CENTRAL-AIR TRAFFIC FLOW MANAGEMENT - CONCEPT OF OPERATIONS
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1. **EXECUTIVE SUMMARY**

Air traffic in India continues to grow rapidly and this trend is likely to continue to expand into the future. Increased traffic is expected at many of the existing airports. This increase in demand requires a corresponding effort to utilize system capacity efficiently. This will require Air Traffic Flow Management (ATFM) capabilities for effective Demand and Capacity Balancing (DCB). The ATFM tools will enable improved management of demand and capacity, and will help system stakeholders to deal with the increased complexity of the nation’s air routes.

Demand and capacity balancing will allow airspace users to optimize their participation in the ATM system while mitigating conflicting needs for airspace and aerodrome capacity through collaborative usage of decision-support tools thus ensuring most efficient use of airspace resources, equitable access for all airspace users, accommodate user preferences and ensuring that demand on an airspace resource will not exceed its capacity. Demand and capacity management aims to maximize the ATM system capacity whilst minimizing the effects of constraints. This will achieve system-wide traffic optimization through the application of demand and capacity balancing and traffic synchronization.

The system will endeavor to remove constraints wherever possible, and minimize the effect of constraints through management and modification of trajectories where removal is not possible. Where constraints are unavoidable, the earliest possible notice will be given to those affected. The intent is that any modifications will be the minimum required to avert any conflict, meet runway capacity requirements.

This strategy envisages a transition in traffic management away from today’s emphasis on tactically adjusting demand to fixed capacity. It envisages a more strategic and collaborative approach to managing system-wide resources and capacities to match capacity with, rather than constrain, demand. The nature of tactical flow management will be more dynamic and adaptive to operate to finer capacity and time limits and cope with real-time events. Terminal Flow Control measures will be implemented at busy terminal approach areas and airports which are capacity constrained. The demand will be balanced with the capacity through strategic slot management process and dynamic flow control measures.

A Central ATFM system will be established to dynamically assess the airspace situation and capacity optimization taking into consideration various constraints such as airspace/airport situation, weather conditions, traffic congestion, that affect the smooth flow of traffic throughout the Indian FIRs. Demand and Capacity Assessment Processes and tools to identify, collect, analyze, validate and distribute demand and capacity data to produce an accurate picture of the capacity, constraints and demand patterns through all phases of flight will be developed.

Mitigating measures and alternate actions to avoid congestion and delay both in the terminal and enroute airspace and airports will be achieved through Collaborative Decision Making (CDM) processes involving all stakeholders.

This document outlines a high-level concept of operations for ATFM system in India. It will describe the ATFM system architecture, the roles and responsibilities of the ATFM personnel, the role and responsibilities of CCC and TMUs, the CDM process, the Flight Planning requirements for ATFM
operations and the ATFM system implementation processes including some probable operational scenarios that describe how ATFM operations would be conducted.

The document is intended as an initial planning tool. The concept of operation is expected to evolve as inputs and recommendations from all interested and relevant parties are received and considered. The detailed operating procedures, business rules and ATFM regulations will be developed in due course of ATFM Phase I implementation.
2. **INTRODUCTION**

Optimization of network operations is essentially about the increasingly fine balancing of variable capacity and variable demand to ensure that each available capacity opportunity (airspace or runway slot) in the system is consistently presented for use, and that the users are given an opportunity to consistently access that presented capacity – not just at a single node or location, but across their integrated operations.

In circumstances where capacity consistently exceeds demand, there is generally no significant need to introduce flow or capacity management initiatives – slots are always available, and are used as required. Where there is competition for a particular slot, basic ATC interventions (vectoring, speed control, etc) manage the conflict.

In the past, where flow management initiatives were introduced, their primary application was either in the protection of the ATC system against overload, or to manage environmental or other expectations at a particular node. Rarely were such initiatives implemented for the benefit of the broader stakeholder community. Now, where demand does start to regularly exceed capacity, whilst some focus is placed on developing new capacity, given the long lead times for major infrastructure improvements (new runways, taxiway upgrades, new parking gates etc.) most emphasis is on better utilization of currently available capacity – or in many cases, simply transferring the capacity shortfall to the user through ground delay programs, demand limiting, and so on.

This is exacerbated by the traditionally tactical and reactive nature of the system – from an ANSP perspective aircraft are managed as they present on a ‘first come first served’ basis, and from a user perspective aircraft are presented to the system when they are ready, generally regardless of scheduled times. It is further exacerbated by the open nature of the system – that is, the inability to consistently control significant variables such as weather, system outages, landside disruptions, etc - and the relative lack of fidelity in strategic forecasting and tactical interpretation of available capacity. To a large extent, given the relative situational awareness monopoly, network management is currently a unilateral decision making process, managed by the ANSP.

Effectively managing the expected increase in traffic demand within a limited capacity environment, whilst promoting an environment within which airspace users can continue to grow their businesses, requires a change in network management paradigm that integrates a much larger volume of situational awareness information, and establishes an increasingly fine granularity of decision making and business rules. This cannot be done unilaterally – it requires distribution of responsibilities, flexibility in system responsiveness, and integration of management.

The key to further improving demand/capacity management is in utilising all available information from affected stakeholders to support a collaborative environment where all stakeholders participate in determining the best actions to balance demand against available capacity. This is best achieved through the implementation and use of collaborative decision making capabilities.

Such a system termed as Air Traffic Flow Management (ATFM) is strongly advocated by ICAO in its The Global Air Navigation Plan developed by ICAO (Doc 9750, Third Edition – 2007) which is a strategic
document to guide States for implementation of the global plan with horizon up to and beyond 2025. The document lists out several “Global Plan Initiatives” (GPIs) to be taken by the States to ensure that a safe, secure, efficient and environmentally sustainable air navigation system is available at global, regional and national levels.

Global Plan Initiative (GPI–6) describes the scope of Air Traffic Flow Management as the implementation of strategic, tactical and pre-tactical measures aimed at organizing and handling traffic flows in such a way that the totality of the traffic handled at any given time or in any given airspace or aerodrome is compatible with the capacity of the ATM system.

The ICAO Global ATM Operational Concept (GATMOC) provides following vision for future demand and capacity balancing, which envisages:

“…Demand and Capacity Balancing will strategically evaluate system-wide traffic flows and aerodrome capacities to allow airspace users to determine when, where and how they operate, while mitigating conflicting needs for airspace and aerodrome capacity. This collaborative process will allow for the efficient management of the air traffic flow through the use of information on system-wide air traffic flows, weather and assets. Key conceptual changes include:

a. through collaborative decision making at the strategic stage, assets will be optimized in order to maximize throughput, thus providing a basis for predictable allocation and scheduling;
b. through collaborative decision making at the pre-tactical stage, when possible, adjustments will be made to assets, resource allocations, projected trajectories, airspace organization, and allocation of entry/exit times for aerodromes and airspace volumes to mitigate any imbalance; and
c. at the tactical stage, actions will include dynamic adjustments to the organization of airspace to balance capacity, dynamic changes to the entry/exit times for aerodromes and airspace volumes, and adjustments to the schedule by the users....”

