growing expectations of the aviation community. The purpose of the GANP is to equitably accommodate all airspace users' operations in a safe, secure and cost-effective manner while reducing the aviation environmental impact. To this end, the GANP provides a series of operational improvements to increase capacity, efficiency, predictability, flexibility while ensuring interoperability of systems and harmonization of procedures.

3.2.2. Global Air Safety Plan (GASP)

3.2.2.1. Aviation Safety is continually improved using Safety Management and risk assessment processes. This leads to tactical work program adjustments organized around the Safety Framework action cycle.

3.2.2.2. Policy activities stem from the GASP, which formalizes collaboratively agreed initiatives and targets. Tactical annual adjustments to the Safety work program are made based on the trends and outcomes reflected in ICAO's yearly Safety Report.

3.2.2.3. The GASP supports the implementation of the GANP by promoting effective implementation of safety oversight and a safety management approach to oversight, including safety risk management to permit innovation in a managed way.

3.2.3. Universal Safety Oversight Audit Programme (USOAP)

3.2.3.1. Each ICAO Member State should establish and implement an effective safety oversight system that reflects the shared responsibility of States and the broader aviation community, to address all areas of aviation activities. The Universal Safety Oversight Audit Programme (USOAP)[1] Continuous Monitoring Approach (CMA) measures the effective implementation of a State's safety oversight system.

3.2.3.2. To standardize the conduct of audits under USOAP CMA, ICAO has established protocol questions (PQs) that are based on the safety-related ICAO Standards and Recommended Practices (SARPs) established in the Annexes to the Chicago Convention, Procedures for Air Navigation Services (PANS), ICAO documents and guidance material. Each PQ

[1] https://www.icao.int/safety/Documents/ICAO_SR_2018_30082018.pdf

contributes to assessing the effective implementation (EI) of the eight critical elements (CEs) in the eight audit areas. These eight CEs are:

(a) Primary aviation legislation (CE-1),

(b) Specific operating regulations (CE-2),

(c) State system and functions (CE-3),

(d) Qualified technical personnel (CE-4),

(e) Technical guidance, tools and provisions of safety-critical information (CE-5),

(f) Licensing, certification, authorization and/or approval obligations (CE-6),

(g) Surveillance obligations (CE-7) and

(h) Resolution of safety issues (CE-8).

3.2.3.3. The eight audit areas identified in the USOAP are:

(a) Primary aviation legislation and civil aviation regulations (LEG),

(b) Civil aviation organization (ORG),

(c) Personnel licensing and training (PEL),

(d) Aircraft operations (OPS),

(e) Airworthiness of aircraft (AIR),

(f) Aircraft accident and incident investigation (AIG),

(g) Air navigation services (ANS), and

(h) Aerodromes and ground aids (AGA).

3.2.3.4. The use of standardized PQs ensures transparency, quality, consistency, reliability and fairness in the conduct and implementation of USOAP CMA activities.

3.2.4. **Global Air Traffic Management Operation Concept (GATMOC)**

3.2.4.1. According to GATMOC, the general objective of Air Traffic Management (ATM) is to achieve a global, inter-operational air traffic management system for all users during all flight phases, that meets the agreed levels of safety, provides optimum operations, is environmentally sustainable and meets national security requirements.

3.2.4.2. The future system must evolve from the current system to, in as much as possible, meet the needs of the users according to clearly established operational requirements. The

process of evolution involves migration and integration which are the most difficult institutional issues for an Air Navigation Service Provider (ANSP).

3.2.4.3. The Asia Pacific Seamless ATM Plan (APSAP) has firmly advocated the concept of Seamless ATM and airspace. The principles of Seamless ATM are:

(a) Airspace boundaries and divisions should not restrict the development of the airspace structure.

(b) Planning should be coordinated between adjacent areas in order to achieve a seamless airspace, in which the user does not perceive any division.

(c) The airspace should be free of operational discontinuities and inconsistencies and should be organized in such a way as to accommodate the requirements of different types of users.

(d) The migration between areas should always be seamless to users.

(e) Human factors and training aspects are taken under consideration in all ANS improvement modules.

3.3. ANS – Indian Scenario

3.3.1. With the launch of GPS Aided Geo Augmented Navigation (GAGAN), India has become the fourth country in the world to use satellite-based navigation system.[2]

3.3.2. **Impetus to ANS through 5-Year Plans** - Twelfth Five Year Plan (2012-2017) of Government of India (GOI), recognized the critical role of Air Navigation Infrastructure towards augmenting and supporting the growth of Indian Civil Aviation sector. Excerpts from Twelfth Five Year Plan:

> *"The current Indian ATM system provides safe and efficient ATM services today and implementation of the strategies will take full account of air traffic in entire Indian airspace (both continental & oceanic). The document recognizes the need for implementation of changes to the ATM system to consider the needs of all airspace users by applying sound safety management principles and cost benefit analysis."*

3.3.3. The vision for the Indian civil aviation industry for the Twelfth Plan period was:

> *"To propel India among the top five civil aviation markets in the world by providing access to safe, secure and affordable air services to everyone through an appropriate regulatory framework and by developing world class infrastructure facilities."*

3.3.4. In order to facilitate this significant growth potential, India needed more airports, higher capacity, supporting infrastructure, finance and human resources. All this required

[2] NCAP 2016 -http://www.civilaviation.gov.in/sites/default/files/Final_NCAP_2016_15-06-2016-2_1.pdf

progressive and positive fiscal regime and policies and collaborative approach between the government and industry.

3.3.5. The AAI air navigation system master plan envisaged significant investments in modernization of airport infrastructure, upgradation of Communication Navigation Surveillance (CNS), Air Traffic Management and Meteorological Equipment, enhancing manpower and training infrastructure and harmonization with global initiatives and regional air navigation plans.

3.3.6. AAI has undertaken steps for upgrading its Communication Navigation Surveillance (CNS) and Air Traffic Management (ATM) infrastructure. The implementation of Performance based navigation (PBN) in India commenced in 2007 to achieve enhancements in air capacity, efficiency and safety. PBN-based RNAV-1 standard instrument departures (SID) and standard terminal arrivals (STAR) procedures are being implemented at all operational airports in a phased manner.

3.3.7. The Upper Airspace Harmonization (UAH) undertaken by AAI enables safe and more efficient use of air space besides providing straighter routes. The UAH has been enabled by deployment of advance technology in form of overlapping surveillance cover through RADAR/ ADS-B/ Multi-lateration combined with seamless air-to-ground communication and automation systems. This has resulted in seamless connectivity throughout Indian airspace. Results observed on airlines getting their preferred route, flight levels and carbon emission control after the deployment of new systems are very positive.

3.3.8. In January 2017, AAI launched the C-ATFM (Central Air Traffic Flow Management) System and formally dedicated the Central Command Centre at the New Air Traffic Services Complex, thereby becoming the 7th country in the world to implement the Air Traffic Flow Control Measures across the country.

3.3.9. The C-ATFM system is primarily meant to address the balancing of capacity against the demand to achieve optimum utilization of major resources, viz., airport capacity, airspace and aircraft at every Indian airport facing a capacity constraint. The introduction of C-ATFM has enhanced safety, fuel saving and on-time performance of airlines.

3.3.10. To make Regional Connectivity Scheme cost effective and sustainable, AAI has brought in eight mobile ATC towers. The airports connected in the first phase include Bilaspur, Ambikapur, Jagdalpur, Jeypore, Utkela, Vellore, Bokaro and Mithapur.

3.3.11. **Aspects of ANS -** There are 3 main aspects of ANS – People, Technology and Processes. The growth and success of ANS is primarily dependent on these 3 aspects. Interests of the

stakeholders in all these three dimensions must be always satisfied for holistic growth in this sector.

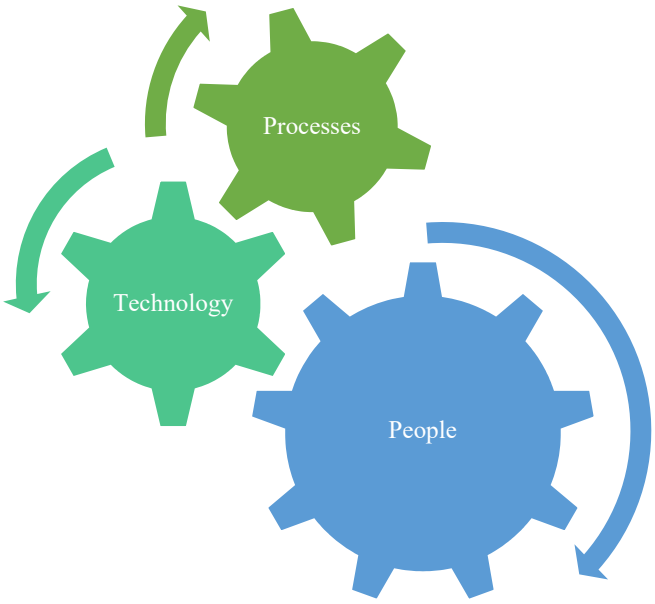

Figure 1 Three Aspects of ANS

3.3.11.1. People

(a) Addressing human factors will bring safety improvements across all safety-related issues. Effective human performance is fundamental to operational safety in aviation and should not be considered in isolation but rather be integrated into all aspects of aviation including equipment and system design, procedures, training and competency.

(b) India has experienced a sustained growth in civil aviation in the last decade. The Indian aviation market is on high growth path. Despite global factors such as crude oil and currency, domestic passenger traffic in the period 2018-19 grew by 16%. Total passenger traffic to, from and within India, during 2018-19 grew by around 14%.

(c) The growth in the number of air passengers in India is projected as follows[3]:

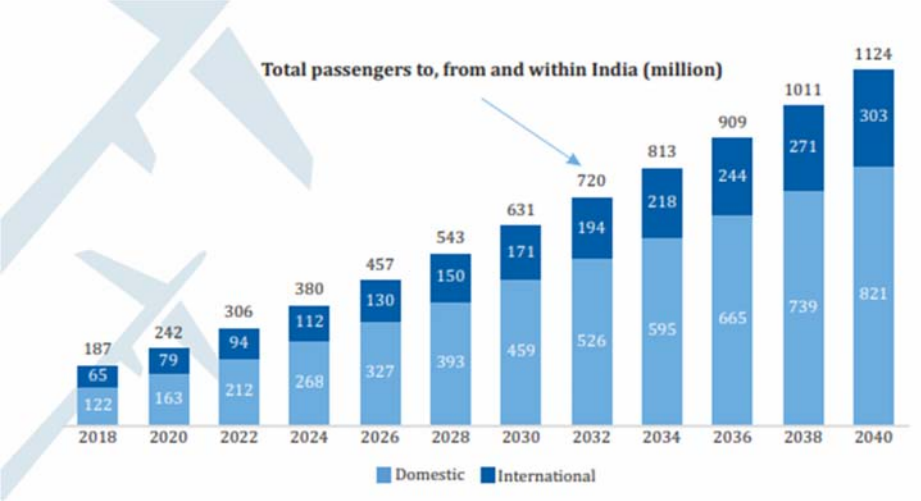

Figure 2 Projected growth in air passengers in India as per Vision 2040 document

(d) Growth in air passengers leads to growth in the air traffic movement in the Indian airspace. The magnitude of growth that is expected will create significant pressures on air traffic management in India to which adhoc responses will not suffice. Long term solutions will require a new way of thinking with a fresh approach. It is also necessary that the organizational focus should not only be on technology and equipment, but also on people and training.

(e) Investing in human capital is critical in this industry. There is immediate necessity of the best and well-trained personnel. Such personnel not only have to be recruited, they should be constantly trained and retained. This will ensure that the Indian skies are one of the safest in the world. Further, this service is a highly specialized one and the right staffing is a task by itself.

3.3.11.2. Technology

(a) Technology being a dynamic variable, the equipment and systems of the air navigation service and the underlying technology must match with the progress in airborne technology. This is a dynamic process. Therefore, there is a need for constant upgradation of the systems and the equipment that are the part of Air Navigation Services.

(b) Indian air navigation service is on the crossroads of modernization of aviation infrastructure. There is constant upgradation of existing systems along with introduction

[3] https://www.globalaviationsummit.in/documents/VISION-2040-FOR-THE-CIVIL-AVIATION INDUSTRY-IN-INDIA.pdf

of state-of-the art technologies. A roadmap has also been laid out listing out the initiatives in upgradation of air navigation infrastructure as part of Vision 2040.

3.3.11.3. *Procedures*

(a) Once the best people are given a "state of the art" environment to work in, the next aspect to be addressed are the safety and security procedures. Together with the employees, equipment and well-laid down procedures, Indian skies would be made much safer, every day.

(b) India, being a member state of ICAO, strives to implement all the safety strategies laid down by ICAO. As per the Universal Safety Oversight Audit Programme (USOAP), India has an overall effectiveness index of 72.93 (as per the 2018 audit).

(c) Comparison of USOAP scores of India and the global average is as follows:

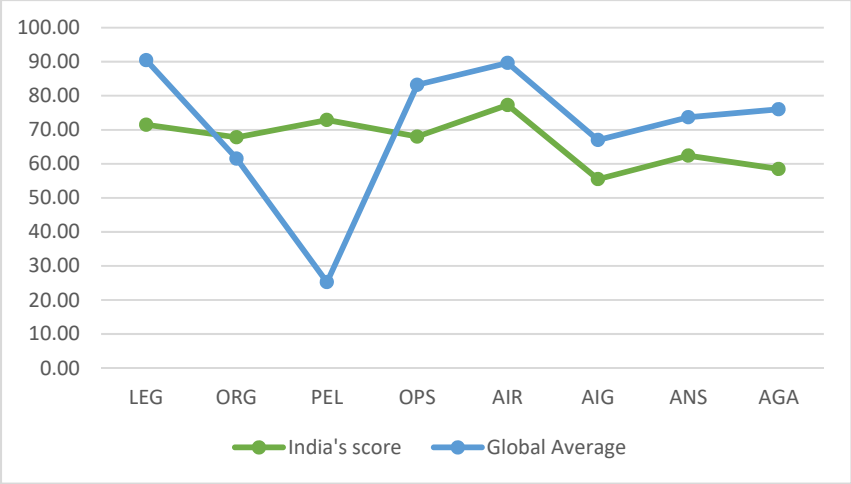

Figure 3 Comparison of audit area wise global average EI and India's EI

Table 1 What the audit area stands for

Audit Area	What it stands for
LEG	Primary Aviation Legislation and Civil Aviation Regulations
ORG	Civil Aviation Organization
PEL	Personnel Licensing and Training
OPS	Aircraft Operations
AIR	Airworthiness of Aircraft
AIG	Aircraft Accident and Incident Investigation
ANS	Air Navigation Services
AGA	Aerodromes and Ground Aids

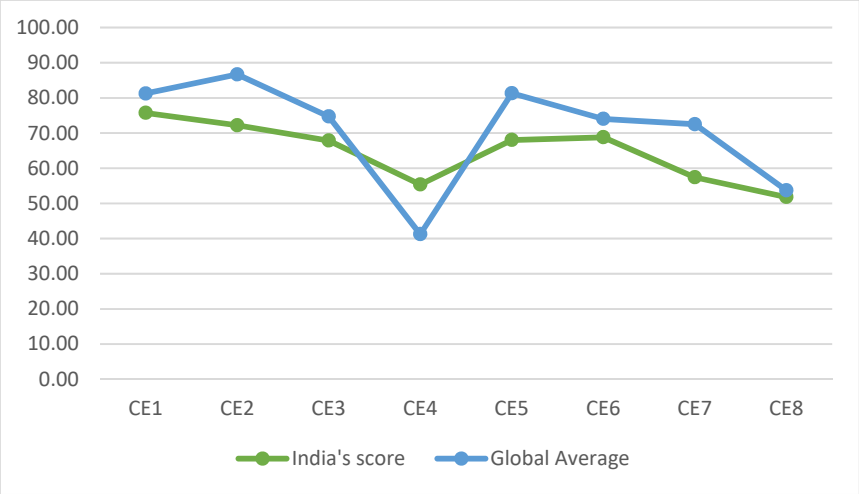

Figure 4 Comparison of critical element wise global average EI and India's EI

Table 2 What the CEs stand for

Critical Element	What it stands for
CE-1	Primary Aviation Legislation
CE-2	Specific Operating Regulations
CE-3	State System and Functions
CE-4	Qualified Technical Personnel
CE-5	Technical Guidance, Tools and Provisions of Safety-Critical Information
CE-6	Licensing, Certification, Authorization and/or Approval Obligations
CE-7	Surveillance Obligations
CE-8	Resolution of Safety Issues

(d) While India has surpassed the global averages in certain audit areas and critical elements, India is slightly below global average in case of other areas. With the programmes initiated/planned as described in Section 4 below, India is expected to surpass the global averages in the near future.

4. Future of ANS in India

4.1. Anticipated Growth in Civil Aviation Sector in India

4.1.1. As per the Vision 2040 report for Indian civil aviation sector, the total passenger traffic (to, from and within India) in India is expected to rise nearly six-fold from 187 million in FY 2018 to around 1124 million in FY 2040.

4.1.2. This includes around 821 million domestic passengers and around 303 million international passengers (to and from India). The overall CAGR across the five clusters works out to around 9% in domestic and 7% in international traffic during FY 2018-2040.[4]

4.2. National Civil Aviation Policy (NCAP) 2016's impetus to ANS

4.2.1. Through this policy[5], the Government proposed to promote the growth of Indian aviation sector in a significant manner as the development of this sector has a multiplier effect on the economy.

4.2.2. The aim of the Government is to provide an ecosystem for the harmonized growth of various aviation subsectors, i.e Airlines, Airports, Cargo, Maintenance Repairs and Overhaul services (MRO), General Aviation, Aerospace Manufacturing, Skill Development, etc.

4.2.3. NCAP 2016 specifically provides an impetus to development of air navigation services in the country through the following schemes:

4.2.3.1. AAI will provide a fully harmonized Air Navigation System considering ICAO's Global Air Navigation Plan, Aviation system Block Upgrade, Modern performance-based technologies and procedures. Accordingly, AAI has developed its ANS Strategic Plan.

4.2.3.2. AAI will continue to provide necessary financial support and facilitate technological upgradation of ANS to keep pace with the global best practices. In order to ensure that technical, financial and administrative requirements are met fully, MoCA will play an effective supervisory role and issue directions to AAI from time to time in this regard.

4.2.3.3. ANS' training institute – CATC Allahabad – will be developed into a world-class training center for ANS professionals for the Indian and global market. AAI is also maintaining two more training centers at Hyderabad and Gondia, which will also be augmented with modern training facilities.

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[4] https://www.globalaviationsummit.in/documents/VISION-2040-FOR-THE-CIVIL-AVIATION-INDUSTRY-IN-INDIA.pdf

[5] http://www.civilaviation.gov.in/sites/default/files/Final_NCAP_2016_15-06-2016-2_1.pdf

4.2.3.4. Another major transformation towards implementing and operationalizing Future Air Navigation System (FANS) such as Ground Based Augmentation System (GBAS) and Satellite Based Augmentation System (SBAS) in India are underway that will lead to better traffic flow management, shorter flights and lower fuel consumption.

4.3. GAGAN

4.3.1. GPS-Aided Geo-Augmented Navigation (GAGAN) - India's GAGAN system - a joint project of AAI and ISRO - is tipped to be the pride of India. It makes India as one of only four regions to have an operational satellite-based augmentation system (SBAS). The other three SBAS have been implemented in USA (WAAS), Europe (EGNOS) and Japan (MSAS). Russia, China, Korea, Australia, Africa and Middle East are in the process of implementing such systems. GAGAN was developed by AAI and ISRO to provide enhanced navigation capabilities including RNP 0.1 and APV 1 services for en-route, terminal area, and Non-Precision Approach (NPA) operations. GAGAN is the first system developed in Equatorial Region making India the leader in Asia Pacific Region and is operational since May 2015. GAGAN is currently operated through a constellation of three geo-stationary satellites: GSAT-8, GSAT-10 and GSAT-15 with fifteen Indian reference stations, two Indian master control centers, three Indian uplink stations and four chains of networks. GAGAN covers a very large areas airspace hitherto unserved by conventional technology. Its operationalization in the Indian Flight Information Region (FIR) is expected to:

(a) Enhance the standards of aviation safety in India;

(b) Ensure efficient utilization of existing airspace capacity through reduced aircraft separation;

(c) Promote regional connectivity;

(d) Provide more direct routes between two locations;

(e) Make flights possible in unfavorable weather and low visibility conditions;

(f) Provide shorter approach paths to the runways;

(g) Reduce noise pollution and carbon emissions;

(h) Enhance surveillance standards across the Indian FlR and oceanic routes; and

(i) Reduces the need for expensive ground based nav-aids (such as ILS).

4.3.2. GAGAN is expected to minimize the occurrence of flight delays, diversions, and cancellations, and reduce the controlled flight into terrain incidents by almost 75 percent. The government has mandated GAGAN-compliant equipment on all new aircraft to be registered in India after 30 June 2020.

4.4. Vision 2040

4.4.1. The vision[6] of Air Navigation Services in India is to provide a technologically advanced air navigation system that has the highest integrity, reliability, accuracy and safety. Some of the major initiatives include the following:

4.4.2. Integration of GAGAN signals with IRNSS

4.4.2.1. Indian Regional Navigation Satellite System (IRNSS) or NAVIC is an independent regional navigation satellite system developed by ISRO. IRNSS provides Standard Positioning Services (SPS) which are meant for general navigation purposes and Restricted Service (RS), which is an encrypted service provided to authorized agencies.

4.4.2.2. IRNSS with its seven satellites provides a wide global coverage comprising the Indian subcontinent, Southeast Asia, Middle East and parts of Far East Asia and Australasia. Unlike GAGAN that is inter-operable, IRNSS is a self-reliant satellite-based navigation over Indian region. Integrating GAGAN signals with IRNSS will provide the greater coverage and accuracy with lesser number of satellites.

4.4.3. Use of block-chain

4.4.3.1. The conventional Air Traffic Management (ATM) system is largely centralized and may not be able to support the increasing air traffic volume. Adopting block-chain technology will result in organizing India's ATM data in an encrypted form in a block chain network instead of a centralized system.

4.4.3.2. DGCA will need to develop oversight and audit mechanisms for these distributed services and their providers. This decentralized and layered design of the automated and block-chain system will make adoption of new technology easier eliminating the need of upgrading the core architecture and the basic system design.

4.4.3.3. Today's air traffic management (ATM) system comprises a wide variety of applications developed over time for specific purposes. It is characterized by many custom communication protocols, each with their own self-contained information systems: on board the aircraft, in the air traffic service unit, etc. Each of these interfaces is custom designed, developed, managed, and maintained individually and locally at a significant cost. Moreover, the ways in which ATM information is defined, structured, provided and used are specific to most of the ATM systems. The integrity and authenticity of the shared data are critical for ATM services in their attempt to reduce air route congestion.

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[6] https://www.globalaviationsummit.in/documents/VISION-2040-FOR-THE-CIVIL-AVIATION-INDUSTRY-IN-INDIA.pdf

4.4.3.4. The System Wide Information Management (SWIM) concept comprises standards, infrastructure, and governance enabling the management and exchange of ATM information between qualified parties through inter-operable services.

4.4.3.5. A blockchain is essentially a distributed database of records, or public ledger of all transactions or digital events that have been executed and shared among participating parties. The main hypothesis is that the blockchain establishes a system of creating a distributed consensus in the digital online world. There are tremendous opportunities in this disruptive technology and the interest of the research community and the industry is constantly increasing.

4.4.3.6. SWIM can be implemented using the blockchain technology, in which each service is managed by a particular blockchain. In this way, each stakeholder which is allowed to access blocks can insert and read information.

4.4.3.7. Blockchains can be used in ATM to improve the security of aeronautical data shared among stakeholders through applications compatible with the SWIM standards.

4.4.3.8. Use of blockchain technology in ATM helps the following security improvements:

- Ensure data integrity, traceability, immutability and nonrepudiation by leveraging the main features of blockchains as a data structure;
- Ensure availability of data and services during all airspace operational phases by using blockchains as a distributed storage and decisional system and
- To create a blockchain-secured data sharing model.

4.4.4. **Unmanned Traffic Management**

4.4.4.1. Unmanned Traffic Management (UTM) works as the existing Air Traffic Management system that handles movement in airspace but will support self-piloting aircraft. The current Indian air traffic system focused primarily on flights between airports and have procedures in place to guide fixed-wing pilots in making control decisions.

4.4.4.2. Under UTM, drone flights in India would use free routing, fixed routes, corridors, or other constructs to avoid conflicts, obstacles or areas too dense for safe operation. UTM will also provide alerts, geo-fencing, registration, and vehicle location services.

4.4.5. **Airspace Corridors**

4.4.5.1. Airspace corridors are defined volumes in space that manages airspace during peak time or manage separation and traffic flow. These corridors have a control service to govern and coordinate its usage. These corridors are specifically designed to accommodate unmanned systems or drones. Any unmanned system would require a clearance from the

corridor's control service to enter. These corridors can take any shape such as cylinders, tubes or cones. Unmanned aircrafts are usually guided inside these airspace corridors using predetermined routes analogous to approach procedures.

4.4.6. **ANS training**

4.4.6.1. Given the pace of innovation in air navigation systems, training of ANS staff in latest technologies will assume critical importance. By 2040, AAI's ANS training centre (CATC Allahabad) should become one of the top five ANS academies of the world, with at least 30% of its trainees coming from outside India.

4.5. Key action steps to achieve Vision 2040

4.5.1. **GAGAN Taskforce and PMU**

4.5.1.1. AAI should set up a GAGAN Task Force comprising representatives from AAI, MoCA, DGCA, airlines, airports, NSOPs, OEMs, component manufacturers and software providers etc. AAI should establish a GAGAN Program Management Unit (PMU) as a single point of contact for coordinating with various stakeholders and undertaking necessary implementation activities.

4.5.2. **LPV Approaches**

4.5.2.1. AAI should expedite its efforts for developing GAGAN based Localizer Performance with vertical guidance (LPV) approaches at Indian airports. Consideration should be given to focus on Tier-2 airports and regional airports, where air connectivity is a challenge. DGCA should certify these approaches in a timely manner.

4.5.3. **RNFC waiver**

4.5.3.1. AAI has proposed a Route Navigation Facility Charge (RNFC) waiver of 5 percent to stimulate the retrofitting of aircraft owned by the scheduled operators with the GAGAN receivers.

4.5.4. **Non-aviation applications**

4.5.4.1. Conduct a pilot project to quantify real time benefits of GAGAN. GAGAN provides wide opportunities for precision Position, Navigation and Timing (PNT) in numerous industries and organizations. While many users in India have been utilizing GAGAN services for the purposes of various studies, it needs to be commercially leveraged by non-aviation sectors. The GAGAN PMU can act as a receiver certification agency and provide technical support for short-term pilot projects and 'proof of concept' (PoC) for use of GAGAN in non-aviation sectors.

4.5.5. **Global benchmarking**

4.5.5.1. The GAGAN PMU can incorporate and disseminate lessons from similar initiatives carried out by countries like USA, EU and Japan. These countries are mandating SBAS through implementation of Automatic Dependent Surveillance - Broadcast (ADS - B). For instance, the United States Federal Aviation Administration (FAA) has mandated the use of ADS - B in all the aircraft flying in most US airspace categories above 10,000 ft. from 1 January 2020. India has mandated carriage of ADS-B equipment in airspace at or above 29000 ft from 1st January, 2020 and in the process of mandating the ADS-B in terminal airspaces in phases where only ADS-B based surveillance approach services are planned.

4.5.6. **Revenue from exports**

4.5.6.1. GAGAN's geostationary satellites GSAT-8, GSAT-10 and GSAT-15 have a wide footprint extending from Africa to Australia. The GAGAN system can support 45 ground stations, leaving room for 30 new ground stations in neighboring countries within the GAGAN footprint. AAI can utilize its expertise to develop, certify and manage GAGAN system in ASEAN, SAARC and Gulf countries. AAI can setup a consulting arm on the lines of the Delhi Metro which is providing consulting to many metro projects in India and abroad (e.g. Jakarta Metro).

4.5.7. **DGCA regulations**

4.5.7.1. GAGAN PMU should coordinate closely with DGCA and the industry to ensure that requisite amendments are made in the DGCA regulations and manuals to certify any new navigation technology and equipment adopted by Indian aircraft carriers.

4.5.8. **Old nav-aids**

4.5.8.1. GAGAN PMU should implement the concept of 'Minimum Operational Network', which will gradually phase out the conventional nav-aids over time to reduce their operations and maintenance costs. It can pick up insights from FAA's experience for a similar initiative undertaken in USA.

4.5.9. **PinS**

4.5.9.1. As per DGCA, almost 95% of helicopter operations in India are carried out under Visual Flight Rules (VFR), making it difficult for operations during night and at extreme weather conditions. Globally, GNSS based Point in Space (PinS) approaches use instrumentation as well as visual maneuvering that enables helicopters to land during extreme weather conditions or at difficult terrain.

4.5.9.2. Heli-tracker systems with three-dimensional GPS coordinates send signals which are then translated into a visual record of the helicopter flight path and defined on the topographical maps. AAI should consider implementing PinS and heli-tracker systems in India.

4.5.10. GAGAN Technology Parks

4.5.10.1. The GAGAN PMU should consider the feasibility of establishing GNSS Technology Parks in the country to centralize the GNSS data centers. The Technology Parks will provide a platform to receiver manufacturers, application developers, and GNSS application software providers to establish incubators and provide base for receiver certification and data validation activities. These Parks can further promote research and application development in aviation and non-aviation sectors.

4.5.11. Skill building

4.5.11.1. Given the complexity of new navigation technologies like IRNSS/ GNSS/ GAGAN/ Artificial Intelligence/ Block-chain, high capital investments and a long-drawn implementation process; developing a robust training program for AAI staff is essential for successful implementation of these technologies prior to their installation and operations.