Further to quote Ajay Prasad Committee (constituted for formulating next generation futuristic Air Navigation Services Master Plan for AAI) as in provision 12.64 “as International Standards of ICAO stipulated in Annex 11 which deals with Air Traffic Services and ICAO Doc 4444, make it obligatory for India to have Air Traffic Flow Management System, AAI needs to implement AFTM system expeditiously preferably in the Near-Term-Immediate Plan”

Whilst ANS and airport infrastructure initiatives will continue to be undertaken to increase capacity, it will become increasingly necessary to develop capabilities to both balance available capacity against demand, ensuring that the user community has equitable and consistent access to all potentially available capacity in the system - and to fully utilize new capacity as and when created.

Airports Authority of India, considering all the aspects of Air Traffic Management service optimization and for meeting and exceeding the user and community expectations for flight efficiency, predictability, flexibility and environmental effectiveness, conceptualized a Central Air Traffic Flow Management (C-ATFM) system as an integrated network management of ATM resources in a collaborative manner.

This operational concept of C-ATFM outlines a range of changes in network management that will evolve through the next few years. Key to the concept is the principle of resource utilization with a network
optimization view, management and interchange of relevant information, thus enabling a significant change in the roles of all participants and stakeholders’ within the ATM system. This philosophy is based on evolution of a holistic Collaborative Decision Making environment, where the diverging expectations and interests of all members of the ATM community are balanced cooperatively to achieve an optimum network outcome for all stakeholders.

The concept of operation discussed in this document lays a broad outlay of procedures, roles and responsibilities for the various components of the C-ATFM system. It also describes an initial set of operational procedures which will be developed further during the course of implementation.
3. **OVERVIEW OF C-ATFM SYSTEM**

3.1. **Need for ATFM system in India**

According to AAI estimates international aircraft movements will increase 7% per year for 2014 – 2023. Domestic aircraft movements will increase by 8% per year over these same time periods. International passenger volume will grow by 9% per year during these time frames. Domestic passenger volume will grow at an 8% annual rate for 2014 – 2018, and grow at an annual rate of 10% for 2019 – 2023. India must satisfy this increased demand while operating under difficult weather constraints (e.g., extensive and long-lived fog, turbulence and convective weather associated with monsoons and the occasional typhoon).

Today, the primary method for long-term balancing demand with system capacity is to restrict demand by allocating a fixed number of arrival/departure slots to scheduled aircraft operating into and out of India’s major, congested airports. Slot allocations are made on a bi-annual basis, with the numbers adjusted for seasonal weather and traffic conditions. The slots equitably distribute the restricted airport and airspace capacity to aircraft operators. Short-term (e.g., during a flight day) balancing is accomplished by air traffic control (ATC) imposing delays on aircraft and airlines’ decisions to divert to alternate airports during periods of weather-restricted capacity.

Weather information and airport capacity information is made available to ATC and flights via India’s Aeronautical Information System (AIS). Each party makes independent decisions about how to restrict and manage flights during problem periods. This often results in less than optimal utilization of available airspace, airports, and aircraft resources.

3.2. **Overview of ATFM Implementation**

Keeping in view the current and future growth of traffic and to ensure safe and efficient flow of traffic through various airports and airspace, Airports Authority of India is implementing Central Air Traffic Flow Management system integrating various stakeholders as part of the system to program various operational constraints strategically and tactically in such a way that the demand and capacity are optimally balanced through Collaborative Decision making process.

The solutions must dynamically balance capacity and demand, while providing a CDM capability to allow airlines to most effectively utilize available capacity for the maximum benefit of their business, operations and passengers.

The proposed C-ATFM System will balance demand and capacity in Indian airspace and airports for most efficient operations that will include both international and domestic traffic.

3.3. **Deployment Approach**

The CATFM System requires a combination of hardware and commercial-off-the-shelf (COTS) software. The product capabilities will be phase dependent with each phase providing additional ATFM functionality.

A key part of the future ATFM concept is Collaborative Decision Making (CDM) which helps ATC achieve its goal of managing the ATC system and the operators achieve their goal of managing their schedules. The result of CDM is a shared situational awareness and collaborative resolutions for “win-win” solutions for
both ATC and stakeholders. Collaboration leads to enhanced options, resulting in improved decision making, stakeholder acceptance and support, and increase service performance.

C-ATFM project will be undertaken in three phases.

- **Phase 1: C-ATFM for six metro airports**
  - The C-ATFM system will consist of a Central Command and Control Center (CCC) which will be provided with strategic and tactical ATM information from across the country. The CCC will be aided by Traffic Management Units (TMU) located at all the major ACC and APP units which will function as local ATFM units coordinating with CCC for effective ATFM implementation.
  - The CCC will be located at Delhi and in the first phase TMUs will be established at the six major metro stations, i.e., Delhi, Mumbai, Chennai, Kolkata, Bangalore and Hyderabad. These six TMUs will be provided with strategic and pre-tactical demand predictions to determine periods of excess demand compared to the available capacity.
  - The C-ATFM Phase 1 baseline system would be in place by end of 2015. This would provide AAI and Aircraft Operator users with significant capabilities to perform strategic, pre-tactical, and tactical ATFM and CDM associated with sectors demand of Indian airspace and arrivals into the six airports.
  - With access to aircraft operator schedule data and operational flight data from AAI’s ATC automation system, strategic and pre-tactical demand predictions are provided by the C-ATFM system to determine periods of excess demand compared to the available capacity.
  - C-ATFM will provide capabilities to model and implement Traffic Management Initiatives (TMIs) to smooth the demand to the available capacity via Ground Delay Programs. TMIs are shared with aircraft operators as an integral part of the CDM process. For periods of significant, unexpected capacity reductions, Ground Stop TMIs will also be modelled and implemented.
  - Once a TMI is implemented, CATFM will provide updated demand predictions to monitor TMI performance. Updated predictions are driven by tactical flight data updates from the automation systems as well as flight specific updates provided by aircraft operators.
  - Aircraft Operators are provided capabilities to perform schedule management adjustments (e.g., slot substitutions) to optimize their operations consistent with the available capacity determined by AAI and the constraints of the TMI.
  - A web portal access shall be made available to the stakeholders and also neighboring States to have an increased situational awareness of the current ATFM status in India. Web is an important part of the enhanced ATFM system, as it allows Airline/aerodrome operators and ATS Units, access to information about TMIs. AOs will be able to view flight details and manage their own ATC slots during a TMI. ATS Units, Airline and aerodrome operators will be able to view all flights arriving and departing from their aerodrome.
  - C-ATFM system will also provide real-time and post operational reports to help AAI and their stakeholders evaluate system performance and lessons learned.
  - In addition to the operational capabilities, C-ATFM provides System Administration and Adaptation Management functions to monitor and control the operational system and support the preparation and validation of system reference data.
• Phase 2: Nationwide implementation at all airports and Indian continental airspace.
  o In phase 2 of the project a nationwide ATFM system covering all airports to support ATFM and CDM for airspace programs and arrivals into airports throughout India will be implemented. This phase will be operational by 2016.
  o A total of 36 TMU (both APP and TWR) will be functional.
  o The TMUs will be networked with ACC TMU and CCC.
  o In addition other TWR TMUs will be able to interact with CCC through secured WEB Access.
  o The CDM partners will access CCC through secured CDM portal with different levels of privilege.
  o The general public will be able to access ATFM information on the CCC web portal.
  o The WEB portal will display actual traffic situation in Indian skies.
  o The other functionalities include enhanced DCB measures, enhanced CDM functionalities and statistical reports. The evolution of the system will complement the basic ATFM system from Stage 1.

• Phase 3:
  - The Indian C-ATFM system will need to be a part of sub-regional and regional ATFM system for optimum and seamless ATM across APAC region. The Indian C-ATFM system will have capabilities to expand as a sub-regional/regional ATFM system.
  - The third phase of C-ATFM development will involve developing functionalities which will enable Indian C-ATFM system for exchanging ATFM information with adjacent ATFM systems and participate in a regional ATFM process.
  - The system will have scope for interfaces for seamless data exchange with other ATFM systems in the sub-region and region, thus supporting evolution of an international ATFM system.
  - The specific functionality will be developed in collaboration with the States/ANSPs coming together for international ATFM integration.

3.4. Salient Features of Indian ATFM
  - The Indian ATFM application is consistent with the ICAO Regional Air Navigation Plan.
  - It will provide additional planning and management capabilities needed to handle traffic growth in India with efficiency and effectiveness.
  - System will facilitates collaborative flow and capacity management during all phases of ATFM operations, viz., Strategic, Pre tactical, Tactical and Post Analysis phases.
  - Integrated CDM with all relevant stakeholders for common situational awareness will be the key stone of C-ATFM
  - Three layer approach: CCC, ACC TMU and TWR/APP TMU.
  - Use of automated tools like TMI, GS, GDP etc.
  - Distributed and shared responsibilities at local levels. Overall operational control with CCC
  - Post analysis capabilities to provide valuable data mining capabilities for improving efficiency and safety
  - Phase wise implementation strategy in tune with national strategic plan objectives in order to ensure maximum utilization of available capacity and permit all stakeholders to obtain sufficient experience.
Evolution of the ATFM system aimed with achieving synergy with implementation of allied/complementary systems of various stakeholders

- Envisaged as a vital regional tool for seamless ATM in the region
- Has inbuilt flexibility for catering to changing environment for regional harmonization

3.5. **Dependencies (Factors) considered:**

- Air traffic flow management and capacity related delays account for just 8% of all flight delays in India, compared to around 17% in China, 28% in the US and 22% in Europe. However with air traffic in India growing at double digit rate, demand is expected to exceed capacity in the near term and medium term time horizons.
- Airport infrastructure improvement programs may not keep pace with demand to address capacity issues adequately in the near term.
- The additional and new airport infrastructure to address deficient capacities is expected to be available in the medium to long term time horizon.
- India has developed a Future Air Navigation Plan called FIANS, aligned with the Asia Pacific regional Air Navigation Plan. The FIANS has been suitably modified to reflect the ICAO approach of ASBU focusing on Airports, Airspace and Traffic Flow improvement modules.
- Airspace capacity improvement programs are proceeding as planned in the Air Navigation Plan. These include FUA, Upper Airspace Harmonization, Rationalization of route structures, RNAV/RNP routes, SIDs and STARs, Reduced Horizontal separation etc.
- Mature and proven CNS technologies like ADS-B, Data Link, Mode-S, VDL-2 are being adapted to increase safety and efficiency of the national Airspace.
- The domestic air traffic will continue to be dominated by traffic flows between major metros. The international traffic to and from Indian airports is expected to increase significantly.
- The major airports and TMAs associated will continue to experience periods of excess demand over capacity. Sector overloads and excessive airborne delays will continue.
- The developments of regional airports will significantly alter the distribution of peak traffic loads.
- Existing Airport Traffic Flow control Measures
  - Include Strategic allotment of Airport Slots with an objective to ensure a balance between the demand of regular flights and airport capacity. The application of slots ensures the hourly distribution of flights in all airports along with capacity for non-scheduled operators.
  - As part of Tactical Flow control mechanism at major airports, a slot adherence monitoring and reallocation of slots mechanism is also in place to ensure dynamic DCB. OTP data is collected as part of monitoring mechanism to improve flow control measures.
- The ATFM system will enhance Airport ATFM capabilities and will introduce Airspace ATFM measures, thus, playing a major role in reducing the demand and capacity gaps.

3.6. **ATFM and International seamless ATM:**

- Major sub regional traffic flows across Indian FIRs (Mid-east Asia to SE India, Mid-east Asia to East/SE Asia, Central Europe to SE Asia etc.) are part of identified MTF in Asia-Pacific Region. The international air traffic to and from India is mainly distributed along these MTF.
The Airspace Capacity improvement programs as mentioned above being undertaken in Indian FIRs will greatly enhance airspace efficiency and capacity on these MTF.

The challenge is harmonize the ATM developments across cross-boundary FIRs to achieve seamless ATM operations. The Asia Pacific seamless ATM Plan (APSAPG) provides guidance to States in this regard. AAI has updated ANS Strategic Plan to reflect the significant considerations of the APSAP. Regional ATFM mechanism is one of the most critical focus area of the APSAP.

The introduction of ATFM in India will ensure most efficient utilization of available airspace at a vital junction between mid-East Asia and SE Asia.