4.5.12. Indian Institution of Satellite Navigation

4.5.12.1. To create and disseminate knowledge about satellite navigation through collaboration with practitioners, end-users, academia and young entrepreneurs, the GAGAN PMU may consider establishing an Indian Institution of Satellite Navigation (IISN).

4.5.12.2. A case in point is the highly reputed Institute of Navigation (ION) in Virginia, USA, a not-for-profit professional organization dedicated to advancing Positioning, Navigation and Timing (PNT). ION's international membership is drawn from professional navigators, engineers, physicists, mathematicians, astronomers, cartographers, meteorologists, educators, geodesists, surveyors, pilots, mariners and anyone interested in position-determining systems. Corporate members include corporations, civil and military government agencies, private scientific and technical institutions, universities and training academies, and consulting firms. ION members get access to the institute's journals, technical papers, seminars and conferences.

4.5.12.3. With the advent of IRNSS, the need for such an institution will increase. AAI can partner with ISRO, Rajiv Gandhi National Aviation University (RGNAU) Rae Bareli, CATC Allahabad, airlines, airports and general aviation players to set up the institution.

4.5.13. Civil Aviation Research Organization (CARO)

4.5.13.1. In 2018, during the 179th Board meeting, the AAI Board has approved the establishment of a world class Civil Aviation Research Organization (CARO) at Begumpet Airport, Hyderabad, to cater to its ANS/Airport challenges. In this regard AAI has started constructing CARO building (23700 square metres of built-up area) along with 120 room hostel block, which can be further augmented on need basis. Establishing and populating the CARO centre with world class infrastructure and functional units requires deep understanding in the following areas:

- Human Machine Interface
- ANS operational assessment experiences
- Holistic understanding of ANS service delivery
- Comprehensive hands-on understanding of reality of the technology and solution availability and promised operational impact
- Experiences and know-how of aviation enterprise level engineering
- Analysis and simulation tools that are necessary.

4.5.13.2. In addition to the above AAI technical centre master plan and ATM R&D roadmap envisages about 600 skilled manpower in CARO.

5. Economics of ANS

5.1. Financial Overview

5.1.1. The financial overview of ANS department for the past 5 years is as provided below:

Rs. in Crores

Table 3 Financial overview of ANS department for past 5 years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
Basis	*Actuals*	*Actuals*	*Actuals*	*Actuals*	*Projections*
ATM Growth Rate		17%	14%	14%	14%
Revenue					
TNLC	366.68	428.32	488.61	517.99	592.65
RNFC	2,212.01	2,540.78	3,002.18	3,175.40	3,633.07
Other CNS/ATM Service Revenue	2.40	3.73	4.56	0.26	0.29
Other Income	2.76	11.03	7.63	7.95	9.09
Total Revenue	**2,583.85**	**2,983.86**	**3,502.97**	**3,701.60**	**4,235.10**
Expenses					
Operating Expenses	201.69	227.59	277.42	288.65	308.85
ADSB - Additional Operating Expenses	-	-	-	-	176.33
Employee Benefit Expenses	1,178.34	1,329.65	1,620.77	1,686.35	2,090.59
Administrative & Other Expenses	130.52	147.28	179.53	186.79	205.47
Depreciation, Amortization & Impairment	226.44	229.68	232.19	229.43	284.07
Total Expenses	**1,736.99**	**1,934.20**	**2,309.91**	**2,391.22**	**3,065.32**
Profit Before Tax (PBT)	**846.86**	**1,049.66**	**1,193.06**	**1,310.38**	**1,169.78**

5.1.2. The expenses shown above includes apportionment of expenses pertaining to the ANS department. Apportionment of expenses has been done based on the revenue from each of the business streams.

5.1.3. The percentage increase in the revenue and expenses of the ANS vertical across the past years is as follows:

Table 4 Percentage Increase in ANS vertical

Particulars	2016-17	2017-18	2018-19	2019-20
Basis	*Actuals*	*Actuals*	*Actuals*	*Projections*
Material Components of Revenue				
TNLC	17%	14%	6%	14%
RNFC	15%	18%	6%	14%
Material Components of Expenses				
Operating Expenses	13%	22%	4%	7%
Employee Benefit Expenses	13%	22%	4%	24%

5.1.4. There is constant increase in the expenses over the years. This is in line with the increase in revenue over the years.

5.1. Existing ANS Tariff Structure

5.1.1. The Air Navigation Services and tariff structure is as mentioned below:

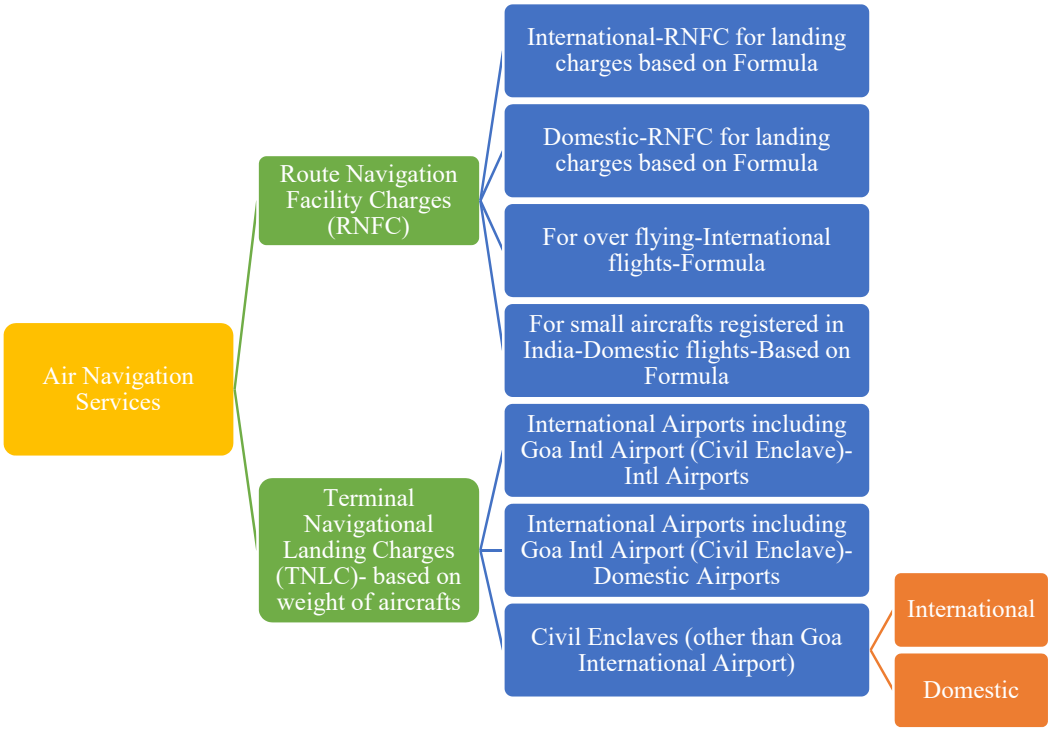

Figure 5 Existing tariff structure of ANS

5.2. History of Change in Tariff for ANS Services

5.2.1. Tariff for Air Navigation Services was determined in 2001 and an adhoc rate increase of 10% was allowed.

5.2.2. In 2009, another 10% increase was allowed on tariff on adhoc basis for both domestic and international sectors.

5.2.3. Thereafter, prices were increased by 10% in December 2016 for both domestic and international tariff. However, domestic tariff increase was rolled back in July 2017.

5.2.4. Further increase of 5% was given in April 2017 for both domestic and international flights. This was later rolled back for domestic flights in July 2017.

5.2.5. It is to be noted that the increases which were approved were determined on adhoc basis. User consultations were not undertaken for any of these increases. Hence, there was a rollback of charges at various points in time.

5.2.6. There has been no change in the tariff since then. Hence, in effect, for domestic flights, rates which were applicable in 2001 continue to be applied even after almost 2 decades.

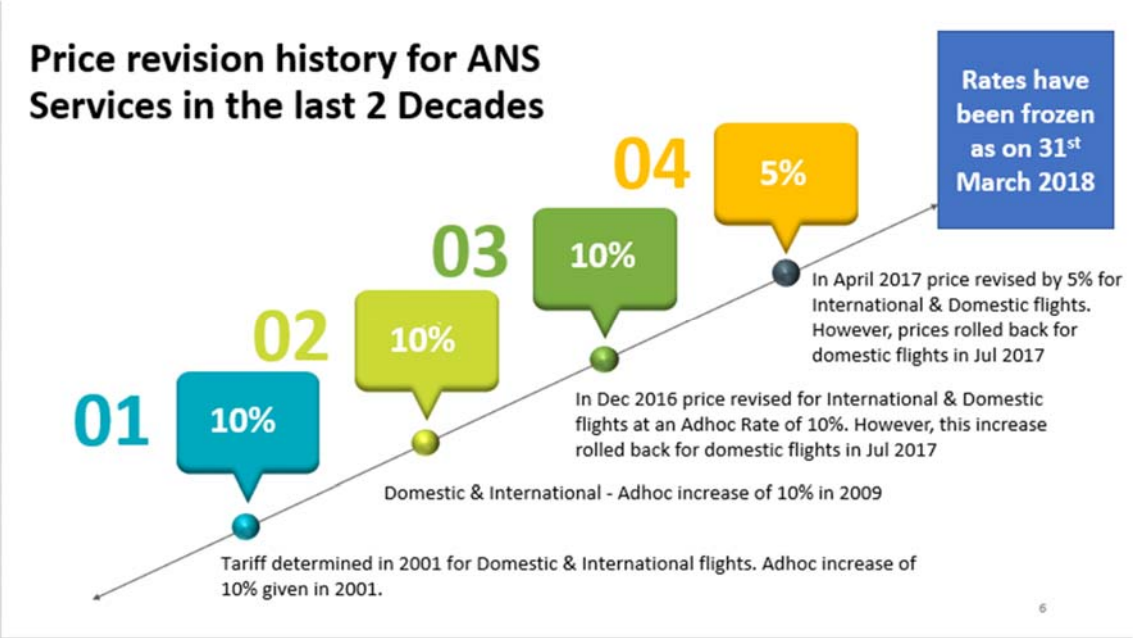

Figure 6. Price revision history for air navigation services in the last two decades

5.3. Need for Tariff Determination for ANS

5.3.1. Tariff determination for ANS, in the past was done by MoCA without a stakeholder consultation process. Tariff was determined in the year 2001 with certain adhoc increases thereafter as detailed in para 5.2 above.

5.3.2. There is a need to determine a philosophy for tariff determination and results of application of such philosophy should be put forth for comments from stakeholders. In this exercise, it is also important to consider protection of public interest, and thus the question of what is "justified increase" arises.

5.3.3. Considering CPI as a reflection of inflation in the economy over the years, the price increases that ought to have been given since 2001 and the price increases that were allowed are compared. Results of the same are provided below:

Table 5 Comparison of CPI index and tariff increase for the past 2 decades

Year	CPI Index	Domestic Increase net of roll back	International Increase net of roll back
2001-02	4.30	10.00	10.00
2002-03	4.00	-	-

Year	CPI Index	Domestic Increase net of roll back	International Increase net of roll back
2003-04	3.90	-	-
2004-05	3.80	-	-
2005-06	4.40	-	-
2006-07	6.70	-	-
2007-08	6.20	-	-
2008-09	9.10	-	-
2009-10	12.40	10.00	10.00
2010-11	10.40	-	-
2011-12	8.40	-	-
2012-13	10.40	-	-
2013-14	9.70	-	-
2014-15	6.30	-	-
2015-16	5.60	-	-
2016-17	4.10	10.00	10.00
2017-18	3.08	-10.00*	5.00
2018-19	3.40	-	-
Total	**116.18**	**20.00**	**35.00**

**Increase of 5% less roll back of 10% increase of Dec-16 and roll back of 5% increase of Apr-17*

5.3.4. The increases have not been in line with the CPI index over the past 2 decades. ANS department's Revenues and Operating Results as indicated in Table 3, are due to the following reasons:

5.3.4.1. Traffic (ATMs) increased significantly over the years leading to higher Revenue collections.

5.3.4.2. Continuing business with the existing equipment and capacity. There were no large investments made to increase capacity. This was also because existing equipment was sufficient to handle the growing traffic. This, however, needs replenishments in the coming years.

5.3.4.3. The department was able to manage the traffic with the existing resources and capacity. Since, there was no major additions to/enhancement of capacity, there was no requirement of additional operating expenses – either in the form of human resources/other initiative specific expenses.

5.3.5. This results in a discussion of whether the department can continue at the same profitability in the near future.

5.3.6. With new programmes and initiatives planned as mentioned in para 4.5 above, the operating costs is on the increase. Detailed cost estimates for the next 10 years are provided in para 8.5.6 below.

5.3.7. Upgradation of technology, and to bring in the most advanced and state-of-the art equipment comes at a cost. Hence, considerable investment is planned for the next 10 years. Detailed discussion on the investments proposed for the next 10 years is mentioned in para 8.3.2 below.

5.3.8. There is additional expenditure – both operating and capital planned for the next 10 years in order to enhance the capacity of the ANS department. Further, this coupled with slowing down of traffic due to current aviation scenario (refer para 8.2.2 below), leads to reduction in profitability over the years (refer Table 24 below). Given the same tariff, projected traffic and projected expenses, profit before tax is expected to reduce to 2% over the next 10 years.

5.3.9. Hence, in order to maintain the profitability of this department in line with its history or in line with the global average at least, there is a need to increase the price over a 10-year period.

5.4. Authority to Determine Tariff for ANS

5.4.1. This section discusses the institution that has the authority for determination of tariff for ANS:

5.4.1.1. Airport Economic Regulatory Authority of India (AERA) or

5.4.1.2. Airports Authority of India (AAI) or

5.4.1.3. Ministry of Civil Aviation (MoCA)

5.4.2. Powers and Functions of Airport Economic Regulatory Authority of India (AERA) are laid out in Section 13(1) of the AERA Act, 2008, which is reproduced below:

"…13. Functions of Authority—(1) The Authority shall perform the following functions in respect of major airports, namely:—

(a) to determine the tariff for the aeronautical services taking into consideration—

(i) the capital expenditure incurred and timely investment in improvement of airport facilities;

(ii) the service provided, its quality and other relevant factors;

(iii) the cost for improving efficiency;

(iv) economic and viable operation of major airports;

(v) revenue received from services other than the aeronautical services;

(vi) the concession offered by the Central Government in any agreement or memorandum of understanding or otherwise;

(vii) any other factor which may be relevant for the purposes of this Act:

Provided that different tariff structures may be determined for different airports having regard to all or any of the above considerations specified at sub-clauses (i) to (vii);

(b) to determine the amount of the development fees in respect of major airports;

(c) to determine the amount of the passenger service fee levied under rule 88 of the Aircraft Rules, 1937 made under the Aircraft Act, 1934 (22 of 1934);

(d) to monitor the set performance standards relating to quality, continuity and reliability of service as may be specified by the Central Government or any authority authorized by it in this behalf;

(e) to call for such information as may be necessary to determine the tariff under clause (a);

(f) to perform such other functions relating to tariff, as may be entrusted to it by the Central Government or as may be necessary to carry out the provisions of this Act…"

5.4.3. Definition of "Aeronautical services" as per Section 2(a) of the AERA Act is as follows:

"…"aeronautical service" means any service provided—

(i) for navigation, surveillance and supportive communication thereto for air traffic management;

(ii) for the landing, housing or parking of an aircraft or any other ground facility offered in connection with aircraft operations at an airport;

(iii) for ground safety services at an airport;

(iv) for ground handling services relating to aircraft, passengers and cargo at an airport;

(v) for the cargo facility at an airport;

(vi) for supplying fuel to the aircraft at an airport; and

(vii) for a stake-holder at an airport, for which the charges, in the opinion of the Central Government for the reasons to be recorded in writing, may be determined by the Authority;…"

5.4.4. Through combined reading of the above definitions contained in the AERA Act, it is determined that AERA has the authority to determine the tariff relating to air navigation services in "major" airports. However, ANS is a service which treats Indian airspace as a single sky/entity. The Indian airspace is indivisible and cannot be attributed to its constituent airports.

5.4.5. Further, the following sections are present in the AAI Act, 1994 as amended by the AAI Amendment Act 2003:

"…22. The Authority may,-

(i) With the previous approval of the Central Government, charge fees, or rent-

(b) for providing air traffic services, ground safety services, aeronautical communications and navigational aids and meteorological services at any airports and at any aeronautical communication station;"

"…22A. The Authority may, after the previous approval of the Central Government in this behalf, levy on, and collect from, the embarking passengers at an airport, the development fees at the rate as may be prescribed and such fees shall be credited to the Authority and shall be regulated and utilized in the prescribed manner, for the purposes of…."

"…41. (1) The Central Government may, by notification in the Official Gazette, make rules for carrying out the provisions of this Act…"

5.4.6. Sections 22A and 41 of the AAI Act were further amended with the introduction of AERA Act, 2008. Through this amendment, the determination of 'development fees' by AAI, with approval of Central Government was restricted to other than major airports. However, such amendment was not extended to Section 22(i)(b). Hence, it is inferred that it was not the intention of law that AERA should determine tariff for Air Navigation Services. Further,

through Section 22 of the AAI Act, AAI has the authority to levy charges for air navigation services with prior approval of the Central Government (in this case, with prior approval of the Ministry of Civil Aviation (MoCA)).

5.4.7. Having established the need and authority for determination of tariff for ANS, the environment within which such charges are to be determined is to be determined. For this, guiding principles enunciated in various International Civil Aviation Organization (ICAO) documents are considered in formulating the tariff determination philosophy.

6. Tariff Philosophies and Guiding Principles

6.1. ICAO Principles

6.1.1. ICAO's Policies on Charges for Airports and Air Navigation Services (Doc 9082)[7] contains the recommendations and conclusions of the Council resulting from ICAO's continuing study of charges in relation to the economic situation of airports and air navigation services provided for international civil aviation. The policies, which are intended for the guidance of Contracting States, are mainly based on the recommendations made in this field by the various conferences on the economics of airports and air navigation services, which are held regularly by ICAO. The last such conference took place in Montréal from 15 to 20 September 2008 (Report of the Conference on the Economics of Airports and Air Navigation Services (CEANS) (Doc 9908) refers). As per a recommendation adopted by CEANS and endorsed by the ICAO Council, States are encouraged to incorporate the four key charging principles of non-discrimination, cost relatedness, transparency and consultation with users into their national legislation, regulation or policies, as well as into their future air services agreements, in order to ensure compliance by airport operators and air navigation services providers (ANSPs).

6.1.2. ICAO's Manual on Air Navigation Services Economics (Doc 9161)[8] provides practical guidance to States, air navigation services providers and designated charging and regulatory authorities to assist in the efficient management of air navigation services and in implementing ICAO's Policies on Charges for Airports and Air Navigation Services (Doc 9082). This guidance takes into account wide range of circumstances faced by air navigation service providers. It is based on international policies and principles on cost-recovery in air navigation services that States have developed through ICAO and describes procedures and practices that are in conformity with these policies and principles. The basis for these policies and principles is set out in Article 15 of the Convention on International Civil Aviation (Doc 7100), the charter of ICAO. Extensive policy guidance in this area was subsequently developed by the ICAO Council and is contained in Doc 9082.

6.1.3. Doc 9082 in its document details about cost basis for air navigation services charges as reproduced below:

"An equitable cost-recovery system could comprise charges based on the allocation of total air navigation services costs incurred on behalf of users."

[7] https://www.icao.int/publications/Documents/9082_9ed_en.pdf
[8] https://www.icao.int/publications/Documents/9161_en.pdf

6.1.4. Air navigation services charging systems

6.1.4.1. Characteristics[9] of air navigation charging systems as provided by ICAO are as under:

(a) Ensure that systems used for charging for air navigation services be established in accordance with the following principles- simple, equitable, suitable for application on regional basis, administrative cost of collection must not exceed a reasonable proportion of charges collected, charges should not discourage the use of the facilities and services necessary for safety or introduction of new techniques.

(b) Should be based on sound accounting principles, should be non-discriminatory and be consistent with the form of economic oversight adopted.

(c) When charging systems are introduced or significantly revised, account should be taken of the economic and financial impact on both the users and the provider State or States. To avoid undue disruption to users, resulting increases in charges should be introduced on a gradual basis; however, it is recognized that in some circumstances a departure from this approach may be necessary.

(d) Charges should be levied in such a way that no facility or service is charged for twice with respect to the same utilization. The charges levied on international general aviation, including business aviation, should be assessed in a reasonable manner, having regard to the cost of the facilities needed and used and the goal of promoting the sound development of international civil aviation as a whole. States should refrain from segmenting Flight Information Regions (FIRs) solely for the purpose of generating revenue unrelated to the costs of service provision.

6.1.5. Types of Charges

6.1.5.1. *Approach and aerodrome control charges*[10] - Where charges for approach and aerodrome control are levied, whether as part of the landing charge or separately, the charge should, so far as possible, be a single element of the landing charge or a single charge per flight and could take aircraft weight into account but less than in direct proportion.

6.1.5.2. *Route air navigation services charges*[11] - The charge for route air navigation services should be, so far as possible, a single charge per flight for all route air navigation services provided at the national or regional level. The charge could be based essentially on:

(i) The distance flown within a defined area.

[9] https://www.icao.int/publications/Documents/9082_9ed_en.pdf
[10] https://www.icao.int/publications/Documents/9082_9ed_en.pdf
[11] https://www.icao.int/publications/Documents/9082_9ed_en.pdf

(ii) The aircraft weight.

6.1.5.3. If used, the element of distance flown should be applied by means of a distance scale using great circle distances or other commonly agreed distances. If used, the element of aircraft weight should be applied by means of a weight scale using broad intervals which should be standardized so far as possible. This weight scale should consider, less than proportionately, the relative productive capacities of the different aircraft types concerned.

6.1.5.4. Without prejudice to the guidelines provided above, which constitute a charging system for general application, it is recognized that:

i) The characteristics of a given airspace will determine the most appropriate charging method for that airspace, having regard to the type of traffic, the distances flown, and the characteristics of the aircraft in that airspace.

ii) When the distance flown and/or the aircraft types are reasonably homogeneous, the distance and weight elements may be separately or jointly neglected.

iii) In some circumstances, it may be considered appropriate to use a combination of a flat charge per flight and a charge based on the parameters recommended above in recognition of an element of fixed costs in providing air traffic services.

6.1.5.5. The manual on Air Navigation Services Economics (Doc 9161)[12] in the document details the process for setting up Air Navigation Charges and various aspects of levying ANS charges:

(a) Broad descriptions of accounting systems designed to meet requirements for certain specific management functions.

(b) The inventory that needs to be drawn up of all the air navigation facilities and services that directly provide services for aircraft en-route as well as approach and aerodrome control.

(c) Provides guidelines on how to determine the cost basis for air navigation services charges.

(d) Deals with the allocation of costs to non-aeronautical and various aeronautical functions, focusing in the case of the latter on such functions as airport and en-route utilization, service location, and categories of users.

[12] https://www.icao.int/publications/Documents/9161_en.pdf

(e) Addresses the establishment of the cost basis for individual air navigation services charges.

(f) Refers to special costing considerations pertaining to CNS/ATM systems.

(g) Addresses various factors that need to be considered once costs attributable to air navigation services have been determined, before the charges are set.

(h) Suggests systems to be applied with regard to individual types of charges, i.e. route charges, approach and aerodrome control charges, and how charges could or should be established in each instance.

(i) Focus on various factors related to the collection of charges, for example, when charges are to be paid, and collection problems.

(j) Reflect on charges and cost-recovery aspects of CNS/ATM systems.

6.2. Possible Forms of Economic Oversight

6.2.1. Economic oversight[13] may take several different forms, from a light-handed approach (such as the application of competition law) to a more robust approach (such as direct regulatory interventions in the economic decisions of ANSPs), as follows:

a) Application of competition law;
b) Fallback regulation ("market regulation");
c) Institutional requirements ("institutionalized checks and balances");
d) Price cap regulation ("incentive-based regulation"); and
e) Rate of return regulation ("cost of service regulation").

6.2.2. Application of Competition Law

6.2.2.1. The concept of competition law refers to laws (including regulations and policies) that aim to foster or maintain competition in markets by prohibiting anti-competitive practices. The process of applying competition law normally consists of responding to complaints, monitoring market behaviors, prosecuting offenders, adjudicating liability, and imposing sanctions upon parties adjudged to have violated the law. Such actions are likely to also have a deterrent effect on anti-competitive behaviors.

6.2.3. Fall Back Regulation

6.2.3.1. Fallback regulation is predicated on making explicit the "threat" of a more robust form of economic oversight if a company does not ensure that its behavior stays within

[13] https://www.icao.int/publications/Documents/9161_en.pdf

"acceptable" bounds. **The benefit of this light-handed approach is to mitigate a potential risk of abusing dominant position without incurring the regulatory costs and distortions. Normally, this would be accompanied by the application of standard competition law. For this approach to work, the ANSP must understand what constitutes unacceptable behavior.** A difficulty might be that by defining the commercial boundaries in detail there might be a risk of creating precisely the regulatory distortions that it seeks to avoid.

6.2.4. Institutional Regulation

6.2.4.1. Research and experience indicate that the interests of all stakeholders can be best served if users are sufficiently well-informed through the constructive engagement of ANSPs and users. Certain institutional requirements can enhance transparency and the flow of information, thereby transmitting the right signals and responses between ANSPs and users.

6.2.4.2. Light-handed types of institutional requirements include conditions on:

(a) Mandatory consultation between ANSPs and users in the establishment of air navigation services charges and development plans in order to ensure adequate disclosure of costs and transparency in the economic and financial underpinnings of rate and service proposals. If a meaningful consultation process is well-established, it could eliminate or reduce the need for a robust form of economic oversight;

(b) Implementation of a performance management system; and

(c) Establishment of corporate governance including stakeholder membership on the board of directors, which is a means of promoting the adequate flow of economic information between the ANSP and its users.

6.2.4.3. More robust types of institutional requirements include conditions on:

(a) ***Joint ownership*****, or mixed enterprise,** as a means of ensuring information flow, consultation and consensus in the establishment of air navigation services charges and development plans; however, there might be potential anti-competitive issues involved regarding airline competition and barriers to entry where joint ownership means airlines having a large say about investment plans and about the management of the ANSP; and

(b) ***Not-for-profit financial status*****.** The rationale behind this arrangement is that removing the profit incentive from an otherwise commercially oriented organization relieves it of the stimulus to abuse its dominant position. However, it can also be argued that a profit motive protects the public against the risk of an ANSP failing to **generate sufficient surplus**

revenues to sustain and modernize its facilities on a timely basis. In whatever case, the managers will have to trade-off between multiple objectives, which are well-known problems of management incentives.

6.2.5. Price Cap Regulation

6.2.5.1. Some forms of economic oversight are designed to encompass incentive elements within them. The archetypal example is price cap regulation, under which the regulator sets a maximum chargeable rate applicable for a specific period, normally by using the retail/consumer price index minus (or plus) an incentive target (an "x" factor). If the ANSP exceeds the target, it may keep any over-recoveries. Where the target is not met, the ANSP would not be allowed to increase charges to compensate for the under-recovery and would have to find the means to balance its accounts during the regulated period. Under this scenario, the ANSP has a strong incentive to improve its efficiency and reduce its costs.

6.2.5.2. The price cap regulation has some potential shortcomings. For example, over time, as the ability of the regulated company to outperform the cap is reduced, the incentive effect is less effective. Also, since a price cap is usually set for several years on the basis of projected capital expenditure as well as on existing assets, the ANSP may have an incentive to overstate capital expenditure prior to the price cap being set and, subsequently, not to undertake the full programme (the price cap can give the ANSP a short-term return on the assets without actually having to invest in them). Such issues can largely be dealt with through the establishment of a clear and comprehensive definition of outputs and their pricing, which allows the regulated entity to argue that the lower-than-planned expenditure is the result of (desirable) efficiency gains. The resulting regulatory system does, however, become increasingly complex and hence more expensive for the regulator, the regulated companies and all users.

6.2.5.3. Output-based price caps may mitigate this problem. Prices set instead in relation to output performance may provide better incentives to invest efficiently. The price can be varied up or down based on meeting performance specifications. If price caps can be linked closely to outputs over time, the ANSP will have fewer incentives to delay or not undertake productive investments. The barriers to this form of regulation are the long lead times to investment such that the benefits in terms of outputs are often achieved only many years later and the challenge of defining outputs in such a way that they cover service quality as well as capacity.

6.2.6. Rate of return regulation

6.2.6.1. A rate of return regulation (also called cost of service or cost-plus regulation) is designed principally to address the issue of excessive profits in enterprises with monopoly

characteristics. The ANSP may be required to obtain approval for the level of charges and investments, the objective being to limit the provider's rate of return on capital at the level prevailing in a competitive market. In its simplest form, it allows cost pass-through for both operating and capital expenditures. However, rate of return regulation may provide the ANSP with a strong incentive for over-investment in order to increase the volume of its profit. Where there are no other incentives on efficiency (for example, through governance) rate of return regulation may provide limited incentive to cost-effectiveness and may also encourage overinvestment beyond the requirement of users.

6.3. Selecting appropriate form of oversight

6.3.1. The selection of the appropriate form of economic oversight depends, inter alia, on the degree of competition, and the legal, institutional and governance frameworks, including the roles, rights and responsibilities of the different parties involved, as well as the costs related to specific oversight forms. Whatever approach is adopted, economic oversight should be performed in a transparent, efficient and cost-effective manner, while keeping regulatory interventions at a minimum and as required, for instance, when there is a disagreement between the parties, where strong market positions create the potential for overcharging, or where there is increased potential for discriminatory behavior against specific users. Since circumstances change over time, the different options might be appropriate at different times. It is therefore desirable to ensure a certain degree of flexibility so that it can be adapted to changing circumstances.