The benefits of a seamless and harmonized ATM system in Indian airspace with the development of compatible systems across FIRs will contribute to efficient, safe and optimal flow of air traffic in this corridor.
4. **C-ATFM SYSTEM ORGANIZATIONAL STRUCTURE**

4.1. **Organizational Structure of ATFM**

- The C-ATFM structure consists of a Central Command and Control Center (CCC) networked with Traffic Management Units (TMU) at major ACCs, APP units, Aerodrome Towers (TWR). The CCC is also accessible via WEB through secured access from selected Towers not directly connected to ATFM network.
- The C-ATFM is envisaged to function in a collaborative manner. Access to the ATFM system for selected CDM Partners is granted through secured CDM portal.
- The CCC will be located at Delhi along with a backup and training facility.

4.2. **Organizational Structure**

ATFM will be managed through the use of flow management units at each of the different AAI operational levels.

The ATFM organizational structure breaks into three layers. The first layer is the AAI Central Command and Control Center (CCC). The second layer includes all the twelve Area Control Center (ACC) Traffic Management Units (TMUs). The third layer includes selected Approach Control facilities with Approach Traffic Management Units (APP TMUs) and selected Airport Traffic Control Tower (TWR) facilities with Airport ATC Tower Traffic Flow Management Units (TWR TMUs).

4.3. **Roles and Responsibilities**

The different ATFM units will be responsible for collectively identifying and resolving demand/capacity imbalances for airports and all airspace under AAI control. However, in carrying out
this shared responsibility, traffic management units at the individual facilities will have operational responsibilities consistent with their associated geographic areas. Overall responsibility for the coordination and execution of Traffic Management Initiatives (TMIs) will reside with the CCC’s traffic flow management positions. The decisions made at local levels impact flows across the network and therefore they must be taken in collaboration with stakeholders.

4.4. Central Command and Control Center

4.4.1. General Responsibilities

The CCC has the primary ATFM responsibility for India. The CCC should be established and adjusted to meet the demand of ATFM of India in both current operation, mid-term (3 to 5 years out) and future (5 to 20 years out) development.

Specifically, the CCC is:
- Responsible for balancing capacity/demand at all airports within airspace for which AAI has control authority. This is achieved by analyzing capacity/demand imbalances using available manual and automation tools and defined processes and procedures.
- The final authority in resolving any conflicts concerning civil airspace capacity/demand.
- Responsible to ensure that a “system approach” to ATFM is utilized when consideration is being given to the implementation of Traffic Management Initiatives (TMIs).
- TMIs that cross ACC boundaries are the responsibility of the CCC. Authority for TMIs and operations that do not cross ACC boundaries may be delegated, through policy or procedures, to the appropriate ACC.

4.4.2. The ATFM Functions of CCC are

- **Flight Plan Management:** Manage flows in strategic and pre-tactical phases, arrange and maintain scheduled flight table, handle international and inter-regional initial flight plan applications, manage various flight plans and their alterations, develop TMIs during large (special) events, organize ATFM fixed schemes, assess static sector capacity and static airport arrival rates/airport departure rates (AAR/ADR), participate in the allocation and adjustment of airspace structures.

- **Tactical ATFM:** Manage flow in tactical phase, organize AAI ATFM facilities, units and positions to identify air traffic flow problems in tactical phase, organize and collaborate with relevant ATFM facilities and personnel to develop and revise ATFM initiatives, organize to initiate and terminate the nationwide implementation of tactical ATFM measure, supervise AAI ATC facilities during their implementation of ATFM initiatives and collect feedback, collect operational logs and analyze post information, participate in developing large (special) event TMIs, and participate in the management of ATFM fixed scheme.

- **Operation Evaluation:** Take charge of statistics, post analysis and summarization of ATFM logs and operational data, inspect and evaluate the operational safety and efficiency of air traffic operation facilities, and solve problems on site.

- **Equipment Operations Monitoring:** Collect basic and operational information of AAI communication, navigation and surveillance, and ATC automation system, and participate in the evaluation of the operational capacity of airspace and airport.
• **Operation Floor:** The positions on the operation floor are mainly kept watch by the managers from the tactical ATFM office. Representatives from flight plan management, operation evaluation, and equipment operation monitoring will join to keep watch in certain positions in the operation floor and fulfill due responsibilities.

4.5. **Area Control Center Traffic Management Unit (ACC TMU)**

4.5.1. **General Responsibilities:**
- ACC TMU, as a second level of the AAI ATFM organization, is responsible for helping the CCC to organize relevant ACC, terminal, airport ATC towers, and other ATC facilities within its geographical area to conduct ATFM.
- The ACC TMU duties include communication, collaboration, and coordination of ATFM issues with surrounding and internal air traffic facilities.

4.5.2. **Main Responsibilities:**
- Identify and assess sector capacity decline due to weather, military activity, aircraft operations, ATC facilities operations, ATC equipment status, airport capacity, etc.;
- Study capacity changes of relevant sectors and airports within area of responsibility and convey the same to CCC.
- Collaborate with CCC to adjust the threshold of arrival/departure rates of sectors and airports;
- Participate in CCC organized planning conference calls for nationwide ATFM;
- Make executive plans of ATFM initiatives in its area and inform relevant ATC positions;
- Feedback implementation status of ATFM initiatives and operation plans to CCC;
- Suggest adjustment or termination of implementation;
- Log local operations, and help CCCs complete post analysis tasks, such as collecting air traffic operational data.

4.6. **Terminal (Approach) Traffic Management Unit (APP TMU)**

4.6.1. **General Responsibility:** APP TMUs will be established in high density Terminal (Approach) areas where ongoing capacity and demand issues require regular ATFM initiatives and ATFM terminal will be set up in other approach control units, as needed. The Traffic Flow Manager of the ACC TMU facility will take charge of ATFM in Terminal (Approach) control facilities without APP TMUs. The Tower TFM or local controller in airport ATC tower will fulfill the relevant responsibilities in airports without APP TMU facilities.

4.6.2. **Main Responsibilities:**
- Manage air traffic demand and constraint within their area of responsibility;
- Find out AAR/ADR and monitor changes due to weather, military information, aircraft operation, ATC operation, ATC equipment, airport operation and other reasons;
- Coordinate with airport tower and ACC TMU to properly adjust capacity threshold;
- Participate in nationwide ATFM decision making organized by the CCC on its own initiative or invited by ATMU;
- Participate in decision making organized by ACC TMU for ACC ATFM initiatives complying with flight plan and airport operation;

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inform the relevant ATC position of ATFM initiatives;
feedback implementation status of the facility and suggestions to ACC TMU;
Log local operations, and collect and report air traffic operational data and other statistical data to ACC TMU.

4.7. Airport ATC Tower Traffic Flow Management Unit (TWR TMU)

4.7.1. General Responsibility: TWR TMU will be set up in some large airport ATC towers according to traffic amount and operation environment of the airport. At middle size towers, a traffic management position may be established and supported with an ATFM automation system terminal. There are full-time TFM s in these towers during busy time periods. The TFM or local controller will take ATFM charge during non-busy time periods. The controllers on duty take charge of ATFM in small airport towers. Towers without APP TMU facilities take the ATFM charge of ATFM in that terminal area.

4.7.2. Main Responsibilities:
- Assist in the management of air traffic demand and constraint issues at the tower;
- identify and assess AAR/ADR changes due to weather, military information, aircraft operation, ATC operation, ATC equipment, airport operation or other reasons;
- coordinate with APP TMU and/or ACC TMU to properly adjust threshold of AAR/ADR,
- participate in nationwide ATFM decision making organized by ACC on its own initiative or invited by ACC TMU;
- participate in decision making organized by ACC TMU for ACC ATFM initiatives complying with flight plan and airport operation;
- inform the relevant ATC position of ATFM initiatives;
- feedback implementation status of the facility and suggestions to ACC TMU;
- Log local operations, carry out post evaluation of daily ATFM, and report statistical data to ACC TMU.

4.8. Other Units Related to ATFM

In addition, there are some units that directly affect the efficiency of civil aviation ATFM. The ATFM facilities/units/positions of civil aviation should effectively collaborate with these units to achieve orderly ATFM and optimize resource allocation.

This section discusses the roles of the units in civil aviation ATFM.

4.8.1. Regulator (DGCA)
- Draft or develop national laws, regulations, rules, and standards of air traffic flow management;
- Help develop the standards of air traffic operation management;
- Help develop performance metrics for the ATFM network system;
- Supervise the implementation and compliance of relevant laws, regulations, rules, and standards by all ATFM Stakeholders and
- Further develop legislative requirements based on analysis of air traffic operations.
4.8.2. Airlines and Other Aviation Service Providers
Many airlines have Air Traffic Operations Coordination Positions inside their AOCs, to collaboratively coordinate air traffic issues with the ATS provider. As a contact point, these air traffic coordination positions should directly contact ATFM facilities as follows:

- Participate actively in the ATFM process as CDM Partners;
- They should master and respond to the ATFM information related to the company;
- They could file flight plans, provide latest updates on the active and planned flight plans; and
- Participate and comply with the ATFM tactical operation plan according to the advisory from air traffic flow management initiatives.

4.8.3. Airports
The Air Traffic Operations Coordination Position, or a similar function, of an airport is located inside the airport operations control center (AOCC). This position, or other positions designated by the airport operator, is a contact point for airport operation control units directly contacting ATM facilities.

- They should master and respond to the ATFM information related to the airport and
- Participate in decision making for air traffic operation related to the airport, according to the airport’s resource allocation.

4.8.4. Military
The C-ATFM concept envisages active Civil-Military coordination and cooperation in sharing of data, resources thus enabling an optimal use of national airspace system.

- The Military representative is an active participant in the CDM process of ATFM.
- They communicate with civil aviation and provide feedback on information required by civil aviation and advise civil aviation of relevant flights of military aviation, and their airspace use.

4.8.5. Neighboring Countries and Countries Having Close Aviation Contact with India
The C-ATFM system will be designed to be interoperable with ATFM systems of neighboring countries.

- The ATFM system will be flexible to have interactions with other ATFM system at different levels, like from exchanging ATFM tactical information to actively participating in the regional ATFM process.
- The CCC will be the focal point of contact between India and its neighboring countries, as well as countries and regions having close aviation contact with India.
- This C-ATFM system will develop procedures for communication and coordination on international flow problems and ATFM methods.
- In future, it can achieve international CDM and solve cross-border ATFM problems effectively.
5. C-ATFM SYSTEM PERSONNEL – SELECTION, RESPONSIBILITIES AND TRAINING

Introduction

The following diagram shows the broad hierarchy for the C-ATFM system Central Command Centre (CCC).

Organizational Structure of ATFM

I. Broad Administrative Structure

ED (ATFM)

GM (ATFM) OPERATIONAL

GM (ATFM) TECHNICAL

ADMINISTRATIVE SUPPORT

II. CCC Operational Structure

GM (ATFM) Operations

Administrative Staff

CCC - Operational Supervisor

GM (ATFM) Technical

Administrative Staff

Database Analysis and Metrics Report Manager

ATFM Database Manager and Sys. Admin.

CCC - Technical Supervisor
III. CCC Operational Floor – ATFM Operations

- CCC Operational Supervisor
  - ATFM Traffic Manager
    - ACC Monitoring
    - ATFMU Planner
  - ASM
  - CDM
  - FPL Data Management
    - Airlines/ GA
    - FPL Specialist
  - ATS Routes Facilitator
  - Airports

IV. CCC Operational Floor - Technical Support

- CCC Technical Supervisor
  - System Administrator
  - AIS Manager
    - System Software and hardware Maintenance
  - CNS Facilities Monitoring
  - Interface Monitoring
V. **CCC – Offline Positions**

The following operational roles are envisaged at the CCC and TMUs.

- **CCC (and TMU) ATFM Operations Supervisor:** The CCC (and TMU) ATFM Operational Supervisor acts as the top principal of ATFM operation management system to fully master and manage nationwide daily ATFM operations, direct daily operations of nationwide ATC facilities, coordinate air traffic operation problems, make final decisions on air traffic flow management initiative (ATFM initiatives), and have liability for the operability, effectiveness, and safety of decision makings. The ATFM Operational supervisor reports to the GM (ATFM).

  The Flow Manager is responsible for planning the use of airspace and the execution of tasks related to flow management, such as slot allocation and re-routing. The presentation of current and future air situation in the console display, as well as view filters, are at the Flow Manager’s disposal to assist in analysis and decision-making on specific issues.

- The CCC ATFM Operational Supervisor is assisted in ATFM operations by appropriately trained ATFM personnel in the following areas of specialization.
  - **Operations Planning:** Conduct complex analysis of system capacity and airspace users demand, full master status and movements of nationwide air traffics, focus on key problems in nationwide air traffic operations, periodically or timely have CDM in nationwide operations, study and develop national air traffic operation management plans and TMIs, and direct operations of all positions on the operation floor.
  - **Airspace User Coordination:** Handle flight plans occasionally added and adjusted within the operation day, communicate with airspace users on operation plan, receive their
comments, and resolve air traffic problems of airspace users in their operations. The Airspace Operator is responsible for editing airspace data in the database—points of notification, aids, airways, SIDs, STARs, corridors, airports—defining airport capacity, defining notification points and sectors, and setting FIRs boundaries and respective sectors. Besides editing features, Airspace Operator has at its disposal an environment for simulation and visualization of the Air Situation to assist in the optimization of aeronautical infrastructure.