6.3.2. In selecting the appropriate form of economic oversight, States should first consider the scope and degree of competition. Where competition or the threat of it is sufficiently strong, the application of competition law is likely to be adequate.

6.3.3. One of the justifications for selecting other forms of economic oversight, therefore, requires that competition and the application of competition law would be insufficient to address the risk that an ANSP could abuse any dominant position it may have. The issue here is how to identify the circumstances in which competition or the threat of it would not be sufficiently strong. In general, the degree of competitive market constraints could be measured in terms of actual and potential competition from nearby, rival ANSPs or from other modes of transport. The size of the entities and traffic volume relevant to the market are also factors to be considered.

6.3.4. Even where competition may not be considered sufficiently strong, there may be circumstances in which the need for a robust form of economic oversight is less obvious. For example, an ANSP, in collaboration with its users, is the party best placed to determine the optimal service standards, charges system and the level of the charges in relation to the

services rendered. In such cases, the scope of economic oversight should be limited to encouraging that changes to the charges system and to the level of charges be made in agreement between the ANSP and all categories of users where this is achievable.

6.3.5. Other important factors in assessing the most appropriate approach are the potential costs and benefits related to the particular form of economic oversight. The operation and administration of economic oversight is not cost free, and the cost associated to it may increase as the approach taken by a State moves from a light-handed to a more robust form of economic oversight. In the extreme, the regulatory cost may outweigh the expected benefit. The choice of an appropriate form going beyond the application of competition law is, therefore, a matter of searching the spectrum of options for protecting public interests at an acceptable level and at a minimum regulatory cost.

6.3.6. It is possible to conceive variations to each form of economic oversight set out above. In some situations, the combination of two or more forms may yield the best form of economic oversight.

7. Evaluation of form of Economic Oversight for ANS in India

7.1. Considerations and constraints in ANS in India

7.1.1. From paras 6.3.1 to 6.3.6 above, it is derived that the following 3 aspects must be considered in choosing the most suitable form of economic oversight for ANS:

7.1.1.1. Degree of competition and business principles

7.1.1.2. Legal and institutional requirements

7.1.1.3. Cost of implementation of economic oversight

7.1.2. The three aspects are discussed with respect to the Indian environment in the following paragraphs:

7.1.2.1. **Degree of Competition and Business Principles** – Air Navigation Service in India is provided only by AAI. Hence, there is no competition in this industry in India. However, as per the AAI Act, functions of AAI are well defined which are reproduced below:

Section 11 of the AAI Act enumerates as below:

"In the discharge of its functions under this Act, the Authority shall act, so far as may be, on business principles…"

Section 12(4) states that:

"In the discharge of its functions under this section, the Authority shall have due regard to the development of air transport service and to the efficiency, economy and safety of such service."

Section 25(1) of the Act provides that:

"The Authority may, from time to time, set apart such amounts as it thinks fit as a reserve fund or funds for the purpose of expanding existing facilities or services or creating new facilities or services at any airport, civil enclave, heliport or airstrip or for the purpose of providing against any temporary decrease of revenue or increase of expenditure from transient causes or for purposes of replacement or for meeting expenditure arising from loss or damage from fire, cyclone, air-crash or other accident or for meeting any liability arising out of any act or commission in the discharge of its functions under this Act"

7.1.2.2. In view of this, AAI is required to act on sound business principles and ensure that enough reserves are built for upgradation of men and machinery on a regular basis. The return earned by AAI is also required to be regulated in consultation with its users as it operates in a monopolistic environment.

7.1.2.3. **Legal and Institutional Requirement - One India, One sky –** The Indian skies cannot be attributed to different airports. Approach and navigation services do not have very strict boundaries within which they operate. They may be restricted to a single airport or may be

extended far and beyond. Hence, charges have to be determined for the service as a whole and not airport wise. The Authority to determine charges for ANS as discussed in para 5.4 above rests with MoCA.

7.1.3. **Cost of economic oversight –** Frequency and form of economic oversight ought to be determined considering investment of time, efforts and money in this process.

7.2. The Philosophy

7.2.1. Considering the above conditions and constraints, coupled with ICAO guidance on various considerations for tariff philosophy, following is proposed.

7.2.2. Philosophy is proposed, keeping in mind the interests of various stakeholders belonging to each of the tri-fold aspect of ANS – People, Technology and Procedures. Bringing in advanced and state of the art technologies (Technology) comes at a cost – in terms of well-equipped personnel (People), associated operating expenditure and capital expenditure. All these expenditures are towards making Indian skies safer and secure everyday (Procedures). The need for investment is thus established.

7.2.3. Investment means risk in accepted business sense; Risk required rewards in the form of return on investment. Investment risk varies in degree and form depending on the environment in which the business operates. This leads to determining the form of oversight based on the environment in which the company/industry operates.

7.2.4. ANS industry in India is a monopoly, and hence, application of competition law becomes irrelevant. AAI is an organization owned by the Government with responsibilities of ensuring appropriate infrastructure and support for Airport/ANS operations as well as for its commercially viable operations. Tariff for its operations are not unilaterally determined by AAI but are to be reviewed and approved by MoCA.

7.2.5. ICAO in its guidance document for ANS (refer para 6.2.6 above) states that a reasonable return may be given for this service in consultation with the users/stakeholders, even when the ANSPs operate in a monopolistic environment.

7.2.6. Fall back regulation or “light handed” approach (as mentioned in para 6.2.3 above) is one where the boundaries within which ANSPs are required to operate are defined. When the ANSP functions within the boundaries, there is no requirement of any additional stringent measures of oversight. When the ANSP departs from the set limits, then a more robust form of oversight will come into the picture. This ensures that the cost of oversight is also kept low. As a good practice drawn from the rate of regulation form of oversight, stakeholder consultation process would also be conducted while determining tariff.

7.2.7. Involving users in the tariff determination process would ensure sound business principles are adhered to and ensures monopolistic environment is not used to advantage of the only player in the industry.

7.2.8. Thus, we propose a light-handed form of economic oversight coupled with user consultations for determination of tariff for Air Navigation Services in India, for the current control period.

7.2.9. One of the constraints in this method indicated in the ICAO document (as mentioned in para 6.2.3 above) is the determination of the boundaries. In this case, we propose a band of "average profit before tax" of ANSPs across the world as the boundaries which will be evaluated.

7.2.10. The profit before tax % of various ANSPs across the world are provided below:

Table 6 Comparison of Profit Before Tax of ANSPs across the World

ANSP	Country	Year	Currency	Revenue (in Mio)	PBT (in Mio)	% PBT
National Air Traffic Services, Ltd. (NATS)	United Kingdom	2017-18	UK Pound	918.60	132.80	14%
Air Traffic and Navigation Services SOC Limited (ATNS)	South Africa	2017-18	South African Rand	1,678.63	263.05	16%
Airservices Australia	Australia	2017-18	Australian Dollar	1,110.55	117.83	11%
Airways New Zealand	New Zealand	2017-18	New Zealand Dollar	218.74	36.03	16%
Aeronautical Radio of Thailand Ltd	Thailand	2018	Thai Baht	13,115.85	2,358.44	18%
Airport & Aviation Services (Sri Lanka) Limited	Sri Lanka	2018	Sri Lankan Rupee	31,873.43	10,458.41	33%

7.2.11. Basis of selection of the above airports for comparison is as follows:

7.2.11.1. Availability of reliable public information

7.2.11.2. Size of Operations

7.2.11.3. Geographical connect

7.2.12. From the above table, profit before tax % of ANSPs across the world is around 16%.

7.2.13. Considering the comparable countries' average profit before tax, tariff increases for ANS in India would be considered in such a way that the average profit before tax over a 10-year period would be between 14% to 18%, considering different factors affecting the same between other countries and India such as Country Risk, Purchase Parity, Economics of each different country etc.

8. Tariff Determination Components

8.1. Control Period

8.1.1. A period of 10 years is considered as the control period, considering the need to have a longer horizon of time for evaluation and rationalization of rates

8.1.2. For ANS, the first control period is defined to start from 1st April 2020 to 31st March 2030.

8.2. Traffic

8.2.1. Air Traffic Movement over the years

8.2.1.1. Growth in air traffic movements (ATMs) over the past three years was as follows:

Table 7 Air Traffic Movement in India over the years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Air Traffic Movement (in Millions)	1.79	2.04	2.32	2.65	3.04
Increase %		14.19%	13.71%	14.06%	14.64%
5-year CAGR %					11.17%

8.2.1.2. The Indian aviation industry has been on a steady growth in the past years. Air traffic movement in India has been growing at a steady pace of about 14% year on year. The five year 'Compounded Annual Growth Rate (CAGR)' is around 11.17%.

8.2.1.3. Some of the key reasons behind the rapid growth of the Indian aviation sector include[14]:

(a) Steady growth in the Indian economy, which is now poised to become the fifth largest after US, China, Japan and Germany.

(b) Domestic open skies, which allows new airlines to freely enter the market subject to stipulated norms.

(c) Partial open skies in international routes wherein India's neighboring countries and those outside a 5000 km radius from the capital New Delhi can have unlimited flights to designated international airports in India.

(d) Growth of highly competitive Low-Cost Carriers (LCC) in India.

(e) Development and operation of leading airports at Delhi, Mumbai, Hyderabad, Bengaluru, Hyderabad and Cochin through the Public Private Partnership (PPP). Many more are on the anvil.

[14] https://www.globalaviationsummit.in/documents/VISION-2040-FOR-THE-CIVIL-AVIATION-INDUSTRY-IN-INDIA.pdf

(f) Formulation of the industry-friendly National Civil Aviation Policy 2016 (NCAP 2016) that covers almost all aspects of Indian aviation.

(g) Opening of regional airports in India's hinterland through the landmark Regional Connectivity Scheme (RCS) popularly known as UDAN ('Ude Desh ka Aam Nagrik').

(h) Removal of FDI limits for almost all sub-sectors such as airports, air cargo, ground handling, general aviation and Maintenance, Repair and Overhaul (MRO) etc.

(i) Liberalization of global flying rights with all Indian carriers having a fleet of 20 aircraft free to fly abroad.

(j) Clear intent of the government to leverage the strengths of the private sector by way of privatization of the national carrier Air India, helicopter company Pawan Hans and operation of large government-owned airports through PPP.

8.2.2. Projected Traffic

8.2.2.1. **Basis of Projections –** The Corporate Planning and Management Services (CPMS) department of AAI forecasts traffic using econometric and regression analysis. This is done after considering various factors such as demographics, incentives, population, topography, potential benefits, etc. The methodology adopted for forecast of air traffic movements for the control period is as given below:

(a) The passenger traffic forecast has been prepared based on the trend analysis for the past twenty years.

(b) A higher weightage has been given to the traffic growth witnessed during the recent past.

(c) Based on judgmental analysis, recent and historic traffic trends, the growth rates have been moderated and refined.

(d) Subsequently, aircraft movements have been forecasted using Ratio Analysis (Pax to Aircraft Movements Ratio).

(e) Bottom up approach has been adopted (i.e) the traffic forecast for individual airports are prepared and summed up to arrive at the traffic forecast of all the airports taken together.

8.2.2.2. Based on the above methodology, following is the projected traffic for first control period:

Table 8 Traffic projections for 10 years

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Domestic Air Traffic Movements (in Millions)	2.77	3.02	3.29	3.55	3.83
International Air Traffic Movements (in Millions)	0.53	0.56	0.60	0.63	0.66
Total Air Traffic Movements (in Millions)	**3.30**	**3.58**	**3.88**	**4.18**	**4.49**
% Increase in Domestic Air Traffic Movements	9.00%	9.00%	9.00%	8.00%	8.00%
% Increase in International Air Traffic Movements	6.00%	6.00%	6.00%	5.00%	5.00%

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
% Increase in Total Air Traffic Movements	8.51%	8.52%	8.53%	7.54%	7.55%
5-year CAGR %					6.38%

Particulars	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic Air Traffic Movements (in Millions)	4.14	4.47	4.83	5.07	5.33
International Air Traffic Movements (in Millions)	0.69	0.73	0.76	0.79	0.82
Total Air Traffic Movements (in Millions)	**4.83**	**5.20**	**5.59**	**5.86**	**6.15**
% Increase in Domestic Air Traffic Movements	8.00%	8.00%	8.00%	5.00%	5.00%
% Increase in International Air Traffic Movements	5.00%	5.00%	5.00%	4.00%	4.00%
% Increase in Total Air Traffic Movements	7.56%	7.57%	7.58%	4.86%	4.86%
5-year CAGR %					4.94%

8.2.2.3. India is a nation of nearly 1.35 billion people which has a middle-class population of over 350 million (and growing). In such a country, around 700 million passengers must be flying per annum at conservative estimates. 2017-18 figure of 187 million passengers is a small fraction of the total potential. Hence, untapped potential in the Indian skies is large[15]. However, a conservative projection has been made for future considering the below factors:

(a) With the recent fall of Jet Airways, the rate of growth in the ATM has not been at the same pace as in the previous years.

(b) Airports in metro cities in India have started facing capacity constraints. Need for second and third airports in metro cities are being assessed or are in process of being developed. Building airports, being a large project takes substantial time from commencement till commissioning.

(c) Regional Connectivity Scheme (RCS) routes are given a 58% discount on the ANS charges. With impetus given to the routes connecting Tier II and Tier III cities, the chargeable ATMs are lower.

8.3. Regulatory Asset Base

8.3.1. Capital Investment over the years

8.3.1.1. Regulatory Asset Base (RAB) or written down value of capital investment in ANS division for the past years is as below:

Rs. in Crores

Table 9 Regulatory Asset Base over the years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Gross Block					
Opening Gross Block		3,340.37	3,559.10	3,902.59	4,076.22
Additions		218.74	343.49	173.63	503.68

[15] https://www.globalaviationsummit.in/documents/VISION-2040-FOR-THE-CIVIL-AVIATION-INDUSTRY-IN-INDIA.pdf

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Closing Gross Block	**3,340.37**	**3,559.10**	**3,902.59**	**4,076.22**	**4,579.90**
Accumulated Depreciation					
Opening Accumulated Depreciation		2,708.96	2,945.15	2,848.67	3,027.17
Depreciation for the year		236.19	-96.48	178.49	284.07
Closing Accumulated Depreciation	**2,708.96**	**2,945.15**	**2,848.67**	**3,027.17**	**3,311.24**
RAB					
Opening RAB		631.41	613.95	1,053.92	1,049.05
Closing RAB		613.95	1,053.92	1,049.05	1,268.66
Average RAB	**631.41**	**622.68**	**833.94**	**1,051.49**	**1,158.86**

8.3.1.2. It may be noted that the while the gross block is around Rs. 3,500 crores, the net block or the RAB is around Rs. 600 crores to Rs. 1,000 crores. This is because capital investments have depreciated over time. Hence, there is a need to revamp, modernize and upgrade the Air Traffic Control centers with state-of-the art technology in the near future.

8.3.2. Projected Capital Expenditure

8.3.2.1. In the journey towards the twenty-first century when the Indian economy is all set to integrate itself into the global economy, upgradation and modernization of infrastructure and its efficient use have assumed critical importance. It is now increasingly recognized that aviation, far from being a mere mode of transportation for an elite group, is crucial for sustainable development of trade and tourism. In this context, it is vital that aviation related infrastructure grows in anticipation of the escalating needs of the air transport industry. As this is a capital-intensive sector, there is a need for perspective planning with a vision for the next twenty years and to muster the combined resources of the public and private sectors, both domestic and foreign.

8.3.2.2. To facilitate and aid an unconstrained growth of the Indian aviation industry, associated infrastructure needs to be developed. The growth also demands that investment requirements must address the existing capacity constraints in various airports and airspaces. Investments must also be made to meet requirements in the context of growth scenario forecast for the next decade. Thereafter, investments must be made to ensure that the growth in air traffic is managed safely and efficiently.

8.3.2.3. There is also a constant need to bring in cutting edge technology and the associated best practices of the industry in order to make Indian Civil Aviation sector globally competitive.

8.3.2.4. To support a globally harmonized air navigation system, International Civil Aviation Organization (ICAO) has developed Global Air Navigation Plan (GANP), Global Air Safety Plan (GASP) and Global Air Security Plan (GASeP) to provide clear guidance on the guiding operational targets and supporting technologies, avionics, procedures, standards and regulatory approvals needed to realize them. The GANP additionally establishes a framework for incremental implementations based on the specific operational

profiles and traffic densities of each State. This is accomplished through the Aviation System Block Upgrades (ASBUs), a consensus-driven framework which forms the basis of the revised GANP. The ASBUs are organized in five-year increments starting in 2013 and continuing through 2028 and beyond. On this basis, the GANP represents a rolling, fifteen–year strategic methodology which leverages existing technologies and anticipates future developments based on State/Industry agreed operational objectives. This will enable sound investment strategies and help to generate the required commitment to the Plan from States, equipment manufacturers, operators and service providers.

8.3.2.5. India, being a member state of the ICAO strives towards meeting the requirements laid out in the ASBUs. In view of achieving the requirements of ASBUs along with the action plan to achieve Vision 2040 as enlisted in para 4.5 above, following projections for capital expenditure have been charted out:

Rs. in Crores

Table 10 Capital Expenditure Projections for 10 years

Year	Capital Expenditure for Directorate of CNS-P	Capital Expenditure for Directorate of CNS-O&M	Capital Expenditure for Directorate of RCDU, FIU & SMU	Capital Expenditure for Directorate of ATM including R&D	Total Capital Expenditure
2020-21	575.60	41.00	185.00	14.50	**816.10**
2021-22	510.00	45.00	226.00	130.00	**911.00**
2022-23	422.00	50.00	94.00	234.61	**800.61**
2023-24	380.00	46.00	99.00	100.00	**625.00**
2024-25	350.00	48.00	30.00	10.00	**438.00**
2025-26	370.00	45.00	32.00	10.00	**457.00**
2026-27	390.00	47.00	35.00	10.00	**482.00**
2027-28	400.00	50.00	31.00	10.00	**491.00**
2028-29	380.00	52.00	34.00	10.00	**476.00**
2029-30	390.00	50.00	32.00	10.00	**482.00**

8.3.2.6. Details of capital expenditure proposed for the next 10-year period is as follows:

(a) **Communication Systems:** Additional / replacement of VHF Transmitter, HF Transmitter, HF Receiver, VCCS, Voice Recorders, DATIS, AMSS, UPS, FTI

(b) **Navigational Systems:** Additional / Replacement of DVOR, HP-DME, ILS, LP-DME & NDD.

(c) **Surveillance Systems:** Additional / Replacement of ASR/MSSR, ARSR/MSSR, MSSR, Space based ADS-B, ASMGCS

(d) **ATC Automation / Simulator systems:** Additional / Replacement of ATC Automation, ATC Training Simulator, Tower Automation System

(e) **Induction of new technologies:** ATFM, Remote Digital Tower, Mobile Tower, Space Based ADS-B, GBAS

(f) **Upgradation and Expansion of GAGAN:** Upgradation, Expansion, Additional Infrastructure, Development of non-aviation application

(g) **Online Flight Planning System –** Online flight planning system is a combination of web portal and mobile application that allows users to file flight plans and associated messages with AAI

8.3.2.7. AAI has drawn plans to upgrade ATM infrastructure in the country both in terms of conditional provision of automation systems and upgradation of technology which also involves shifting from ground-based navigation to satellite based navigation.

8.3.2.8. Modernization of Air Traffic Services

(a) At Mumbai and Delhi

(i) Upgradation of automation systems to (Auto Track-Ill) with new Air Traffic Controller assistance features such as Arrival Manager, Departure Manager, is almost complete and is at various levels of testing prior to declaring operational.

(ii) Advanced Surface Movement Ground Control Systems (ASMGCS) added to improve efficient handling of Aerodrome Traffic.

(iii) Automatic dependent surveillance I CPDLC has enhanced the surveillance of suitably equipped aircraft over the entire Flight Information Region.

(b) At Hyderabad and Bangalore

(i) Advanced integrated automation systems, that integrates state of the art Radars, flight data processors, air situation display Advanced Surface Movement Ground Radars, have been installed by SELEX Integreti for providing effective Air Traffic Management.

(c) At Chennai / Kolkata

(i) ATS modernization project is underway for replacing old Radars, surveillance systems by the latest state of the art technology one par with Mumbai / Delhi to provide a common platform for integration of the entire systems over Indian Airspace, which will effectively increase Air Traffic capacity and bring synergy in ATS operations.

(d) At Other Area Control Centres (Nagpur/ Varanasi/ Ahmedabad/ Trivandrum/ Mangalore)

(i) Integration of Radar with flight data processors has been completed by ECIL in collaboration with AAI for providing indigenous automation solutions for effective Air Traffic Management within the designated airspace.

(e) Initiatives to Enhance the Standards of AT

(i) Performance Based Navigation: (PBN), Standard· Instrument Departures (SIDs) and STARs (Standard Terminal Arrival Routes) have been introduced at Delhi, Mumbai, Ahmedabad and Chennai order to reduce delays to aircraft.

(ii) Established a number of ATS Connector routes in Mumbai and Chennai airspace to facilitate PBN operations.

8.3.2.9. AAI has drawn the concept of future India Air Navigation (FIAN) and is on the threshold of introducing Air Traffic Flow Management over busy routes, dedicated helicopter routes, providing automation systems at 35 non metro control towers, and the use of space-based augmentation system (GAGAN).

8.4. Depreciation

8.4.1. Straight line method of depreciation is used by AAI for the purpose of preparation of its financial statements. Depreciation rates as applied by AAI based on technical evaluation carried out by AAI has been used as the basis for computing estimated depreciation.

8.4.2. Depreciation over the years

8.4.2.1. Depreciation expense over the years is provided below:

Rs. in Crores

Table 11 Depreciation expense over the years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Depreciation, Amortization & Impairment	226.44	229.68	232.19	229.43	284.07
Gross Block	3,340.37	3,559.10	3,902.59	4,076.22	4,579.90
Average Depreciation %	7%	6%	6%	6%	6%

8.4.3. Projected Depreciation

8.4.3.1. Depreciation expense for the future is projected based on the forecasted capital expenditure. Straight line method of depreciation is used by AAI. Hence, the average rate of depreciation reflects the yearly depreciation amount that gets charged to profit and loss account. Based on this, following depreciation has been projected for the next 10 years:

Rs. in Crores

Table 12 Depreciation Projection for 10 years

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Depreciation, Amortization & Impairment	334.69	391.20	440.86	479.62	506.79
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
Depreciation, Amortization & Impairment	535.13	565.03	595.49	625.01	654.91

8.4.3.2. Average annual rate of depreciation that has been used in the projection is as follows:

Table 13 Average depreciation rate for 10 years

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Depreciation, Amortization & Impairment %	6%	6%	6%	6%	6%
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
Depreciation, Amortization & Impairment %	6%	6%	6%	6%	6%

8.5. Operating Expenses

8.5.1. Operating expenses are divided into the following broad heads in the ANS department:

8.5.1.1. Employee Benefit Expenses

8.5.1.2. Other Operating Expenses

8.5.1.3. Administration Expenses

8.5.2. Composition of above expenses (based on an average of 2015-16 to 2018-19 data) is as given below:

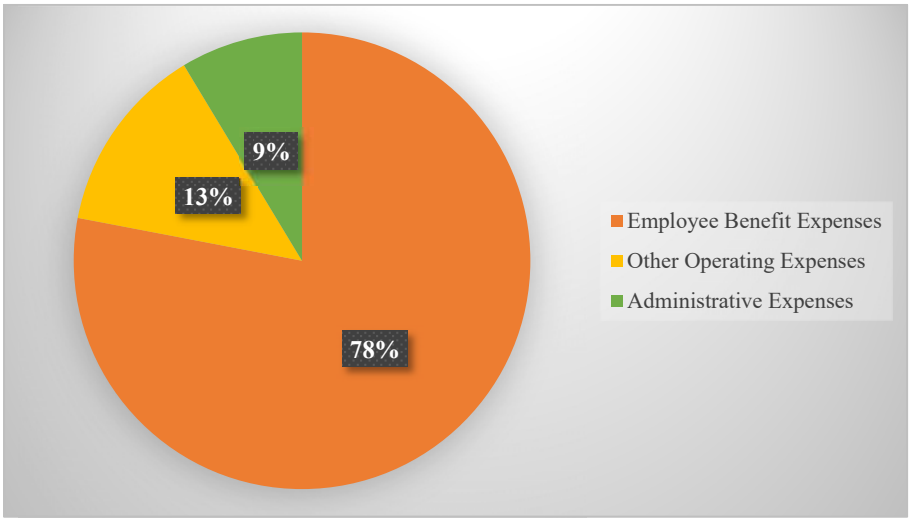

Figure 7 Composition of Operating Expenses

8.5.3. **Allocation of central and regional head quarters' expenses:** These heads of expenses also include expenses which have been allocated from the central and regional head-quarters. There are many expenses which are incurred at the regional head-quarters level as this service is largely "route" based. Hence, not all airports may be involved at the same time in provision of air navigation services. Common monitoring will be carried out, especially for en-route

flights. In view of this, the expenses incurred in the central and regional head-quarters which are exclusive to ANS were systematically identified and allocated to this department while computing the cost of running this department. Other common heads of expenses such as cost of finance department, administrative costs, etc. were apportioned between aeronautical and air navigation services based on the revenue generated from the respective streams.

8.5.4. These expenses are discussed in detail in the following sections.

8.5.5. Employee Benefit Expenses

8.5.5.1. Air Navigation Services is a special and unique service. People are one of the most important aspects of this industry. This service requires the best in the field, immense amount of training and reinforcement. There is a constant need to upgrade the systems in this field. With the upgradation of the systems, there is a need to upgrade the human capital as well. In view of this, employee benefit expense constitutes 78% of the total operating expenses incurred in this department.

8.5.5.2. The employee benefit expenses incurred over the years is as follows:

Rs. in Crores

Table 14 Employee benefit expense over the years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Employee Benefit Expenses	1,178.34	1,329.65	1,620.77	1,686.35	2,090.59
Increase %		13%	22%	4%	24%

8.5.5.3. Projected employee benefit expense is as follows:

Rs. in Crores

Table 15 Employee benefit expense projections for the next 10 years

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Employee Benefit Expenses	2,396.91	2,727.96	3,050.67	3,565.67	3,922.23
% Increase	15%	14%	12%	17%	10%
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
Employee Benefit Expenses	4,314.46	4,745.90	5,220.49	5,742.54	6,316.80
% Increase	10%	10%	10%	10%	10%

8.5.5.4. With the growth in the civil aviation sector in India, the requirement of trained employees in air navigation center is also on the rise. A detailed manpower requirement study was undertaken by the ANS department of AAI for 5 years starting from 2019-20. Gaps were identified between the available personnel and the required personnel in the following 3 categories:

(a) Air Traffic Controllers

(b) Junior Executives – CNS

(c) Manager – CNS

8.5.5.5. The gaps which have been identified are as follows:

Table 16 Gaps between required and projected personnel Air Traffic Controllers, Junior Executives-CNS and Manager-CNS

Level	Year	Initial Projection	Category	Considerations	Required Personnel after considerations	Shortfall in ATC personnel
Air Traffic Controllers	2019-20	4,142	Operations	Additional Units for UAH and Capacity Enhancement Delhi, 11 New RCS Airports	4,543	401
			Non-Operations	Additional requirements for Non-Ops		
	2020-21	4,543	Operations	UAH Mumbai, 11 New RCS Airports	4,811	268
			Non-Operations	Additional requirements for Non-Ops		
	2021-22	4,811	Operations	MOPA Airport, Navi Mumbai Airport, 11 New RCS Airport	5,006	195
			Non-Operations	Additional requirements for Non-Ops		

Level	Year	Shortfall in Junior Executive - CNS
Junior Executive - CNS	2019-20	250
Junior Executive - CNS	2020-21	100
Junior Executive - CNS	2021-22	100
Junior Executive - CNS	2022-23	100
Junior Executive - CNS	2023-24	100

Level	Year	Shortfall in Manager - CNS
Manager - CNS	2019-20	324
Manager - CNS	2020-21	50
Manager - CNS	2021-22	50
Manager - CNS	2022-23	50
Manager - CNS	2023-24	50

8.5.5.6. AAI intends to recruit the personnel to meet the shortfall in the requirement vs availability of officers at the required levels. Hence, cost of all such additional employees to be recruited have also been considered in the projections for the 10 years. This is the reason for increase of 24% in year 2019-20 and further increases ranging between 10% to 17% in the first 5 years.

8.5.5.7. Further, the last wage revision for ANS employees was done in the FY 2018-19. Wage revision happens once in 5 years. Hence, the next wage revision is due in FY 2023-24.

8.5.5.8. For other years, employee benefit expenses have been estimated to increase at the rate of 10%, considering – **7% year on year increments that all the employees** are entitled to on the basic salary, DA and other elements such as HRA, other allowances. 7% increase

in employee benefit cost has been allowed by AERA while determining tariff for major airports.. Apart from these expenses, ANS employees are also entitled to performance related incentives and increments. With increased focus on safety and security, enhanced and exclusive training, the percentage of incentive is also expected to increase. Hence, an additional 3% increase year on year is also considered in the projection for employee cost.

8.5.6. Other Operating Expenses

8.5.6.1. Operating expenses in the ANS department mainly relate to the upkeep of machinery and equipment. With addition of state-of-the art equipment, comes a cost of maintaining the same. All annual maintenance contract expenses are included under this head.