- **Capacity Analysis:** Organize or participate in capacity analysis of nationwide air traffic operation management system, keep contact with relevant facilities and units, and analyze system capacity decline due to weather, military activities, airport operation, communication/navigation/surveillance equipment and other reasons.

- **ACC Monitoring:** Monitor air traffic operations within its responsible ACC, keep contact with local ATC facilities, supervise the execution of relevant ATFM initiatives and plans, receive feedback, and coordinate with relevant positions to study the solutions of conflicts in air traffic operations.

- **CDM Coordinator:** At the heart of C-ATFM concept is CDM with CDM partners. The CDM Coordination ensures effective and timely coordination mechanism with all CDM Partners (Airports, Airlines, and Military etc.) to arrive at most efficient decision to meet the DCB challenges. The CDM process also involves airspace coordination when necessary, under the FUA concept with Military.

- **Special Flight handling:** For handling VVIP flight plans and flight plans with other special requirements, advise relevant facilities and publish the information on schedule, monitor special flight operations, contact aircrew of these flights as necessary, and coordinate to resolve problems occurred in operations.

- **International Coordination:** Communicate with relevant domestic ATC facilities and foreign airspace users, coordinate international ATFM affairs, and collaborate to make decisions and focus on implementation of relevant domestic air traffic operation facilities when it is necessary to extend the management measure and operation plan abroad.

- **Weather Impact Analysis:** Analyze and master the trends of relevant weather systems, track, collect, organize, and evaluate nationwide weather conditions and forecasts, and inform relevant positions on the operation floor of this information; offer directive suggestions to weather analyzers in ATC facilities, airspace users operation units, and airport operation units; participate in operation CDM meetings (planning conference calls) or CDM when necessary.

- **Large (Special) Event Coordinator:** Supervise joint initiative implementations of air traffic operation facilities coming across large (special) events, communicate with and provide feedback to organizers, and coordinate solutions to various problems in civil aviation.

- The CCC has the following specific positions for providing appropriate and relevant information about demand and capacity.

- **Flight Plan Information Management:** Collect and handle all flight plan information from fax, AFTN (e.g., from Societe Internationale de Telecommunication Aeronautiques (SITA)), Aeronautical Telecommunication Network (ATN)), e-mail, etc., to build the
flight plan database for strategic, pre-tactical and tactical demand analysis. The Flight Plan Operator is responsible for maintaining the integrity of the flight plan workflow.

- **Aeronautical Information:** Collect, organize, and provide, in a timely fashion and to relevant positions, aeronautical information such as Notice to Airmen (NOTAM), manage and update all paper and electronic aeronautical information in the operation floor, collaboratively draft and publish the information of operation decision-makings in form of NOTAM when necessary. The Aeronautical Information Operator is ultimately responsible for the operational function of capacity management, assuming the following responsibilities:
  - Reception and processing of conventional aeronautical messages in text format - NOTAM, making this information available to other operators in the center. With the aid of decision support tools, the operator interprets the NOTAM texts capturing the corresponding effects on the capacities of the regulated elements;
  - Reception and processing of meteorological messages, such as, METAR, SPECI, TAF, GAMET, SIGMET, AIRMET and wind forecast (GRIB), the latter used in the route extraction process of a flight plan and the correction of estimates;
  - Acquisition and interpretation of meteorological images. With these data and with the aid of decision support tools, the Aeronautical Information Operator interprets the information received capturing the corresponding effects on the capacities of the regulated elements;
  - Monitoring and maintenance of operational status of the aeronautical and airport infrastructure, capturing the corresponding effects on the capacities of the regulated elements;
  - Establish operational priorities for maintenance and restoration of the technical equipment, following up the corrective actions.

- **Communication, Navigation, and Surveillance (CNS)/ATM Equipment Monitoring:** Communicate with equipment monitoring systems on equipment operations, master equipment status such as periodic shutdown and repair, help the Capacity Position (CP) analyze the influence on system capacity due to abnormal equipment operation, etc

- The CCC is also equipped for conducting post operations analysis and data mining. The functions of the unit are: Collect and analyze various operational data, gather nationwide system operation logs, evaluate the safety, effectiveness, and operability of ATFM initiatives and plans already in the execution state or finishing execution, edit and release various statistical report forms and operation information.

- **System Maintenance:** Maintain various equipment on the operation floor, ensure operation of equipment, and offer consultation services to operation and maintenance personnel in other units.
  - **System Software Maintenance:** Monitor software operations of air traffic operation management systems, ensure safety and orderliness of various networks and databases, and offer consultation services to operation and maintenance staff in other units.
  - The System Administrator is responsible for:
    - Supervision of technical equipment, communication links and working positions;
    - Maintenance of operational configuration data (VSPs);
• Update system date and time;
• Management of flight plan storage;
• Implementation of routine data backup;
• Registration of subscribers/users of ATFM system with their privileges and restrictions

• The CCC also makes provisions for having CDM partners and Stakeholders at the CCC. Some of the Positions are:
  o Airlines Observer: Act as representative of air transport enterprises to supervise the publicity, fairness and justness of air traffic operation management, communicate with airlines to reflect the various demands, coordinate operation conflicts, and participate in emergent handling and decision making for significant air traffic operation problems when invited.
  o General Aviation Observer: Act as representative of general aviation enterprises to supervise the publicity, fairness and justness of air traffic operation management, communicate with airlines to reflect the various demands, coordinate operation conflicts, and participate in emergency handling and decision making for significant air traffic operation problems when invited.
  o Airport Observer: Act as representative of airport enterprises to supervise the publicity, fairness and justness of air traffic operation management, communicate with airports to reflect the various demands, coordinate operation conflicts, and participate in emergency handling and decision making for significant air traffic operation problems when invited.
  o Military Coordinator: Act as representative of the Indian military to monitor civil air traffic operations for the military, advise civil aviation of military activity plans and actual activities that affects civil air traffic operations; help relevant civil ATC facilities continuously evaluate the scope and duration of military activity influence on civil use of airspace capacity; try to reduce undesirable influence of military activities on safety and efficiency of civil air traffic operation; and exchange information with a Special Flight Position (SFP) on special flight plan and movements

Job Descriptions
The following outlines the job descriptions for the required CATFM System.

Executive Director (ATFM)

➢ Overall in charge of ATFM for India
➢ Ensuring adequate budgeting and financial tracking of department
➢ Ensuring the CCC is adequately staffed
➢ Ensuring that the entire aviation community is educated and committed to the ATFM process
➢ Ensuring AAI is kept abreast of developments in ATFM globally
➢ Completing all reports as required by AAI and Directorate General Civil Aviation (DGCA)
➢ Ensuring that procedures for ATFM in India are current and are best practice.
Ensure that ATFM is carried out efficiently in Indian National Airspace.