8.5.6.2. Operating expenses over the years is as follows:

Rs. in crores

Table 17 Other operating expenses over the years

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Other Operating Expenses	201.69	227.59	277.42	288.65	312.26
Increase %		13%	22%	4%	8%

8.5.6.3. Other operating expense projections over the next 10 years is as follows:

Rs. in crores

Table 18 Other operting expense projections for the next 10 years

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Other Operating Expenses	330.47	353.61	378.36	404.84	433.18
% Increase	6%	7%	7%	7%	7%
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
Other Operating Expenses	463.51	495.95	530.67	567.81	607.56
% Increase	7%	7%	7%	7%	7%

8.5.6.4. Projection for operating expenses has been done on a granular basis and considering various programmes which have been initiated. These initiatives are directed towards achieving 'Vision 2040'. Detailed description of the expenses to be incurred is given below:

(a) Payment of recurring bills of Leased lines, Telephone lines, EPABX, Mobile phones, Hotlines, Satellite phone etc.,

(b) Repair and Maintenance expenditure of Communication, Navigation, Surveillance, Automation, Ancillary CNS equipment's and other CNS equipment.

(c) Procurement of Spares for the equipment.

(d) Payment towards WPC Spectrum license charges

(e) Payment towards hiring of Watch and ward for securing the CNS facilities

(f) Towards Stores expenditure for packing and transportation of goods for repair and return

(g) For procurement of CNS sign boards required at various location of CNS facilities

(h) Furniture repair and Maintenance

(i) Training expenditure

(j) Miscellaneous expenditure

(k) Painting expenditure on CNS facilities

(l) Expenditure towards Trans-installation works

(m) AMC expenditure including for **Online Flight Planning System –** Online flight planning system is a combination of web portal and mobile application that allows users to file flight plans and associated messages with AAI.

(n) Air Calibration of CNS facilities like ILS, DVOR, DME

(o) Procurement of Consumables like Paper role for thermal printer for ATC automation system

(p) Calibration of Test equipment

(q) Replacement of Batteries for all UPS

(r) Payment towards hiring of Data Entry Operator, Drivers, etc. for maintenance of CNS facilities.

(s) Payments towards hiring of Conservancy/Technical Assistants

8.5.6.5. Additional operating expenses specifically for the space-based ADS-B project has also been estimated as follows:

Rs. in Crores

Table 19 Projected Expenditure for Space Based ADS-B

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
ADSB	176.33	176.33	193.97	213.36	228.30
% Increase	0%	0%	10%	10%	7%
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
ADSB	244.28	261.38	279.68	299.25	320.20
% Increase	7%	7%	7%	7%	7%

8.5.6.6. **Automatic Dependent Surveillance**– Broadcast (ADS–B) is a surveillance technology, wherein an aircraft determines its position via satellite navigation and periodically broadcasts it, enabling it to be tracked. The information can be received by air-traffic control ground stations as a replacement for secondary radar as no interrogation signal is

needed from the ground. It can also be received by other aircraft in the vicinity to provide situational awareness and allow self-separation.

8.5.6.7. ADS-B affords benefits to flight crews, operators and air traffic controllers. With ADS-B fitted in an aircraft, a pilot is able to view traffic information about surrounding aircraft if those aircraft are equipped with ADS-B out. This information includes altitude, heading, speed, and distance to aircraft. Also, ADS-B is less expensive than radars, and therefore, benefits the system operators. It is cheaper to install and operate compared to primary and secondary radar systems used by Air Traffic Control (ATC) for aircraft separation and control. It also benefits aircraft operators, particularly passengers and freight carriers. These efficient procedures reduce the flying time significantly. This results in saving fuel, flying time and maintenance costs. Consequently, it leads to reduced emissions, especially CO2. Reduced aviation fuel consumption equals lower carbon footprint.

8.5.7. Administrative Expenses

8.5.7.1. Administrative expenses over the years is as follows:

Rs. in crores

Table 20 Administrative expenses over the years

Particulars	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**
	Actuals	*Actuals*	*Actuals*	*Actuals*	*Projections*
Administrative Expenses	130.52	147.28	179.53	186.79	205.47
Increase %		13%	22%	4%	10%

8.5.7.2. Administrative expense projections over the next 10 years is as follows:

Rs. in crores

Table 21 Projected Administrative Expenses for the next 10 years

Particulars	**2020-21**	**2021-22**	**2022-23**	**2023-24**	**2024-25**
Administrative Expenses	226.02	248.62	273.48	300.83	330.92
% Increase	10%	10%	10%	10%	10%
Particulars	**2025-26**	**2026-27**	**2027-28**	**2028-29**	**2029-30**
Administrative Expenses	364.01	400.41	440.45	484.49	532.94
% Increase	10%	10%	10%	10%	10%

9. Analysis of Profitability and Proposed Tariff Increase

9.1. Revenue Projections and Profitability

9.1.1. Considering the traffic projections as mentioned in para 8.2.2 above, following is the revenue projections for a 10-year period without considering any rate increases:

Rs. in Crores

Table 22 Projected ANS Revenues with only Traffic Increase

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Growth Rate					
ATM Growth Rate	8.51%	8.52%	8.53%	7.54%	7.55%
Revenue					
TNLC	643.06	697.83	757.34	814.43	875.92
RNFC	3,942.07	4,277.80	4,642.60	4,992.60	5,369.53
Other CNS/ATM Service Revenue	0.32	0.35	0.38	0.40	0.44
Other Income	9.86	10.70	11.62	12.49	13.44
Total Revenue	**4,595.31**	**4,986.67**	**5,411.93**	**5,819.93**	**6,259.32**

Particulars	2025-26	2026-27	2027-28	2028-29	2029-30
Growth Rate					
ATM Growth Rate	7.56%	7.57%	7.58%	4.86%	4.86%
Revenue					
TNLC	942.14	1,013.47	1,090.30	1,143.33	1,198.95
RNFC	5,775.49	6,212.74	6,683.74	7,008.81	7,349.78
Other CNS/ATM Service Revenue	0.47	0.50	0.54	0.57	0.60
Other Income	14.45	15.55	16.73	17.54	18.39
Total Revenue	**6,732.55**	**7,242.26**	**7,791.30**	**8,170.25**	**8,567.72**

9.1.2. Based on the above projected revenue (refer Table 22) together with the projected operating (refer Table 12, Table 15, Table 18, Table 19 and Table 21) and capital expenditure (refer Table 10), following is the expected profitability of the ANS vertical:

Rs. in Crores

Table 23 Projected profitability of ANS vertical for next 10 years before tariff increase

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Assumptions					
ATM Growth Rate	8.51%	8.52%	8.53%	7.54%	7.55%
Revenue					
TNLC	643.06	697.83	757.34	814.43	875.92
RNFC	3,942.07	4,277.80	4,642.60	4,992.60	5,369.53
Other CNS/ATM Service Revenue	0.32	0.35	0.38	0.40	0.44
Other Income	9.86	10.70	11.62	12.49	13.44
Total Revenue	**4,595.31**	**4,986.67**	**5,411.93**	**5,819.93**	**6,259.32**
Expenses					
Operating Expenses	330.47	353.61	378.36	404.84	433.18
ADSB - Additional Opex	176.33	176.33	193.97	213.36	228.30
Employee Benefit Expenses	2,396.91	2,727.96	3,050.67	3,565.67	3,922.23
Administrative & Other Expenses	226.02	248.62	273.48	300.83	330.92
Depreciation, Amortization & Impairment	334.69	391.20	440.86	479.62	506.79
Total Expenses	**3,464.43**	**3,897.72**	**4,337.33**	**4,964.33**	**5,421.42**
Profit Before Tax	**1,130.88**	**1,088.96**	**1,074.60**	**855.60**	**837.90**
Profit Before Tax %	***24.61%***	***21.84%***	***19.86%***	***14.70%***	***13.39%***

Particulars	2025-26	2026-27	2027-28	2028-29	2029-30
Assumptions					
ATM Growth Rate	7.56%	7.57%	7.58%	4.86%	4.86%

Revenue					
TNLC	942.14	1,013.47	1,090.30	1,143.33	1,198.95
RNFC	5,775.49	6,212.74	6,683.74	7,008.81	7,349.78
Other CNS/ATM Service Revenue	0.47	0.50	0.54	0.57	0.60
Other Income	14.45	15.55	16.73	17.54	18.39
Total Revenue	**6,732.55**	**7,242.26**	**7,791.30**	**8,170.25**	**8,567.72**
Expenses					
Operating Expenses	463.51	495.95	530.67	567.81	607.56
ADSB - Additional Opex	244.28	261.38	279.68	299.25	320.20
Employee Benefit Expenses	4,314.46	4,745.90	5,220.49	5,742.54	6,316.80
Administrative & Other Expenses	364.01	400.41	440.45	484.49	532.94
Depreciation, Amortization & Impairment	535.13	565.03	595.49	625.01	654.91
Total Expenses	**5,921.38**	**6,468.67**	**7,066.77**	**7,719.11**	**8,432.41**
Profit Before Tax	**811.16**	**773.59**	**724.53**	**451.14**	**135.31**
Profit Before Tax %	***12.05%***	***10.68%***	***9.30%***	***5.52%***	***1.58%***

9.1.3. From Table 23 above, it is inferred that the profit before tax % reduces from the current level of 35% to about 2% over the 10-year period.

9.1.4. Further, the average profit before tax % of the ANS division works out to around 12% over a 10-year period.

9.1.5. Considering the need to have returns to take care of the future capital expenditure and the need for development of ANS infrastructure and to provide a reasonable return of around 14% to 18%, a small increase in tariff is proposed.

9.2. Proposed Tariff Increase and Revised Profitability

9.2.1. Considering all the above factors and future profitability, an increase of 4% in tariff in 2020-21 and 4% increase in 2025-26 is proposed with a view to ensure reasonable but not additional profits and to ensure sustainable operations.

9.2.2. Based on the above projected traffic (refer Table 8) together with the projected operating (refer Table 12, Table 15, Table 18, Table 19 and Table 21) and capital expenditure (refer Table 10), following is the expected profitability of the ANS vertical after giving effect to the tariff increase as proposed in para 9.2.1 above for the next 10 years:

Table 24 Profit Projections for next 10 years without Increase in Tariff

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Assumptions					
ATM Growth Rate	8.51%	8.52%	8.53%	7.54%	7.55%
Revenue					
TNLC	668.78	725.74	787.63	847.01	910.95
RNFC	4,099.75	4,448.91	4,828.31	5,192.30	5,584.31
Other CNS/ATM Service Revenue	0.32	0.35	0.38	0.40	0.44
Other Income	9.86	10.70	11.62	12.49	13.44
Total Revenue	**4,778.71**	**5,185.70**	**5,627.93**	**6,052.21**	**6,509.13**
Expenses					
Operating Expenses	330.47	353.61	378.36	404.84	433.18
ADSB - Additional Opex	176.33	176.33	193.97	213.36	228.30
Employee Benefit Expenses	2,396.91	2,727.96	3,050.67	3,565.67	3,922.23
Administrative & Other Expenses	226.02	248.62	273.48	300.83	330.92

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25
Depreciation, Amortization & Impairment	334.69	391.20	440.86	479.62	506.79
Total Expenses	**3,464.43**	**3,897.72**	**4,337.33**	**4,964.33**	**5,421.42**
Profit Before Tax	**1,314.28**	**1,287.98**	**1,290.60**	**1,087.88**	**1,087.72**
Profit Before Tax %	***27.50%***	***24.84%***	***22.93%***	***17.97%***	***16.71%***

Particulars	2025-26	2026-27	2027-28	2028-29	2029-30
Assumptions					
ATM Growth Rate	7.56%	7.57%	7.58%	4.86%	4.86%
Revenue					
TNLC	1,019.02	1,096.17	1,179.27	1,236.63	1,296.79
RNFC	6,246.77	6,719.70	7,229.13	7,580.73	7,949.53
Other CNS/ATM Service Revenue	0.47	0.50	0.54	0.57	0.60
Other Income	14.45	15.55	16.73	17.54	18.39
Total Revenue	**7,280.70**	**7,831.92**	**8,425.67**	**8,835.47**	**9,265.30**
Expenses					
Operating Expenses	463.51	495.95	530.67	567.81	607.56
ADSB - Additional Opex	244.28	261.38	279.68	299.25	320.20
Employee Benefit Expenses	4,314.46	4,745.90	5,220.49	5,742.54	6,316.80
Administrative & Other Expenses	364.01	400.41	440.45	484.49	532.94
Depreciation, Amortization & Impairment	535.13	565.03	595.49	625.01	654.91
Total Expenses	**5,921.38**	**6,468.67**	**7,066.77**	**7,719.11**	**8,432.41**
Profit Before Tax	**1,359.32**	**1,363.25**	**1,358.89**	**1,116.35**	**832.89**
Profit Before Tax %	***18.67%***	***17.41%***	***16.13%***	***12.63%***	***8.99%***

9.2.3. Over the 10-year period, PBT% is projected to decrease from about 27.5% to about 9%. The average profit % over this 10-year period is around 17.34%.

9.3. Conclusion

9.3.1. **In line with the philosophy for determination of tariff for air navigation services, an increase of 4% in tariff for year 2020-21 and another increase of 4% in tariff for the year 2025-26 is proposed**.

9.3.2. **This increase is expected to result in average profit before tax % for the period 1st April 2020 to 31st March 2030 to be around 17.34%, which is reasonable and comparable with AAI's global peers.**

10. ANS Tariff Card

10.1. Existing Tariff Card for Air Navigation Services

Existing Charges for Air Navigation Services at All Airports

1. **Route Navigation Facility Charges (RNFC)**

Domestic	International
RNFC Fees = R x D x W *Where* R = Rs. 4,620/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms	RNFC Fees = R x D x W *Where* R = Rs. 5,330/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms

2. **RNFC for Overflying – International Flights = (R x D X W) + Rs. 5080**
   Where
   R = Rs. 5,330/-
   D = √(GCD/100) with GCD cap as 1200 NM
   W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms

3. **RNFC for Small Aircrafts registered in India: Domestic Flights: -** Route Navigation Facility Charges (RNFC) in respect of aircrafts with maximum All Up Weights:
   a. Upto 10,000 Kgs. Shall be levied at 20% of the applicable rates of weight- Cum-distance formula; and
   b. More than 10,000 Kgs. to 20,000 Kgs. shall be levied @ 40 % of the applicable rates of weight - cum-distance formula.

Notes:

I. RNFC for Overflying mentioned above is applicable only to Delhi, Mumbai, Kolkata and Chennai FIRs.
II. Charges shall be calculated on the basis of nearest MT (i.e. 1000 Kgs.)
III. No RNFC charges on circuit flying and local flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.
IV. RNFC charges at 20% of the applicable rate for small aircraft with MTOW of <10000 kgs. is to be levied for cross country flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.