**General Manager Operational Head**

- Administrative in charge of ATFM for India
- Preparation of adequate budgeting and financial tracking of department
- Manpower management for CCC
- Participate in the Bi-Annual Slot Allocation Process of MOCA to ensure effective Strategic ATFM
- Conducting training program for the entire aviation community on ATFM process
- Keeping ED (ATFM) informed about the developments of nation-wide ATFM activities
- Compilation of all reports as required by AAI and Directorate General Civil Aviation (DGCA)
- Formulation of procedures for ATFM in India and ensure that all are updated
- Monitor & analyze the efficiency of ATFM process that is being adopted in Indian National Airspace.

**General Manager Technical Head**

- Responsible for overall maintenance, management and technical support of ATFM system
- Responsible for planning and ensuring installation of Software
- Ensuring staff are adequately trained and equipped to carry out maintenance and Level 1 technical support.

**CCC Supervisor [JGMs] and TFM at TMU**

- Ensuring ATFM is carried out Strategically, Pre-Tactically and Tactically in the region of responsibility
- Ensure all relevant adaptation data is installed in the ATFM system for the region
- Ensuring that all positions are staffed during published hours of operations.
- Ensure staff are adequately trained for positions
- Produce reports to carry out post event analysis so as to ensure ATFM was used efficiently
- Ensure that all Flow Management personnel in the ACC are trained and comply with ATFM procedures.
- Manage overall operations of ATM NMC
- Coordinate contingency operations on behalf of ATS units
- Ensure integration among ATFMU, AMC and IMU

**ATFM Operational Positions - Job Specifications**

a. **CCC and/TMU Traffic Flow Manager – Supervisor**
i. Position Requirements

- 15 Years ATC experience at multiple sectors
- Minimum 5 years in leadership position
- Appropriate leadership training
- Customer oriented with excellent problem solving abilities
- Excellent interpersonal skills.
- Excellent communications skills

ii. Functions – CDM, ASM, Flight Data

- Assimilate all information in preparation for a daily airspace plan
- Carry out daily teleconferences with relevant Stakeholders
- Assess demand versus capacity and model, publish and amend TMIs when required.
- Carry out CDM with stakeholders
- Produce reports for post event analysis.
- Negotiate pre-tactical Conditional Routes or airspace requests based on traffic demand prediction
- Plan and coordinate capacity adjustment for next day’s operation
- Plan and coordinate ATFM Daily Plan for the next day’s operation
- Manage proper execution of ATFM Measures on day of operation based on ATFM Daily Plan

b. Traffic Flow Manager Specialists

i. Position Requirements

- 10 Years ATC experience at multiple sectors
- Customer oriented with excellent analysis and problem solving abilities
- Excellent inter-personal skills.
- Excellent communications skills
- Excellent Computer skills

ii. Functions - CDM, ASM, Flight Data

- Collection of data/weather information/NOTAM, etc.
- Preparing of Daily airspace plan
- Preparing of Post event reports
- Ensure proper integration of traffic demand inputs
- Ensure proper configuration of ATFM automation support systems
• Coordinate tactical capacity adjustment on ATM resources
• Monitor and execute ATFM Measure on day of operation as required based on ATFM Daily Plan
• Analyze traffic demand prediction to anticipate special Conditional Routes or airspace requests
• Coordinate Airspace Use Plan (AUP) and relevant updates with involved parties
c. **Air Traffic Flow Manager – Assistant**
  i. **Position Requirements**
  • 5 years’ experience as ATC Assistant/Aeronautical Information Service (AIS) Officer
  • Well-developed inter-personal skills
  • Good writing ability
d. **Maintenance and Technical Support Specialists**
  • Responsible for performing day to day technical maintenance of the ATFM system. This includes such activities as:
    ➢ Monitoring overall system performance
    ➢ Performing system health checks
    ➢ Applying software updates
  • Responsible for initial problem determination and resolution activities. This includes such activities as:
    ➢ Troubleshooting technical system issues
    ➢ Logging and maintaining status of reported issues
    ➢ Collecting data necessary for understanding and replicating issues encountered
e. **Technical and Database Specialists**
  ➢ Primary responsibility for database management support and troubleshooting
  ➢ Monitoring database alert logs and trace files
  ➢ Performing database installation and configuration
  ➢ Applying database patches and upgrades

**Skills Required**

**General Skills**

• 5 -15 Years ATC experience at multiple sectors/multiple airports (Experience criteria depending on the TMU or at CCC)
• Minimum 5 years in leadership/supervisory position
• Appropriate leadership training is preferable
• Customer oriented with excellent problem solving abilities
• Excellent inter personal skills.
• Excellent communications, writing skills
• Adequate computer skills
• Exposure to advanced CNS/ATM Concepts will be an added advantage

**CCC Supervisor / TMU Flow Manager**

The **CCC Supervisor / TMU Flow Manager** shall be required to meet the following criteria:
- Have extensive knowledge of the overall ATM operations in the area of responsibility of the ACC(s).
- Have an extensive understanding of the ATM operations in adjacent ACCs.
- Have a comprehensive knowledge of the ATFM organization and its systems.
- Have undergone appropriate ATFCM training.
- Have an extensive understanding of the factors influencing aircraft operations in so far as they may affect ATFCM.

**Traffic Flow Manager / Traffic Manager Specialist**

A Traffic Flow Manager shall be required to meet the requirements:
- Have extensive knowledge of the overall ATC/ATFCM operations in the area of responsibility of the ACC(s).
- Have extensive ATC experience, knowledge and understanding of ATC matters in the area of responsibility of the ACC(s).
- Have an extensive understanding of ATC/ATFCM operations in adjacent ACCs.
- Have an extensive knowledge of the C-ATFM operations.
- Have undergone appropriate ATFCM training.
- These requirements extend to any staff (e.g. ACC supervisors) who carry out the task of the FMP during less busy periods.

**Selection Process**

The ATFM personnel will be selected within AAI. The ATFM directorate in coordination with ATM directorate will make a shortlist of eligible officers. The officers will be given a short orientation introduction to the concept of ATFM. The final selection of ATFM personnel will be done after interview of the shortlisted officers.

**Training Requirements**

Development of the training strategy is a key aspect of system planning which should begin early in the program. In other words, even though much of the training activity will take place after the advanced system is procured, planning should begin in the near term. For example, the functional analysis will help determine what staff will be performing advanced ATFM functions, and what gaps exist between their skills and the skills needed for the ATFMS. Perhaps socialization is a better term for this phase in which the ATC
community becomes better informed of what TFM is and how it operates. This is also carried out with other aviation partners such as the airlines and the military.