4. **Terminal Navigation Landing Charges (TNLC):**

(a) International Airports Including Goa International Airport (Civil Enclave)- International Flights

Weight of Aircraft	For Each Landing / International flight (Amount in Rs.)
Below 10,000 Kgs	1,256.50
10,000 Kgs and above	7560.70

(b) International Airports Including Goa International Airport (Civil Enclave)- Domestic Flights

Weight of Aircraft	For Each Landing / Domestic flight (Amount in Rs.)
Below 10,000 Kgs	1087.90
10,000 Kgs & above	6546.10

Notes:

I. TNLC mentioned above is applicable for Delhi, Mumbai, Chennai, Kolkata, Trivandrum, Bengaluru (BIAL), Hyderabad (Shamshabad – HIAL), Goa and Cochin Airports.
II. TNLC at 5 International airports, i.e Kolkata, Delhi, Mumbai, Chennai, Trivandrum to be reduced by 25% of the current rates for domestic flights
III. For Small Domestic Aircrafts (MTOW upto 21000 Kgs.) TNLC shall be @ Rs 110/- per 1000 Kgs. (Since TNLC rate for Small Domestic aircraft is a concessional rate, there is no further concession/reduction for Small Domestic Aircrafts). However, for Small Domestic Aircrafts where concessional rate indicated above is more than the normal rate, normal rate for TNLC would be applicable.
IV. Changes shall be calculated on the basis of nearest MT (i.e 1000 Kgs)

c) **Civil enclaves (other than Goa International Airport) –**

(i) International Flights –

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 17.70 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 177.00 /-plus Rs. 26.70 per 1,000 kgs in excess of 10,000 kg
20,001 kgs to 50,000 kgs	Rs.444.00 /-plus Rs. 53.30 per 1,000 kgs in excess of 20,000 kg
50,001 kgs to 1,00,000 kgs	Rs.2043 /-plus Rs. 63.50 per 1,000 kgs in excess of 50,000 kg
Over 1,00,000 kgs	Rs.5218 /-plus Rs.71.20 per 1,000 kgs in excess of 1,00,000 kg

(ii) Domestic Flights –

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 9.90 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 99 /- plus Rs.15.40 per 1,000 kgs in excess of 10,000 kg
Over 20,000 kgs	Rs. 253 /- plus Rs.30.80 per 1,000 kgs in excess of 20,000 kg

Notes:

I. Charges shall be calculated on the basis of the nearest MT (i.e 1,000 Kgs)
II. No TNLC charges on aircrafts used for training purpose by the approved flying schools/ flying training institutes.

10.2. Proposed Tariff Card for Air Navigation Services

Airports Authority of India

Proposed Rate Card for Aeronautical Services for FY 2020-21 to FY 2024-25

Effective from 1st April 2020 (or from the date of implementation, whichever is later) to 31st March 2025

Charges for Air Navigation Services at All Airports for the period

1. **Route Navigation Facility Charges (RNFC)**

Domestic	International
RNFC Fees = R x D x W *Where* R = Rs. 4,805/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms	RNFC Fees = R x D x W *Where* R = Rs. 5,543/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms

2. **RNFC for Overflying – International Flights = (R x D X W) + Rs. 5,283**
   Where
   R = Rs. 5,543/-
   D = √(GCD/100) with GCD cap as 1200 NM
   W=√(AUW/50,000)with AUM cap as 2,00,000 Kilograms

3. **RNFC for Small Aircrafts registered in India: Domestic Flights: -** Route Navigation Facility Charges (RNFC) in respect of aircrafts with maximum All Up Weights:
   a. Upto 10,000 Kgs. Shall be levied at 20% of the applicable rates of weight- Cum-distance formula; and
   b. More than 10,000 Kgs. to 20,000 Kgs. shall be levied @ 40% of the applicable rates of weight - cum-distance formula.

Notes:

I. RNFC for Overflying mentioned above is applicable only to Delhi, Mumbai, Kolkata and Chennai FIRs.
II. Charges shall be calculated on the basis of nearest MT (i.e. 1000 Kgs.)
III. No RNFC charges on circuit flying and local flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.
IV. RNFC charges at 20% of the applicable rate for small aircraft with MTOW of <10,000 kgs. is to be levied for cross country flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.

4. **Terminal Navigation Landing Charges (TNLC):**

(a) International Airports Including Goa International Airport (Civil Enclave)- International Flights

Weight of Aircraft	For Each Landing / International flight (Amount in Rs.)
Below 10,000 Kgs	1,307.00

Weight of Aircraft	For Each Landing / International flight (Amount in Rs.)
10,000 Kgs and above	7,863.00

b) International Airports Including Goa International Airport (Civil Enclave)- Domestic Flights

Weight of Aircraft	For Each Landing / Domestic flight (Amount in Rs.)
Below 10,000 Kgs and above	1,131.00
10,000 Kgs & above	6,808.00

Notes:

I. TNLC mentioned above is applicable for Delhi, Mumbai, Chennai, Kolkata, Trivandrum, Bengaluru (BIAL), Hyderabad (Shamshabad – HIAL), Goa and Cochin Airports.
II. TNLC at 5 International airports, i.e Kolkata, Delhi, Mumbai, Chennai, Trivandrum to be reduced by 25% of the current rates for domestic flights.
III. For Small Domestic Aircrafts (MTOW upto 21000 Kgs.) TNLC shall be @ Rs 110/- per 1000 Kgs. (Since TNLC rate for Small Domestic aircraft is a concessional rate, there is no further concession/reduction for Small Domestic Aircrafts). However, for Small Domestic Aircrafts where concessional rate indicated above is more than the normal rate, normal rate for TNLC would be applicable.
IV. Changes shall be calculated on the basis of nearest MT (i.e 1000 Kgs)

c) Civil enclaves (other than Goa International Airport) –

(i) International Flights –

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 18.41 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 184.10 /-plus Rs. 27.77 per 1,000 kgs in excess of 10,000 kg
20,001 kgs to 50,000 kgs	Rs.461.80 plus Rs. 55.43 per 1,000 kgs in excess of 20,000 kg
50,001 kgs to 1,00,000 kgs	Rs. 2,124.70 plus Rs. 66.04 per 1,000 kgs in excess of 50,000 kg
Over 1,00,000 kgs	Rs. 5,4264.70 plus Rs.74.05 per 1,000 kgs in excess of 1,00,000 kg

(ii) **Domestic Flights –**

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 10.30 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 103.00 plus Rs.16.02 per 1,000 kgs in excess of 10,000 kg
Over 20,000 kgs	Rs. 263.62 plus Rs.32.03 per 1,000 kgs in excess of 20,000 kg

Notes:

I. Charges shall be calculated on the basis of the nearest MT (i.e 1,000 Kgs)
II. No TNLC charges on aircrafts used for training purpose by the approved flying schools/ flying training institutes.

Airports Authority of India

Proposed Rate Card for Aeronautical Services for FY 2025-26 to FY 2029-30

Effective from 1st April 2025 (or from the sixth year from the date of implementation, whichever is later) to 31st March 2030

Charges for Air Navigation Services at All Airports for the period

1. Route Navigation Facility Charges (RNFC)

Domestic	International
RNFC Fees = R x D x W *Where* R = Rs. 4,997/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms	RNFC Fees = R x D x W *Where* R = Rs. 5,765/- D = √(GCD/100) with GCD cap as 1200 NM W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms

1. **RNFC for Overflying – International Flights = (R x D X W) + Rs. 5,494/-**
   Where
   R = Rs. 5,765/-
   D = √(GCD/100) with GCD cap as 1200 NM
   W=√(AUW/50,000) with AUM cap as 2,00,000 Kilograms

2. **RNFC for Small Aircrafts registered in India: Domestic Flights: -** Route Navigation Facility Charges (RNFC) in respect of aircrafts with maximum All Up Weights:
   a. Upto 10,000 Kgs. Shall be levied at 20% of the applicable rates of weight- Cum-distance formula; and
   b. More than 10,000 Kgs. to 20,000 Kgs. shall be levied @ 40 % of the applicable rates of weight - cum-distance formula.

Notes:

I. RNFC for Overflying mentioned above is applicable only to Delhi, Mumbai, Kolkata and Chennai FIRs.
II. Charges shall be calculated on the basis of nearest MT (i.e. 1000 Kgs.)
III. No RNFC charges on circuit flying and local flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.
IV. RNFC charges at 20%of the applicable rate for small aircraft with MTOW of <10000 kgs. is to be levied for cross country flying on aircrafts used for training purpose by the approved flying schools/flying training institutes.

3. Terminal Navigation Landing Charges (TNLC):

(a) International Airports Including Goa International Airport (Civil Enclave)- International Flights

Weight of Aircraft	For Each Landing / International flight (Amount in Rs.)
Below 10,000 Kgs	1,359.00

Weight of Aircraft	For Each Landing / International flight (Amount in Rs.)
10,000 Kgs and above	8,178.00

b) International Airports Including Goa International Airport (Civil Enclave)- Domestic Flights

Weight of Aircraft	For Each Landing / Domestic flight (Amount in Rs.)
Below 10,000 Kgs and above	1,176.00
10,000 Kgs & above	7,080.00

Notes:

I. TNLC mentioned above is applicable for Delhi, Mumbai, Chennai, Kolkata, Trivandrum, Bengaluru (BIAL), Hyderabad (Shamshabad – HIAL), Goa and Cochin Airports.
II. TNLC at 5 International airports, i.e Kolkata, Delhi, Mumbai, Chennai, Trivandrum to be reduced by 25% of the current rates for domestic flights.
III. For Small Domestic Aircrafts (MTOW upto 21000 Kgs.) TNLC shall be @ Rs 110/- per 1000 Kgs. (Since TNLC rate for Small Domestic aircraft is a concessional rate, there is no further concession/reduction for Small Domestic Aircrafts). However, for Small Domestic Aircrafts where concessional rate indicated above is more than the normal rate, normal rate for TNLC would be applicable.
IV. Changes shall be calculated on the basis of nearest MT (i.e 1000 Kgs)

c) Civil enclaves (other than Goa International Airport) –

(i) International Flights –

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 19.15 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 191.50 /-plus Rs. 28.88 per 1,000 kgs in excess of 10,000 kg
20,001 kgs to 50,000 kgs	Rs.480.30 plus Rs. 57.65 per 1,000 kgs in excess of 20,000 kg
50,001 kgs to 1,00,000 kgs	Rs. 2,209.80 plus Rs. 68.68 per 1,000 kgs in excess of 50,000 kg
Over 1,00,000 kgs	Rs. 5,643.80 plus Rs.77.01 per 1,000 kgs in excess of 1,00,000 kg

(ii) Domestic Flights –

Weight of Aircrafts	Amount (In Rs.)
Upto 10,000 kgs	Rs. 10.71 Per 1,000 kg
10,001 kgs to 20,000 kgs	Rs. 107.10 plus Rs. 16.66 per 1,000 kgs in excess of 10,000 kg
Over 20,000 kgs	Rs. 273.70 plus Rs. 33.31 per 1,000 kgs in excess of 20,000 kg

Notes:

I. Charges shall be calculated on the basis of the nearest MT (i.e 1000 Kgs)
II. No TNLC charges on aircrafts used for training purpose by the approved flying schools/ flying training institutes.

11. List of Tables

12. List of Figures

13. Abbreviations

Abbreviation	Expansion
AAI	Airports Authority of India
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance - Broadcast
AERA	Airports Economic Regulatory Authority of India
AFS	Aeronautical fixed service
AIM	Aeronautical information management
AIS	Aeronautical information services
AMS	Aeronautical mobile service
AMSS	Aeronautical Mobile Satellite Service
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
APSAP	Asia Pacific Seamless ATM Plan
APV	Approaches with Vertical Guidance
ARSR	Air Route Surveillance Radar
ASBU	Aviation System Block Upgrades
ASEAN	Association of Southeast Asian Nations
ASMGCS	Advanced Surface Movement Ground Control Systems
ASR	Airport Surveillance Radar
ATC	Air Traffic Controller
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATS	Air Traffic Services
BCAS	Bureau of Civil Aviation Security
CAGR	Compounded Annual Growth Rate
CARO	Civil Aviation Research Organization
C-ATFM	Central Air Traffic Flow Management
CEANS	Conference on the Economics of Airports and Air Navigation Services
CNS	Communications, Navigation and Surveillance
CNS-O&M	Communications, Navigation and Surveillance-Operations and Management
CNS-P	Communications, Navigation and Surveillance-Planning
CPDLC	Controller Pilot Data Link Communications
CPMS	Corporate Planning and Management Services
DATIS	Digital Automatic Terminal Information Services
DGCA	Director General of Civil Aviation
DME	Distance Measuring Equipment
DVOR	Doppler Very High Frequency Omni Range
ECIL	Electronics Corporation of India Limited
EGNOS	European Geostationary Navigation Overlay Service
EPABX	Electronic Private Automatic Branch Exchange
FAA	Federal Aviation Administration
FANS	Future Air Navigation System
FDI	Foreign Direct Investment
FIAN	Future India Air Navigation
FIR	Flight Information Region
FIU	Flight Inspection Unit
FTI	
GAGAN	GPS Aided Geo Augmented Navigation
GANP	Global Air Navigation Plan
GASeP	Global Air Security Plan
GASP	Global Air Safety Plan
GATMOC	Global Air Traffic Management Operation Concept
GBAS	Ground Based Augmentation System
GNSS	Global Navigation Satellite System
GoI	Government of India
GSAT	Geostationary Satellite

Abbreviation	Expansion
HP-DME	High Power Distance Measuring Equipment
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IISN	Indian Institution of Satellite Navigation
ILS	Instrument Landing System
ION	Institute of Navigation
IRNSS	Indian Regional Navigation Satellite System
LCC	Low-Cost Carriers
LP-DME	Low Power Distance Measuring Equipment
LPV	Localizer Performance with vertical guidance
MET	meteorological services for air navigation
MoCA	Ministry of Civil Aviation
MRO	Maintenance Repairs and Overhaul services
MSAS	MTSAT Satellite Augmentation System
MSSR	Monopulse Secondary Surveillance Radar
NAVIC	NAVigation with Indian Constellation
NCAP	National Civil Aviation Policy
NDB	Non-Directional Beacon
NDD	
NPA	Non-Precision Approach
NSOPs	Non-Scheduled Operator's Permit
OEMs	
PBN	Performance based navigation
PinS	Point in Space
PMU	Program Management Unit
PNT	Position, Navigation and Timing
PoC	Proof of Concept
PPP	Public Private Partnership
RAB	Regulatory Asset Base
RADAR	Radio Detection And Ranging
RCDU	Remote Control & Display Unit
RCS	Regional Connectivity Scheme
RGNAU	Rajiv Gandhi National Aviation University
RNFC	Route Navigation Facility Charge
RNP	Required Navigation Performance
RS	Restricted Service
SAARC	South Asian Association for Regional Cooperation
SAR	Search and Rescue
SBAS	Satellite Based Augmentation System
SELEX	
SID	Standard instrument departures
SMU	
SPS	Standard Positioning Services
STAR	Standard terminal arrivals
TNLC	Terminal Navigation and Landing Charge
UAH	Upper Airspace Harmonization
UDAN	Ude Desh ka Aam Nagrik
UPS	Uninterruptible Power Supply
UTM	Unmanned Traffic Management
VCCS	Voice Communication Control System
VFR	Visual Flight Rules
VHF	Very High Frequency
VOR	Very High Frequency Omni Directional Range
WAAS	Wide Area Augmentation System