Personnel performing ATFM functions will require standardized and recurrent training in order to maintain their competency level in a constantly changing environment. A detailed ATFM training plan will ensure that personnel attain an optimized operational efficiency in their respective FMU/TMU. This will allow them to successfully face the important changes in their operational environments and provide the highest possible level of service.

All stakeholders involved in the ATFM system must be given the training required to allow for an efficient ATFM service. ATS personnel, as well as AUs, must have the knowledge required to carry out their respective responsibilities. Personnel performing functions at the CCC or at the regional TMU will require standard and recurrent training in order to keep up-to-date in a fluid and constantly changing environment. A detailed ATFM training plan will allow the personnel to attain an optimized operational efficiency in their respective CCC/TMU. This will allow them to successfully face the important changes in their operational environments and provide the highest possible level of service to the customer.

In general, a training program which would prepare specialists for the transition to new ATFMS equipment, computer software, and procedures and which results in the continuous and progressive improvement in the skill level of specialists will be formulated and continuously imparted to selected officers.

Effective daily use and application of the various ATFMS functions will require training at locations where those functions are installed and normally accessed. To facilitate that training, the ATFMSs shall be able to operate using either archived or real-time data. Operation of the ATFMS with archived data (hereafter referred to as the training mode) will allow operational hardware and software at an ATFM position to be used for:

- Familiarization and proficiency training on the decision support functions at an ATFM position
- Training of new personnel or personnel assuming new roles
- Refresher training

When an ATFMS unit is operated in the training mode, functions receiving and processing previously stored/archived data shall operate in the same way when receiving and processing real-time data. However, when in the training mode, transfer of data to other systems shall be inhibited. Despite the inability to share data between workstations, the training mode will still support training on individual ATFMS functions and operational applications of those functions.

When a workstation is configured in the training mode, it shall allow an instructor to:

- Retrieve archived data (e.g., flight, airspace, weather, winds, airport.) needed to support a training exercise
- Configure the workstation by designating the airspace and flights to be used in the training session
- Disable the subject workstation from interacting with the operational/real-time system

When a workstation is configured in the training mode, it shall allow a student to:

- Access all of the functions associated with flight plan processing, situation awareness and problem identification, weather data processing, flow initiative planning, information management and infrastructure support
When in training mode a workstation can operate either one of the following two modes but not both at the same time:

- Operate on archived data as it was real time data and allow execution of all functions including creating and executing TMIs.
- Use real time data planning and set up TMIs but not actually executing them on the live system.

When in the training mode, a workstation shall provide the same level of performance provided when operating in the real-time/normal operating mode.
6. **C-ATFM SYSTEM – OPERATION- GENERAL GUIDELINES**

6.1. **OVERVIEW**

The CATFM System provides ANSPs and Aircraft Operators with a decision support capability to safely, efficiently, and predictably manage demand when it exceeds capacity at constrained resources (e.g., airports) within the ANSP area of responsibility.

The C-ATFM System provides the functions necessary for integrated strategic, pre-tactical and tactical flow management for balancing aggregate capacity with predicted air traffic demand. In addition, the C-ATFM System enables CDM so that all system stakeholders have a role in optimizing system efficiency and safety.

The CATFM System provides ANSP users the ability to proactively manage capacity reducing events through the ability to create and modify Traffic Management Initiatives (TMIs). The CATFM System provides a framework for exchanging data among users who share the need for a common view of air traffic flow operations. When conditions such as weather, controller staffing, equipment outage or spikes in air traffic demand affect a resource’s capacity, easy-to-understand visuals enable users to monitor the impact of those conditions.

The C-ATFM System permits users to identify a capacity/demand imbalance, model the impact of candidate TMIs, coordinate TMIs with CDM participants, and determine which candidates yield optimal solutions to address the capacity/demand imbalance. The C-ATFM System continually updates the known and predicted demand so that ANSP users can monitor the operational conditions and modify the TMI to adapt to the changing environment.

The C-ATFM System fully embraces and supports the goals and processes of CDM. The C-ATFM System enables an Aircraft Operator to exchange slots between their flights in real time, thus optimizing their use of the overall capacity created by the ANSP to achieve the Aircraft Operator’s business goals. CDM slot substitutions and Aircraft Operator flight data changes are realized through a Web-based interface, a more advanced component, and via a direct system-to-system interface between the Aircraft Operator and the C-ATFM System.

The CATFM System provides the following principal functions:

- Predict demand of ANSP-specified resources
- Monitor demand and capacity of ANSP-specified resources
- Evaluate alternatives to address capacity/demand imbalances
- Perform CDM with stakeholders
- Initiate, monitor, and modify TMIs (ATFM Measures) for constrained resources
- Report metrics and analyze performance

6.2. **OVERVIEW OF ATFM OPERATIONS**

Development of ATFM capability in India will be consistent with guidance issued by the International Civil Aviation Organization (ICAO) in the document entitled “Demand and Capacity Balancing”.

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DIRECTORATE OF AIR TRAFFIC FLOW MANAGEMENT
In the event that traffic demand regularly exceeds capacity or when it becomes apparent that forecast traffic demand will exceed the available capacity, the affected ATFM units, in consultation with aircraft operators, should consider implementing measures aimed at improving the use of the existing system capacity and should develop action plans to increase capacity so as to meet the forecast demand.

The ATFM service must take measures to ensure a balance exists between air traffic demand and the declared capacities and help ATC to use, to the maximum extent possible, its capacity. In order to accomplish this, the ATFM unit must monitor air traffic and, if applicable, issue management initiatives to keep a safe, orderly and efficient movement of air traffic.

The ATFM service within a region or other defined area should be developed and implemented as a centralized ATFM organization supported by traffic management positions which are established at each area control center within its area of applicability.

There is a clear distinction between the functions and participants in ATFM vs. ATC. ATC is primarily responsible for maintaining separation between aircraft and ensuring flight safety. ATFM is primarily responsible for enhancing system efficiencies and maintaining traffic flows at safe and manageable levels. Figure 2 illustrates these distinctions.

6.3. **SYSTEM ARCHITECTURE**

The high level architecture of India’s ATFM system will have the following supporting infrastructure which is critical to the success of C-ATFM

- Seamless aircraft surveillance through all phases of flight that can provide a digitized national aircraft position mosaic;
- Voice and data communication between all participants in the ATFM system;
• A national weather picture that includes integrated weather sensor data and accurate forecasts; and,

• Automated decision support and display tools to aid all ATFM and collaborative decision making (CDM) participants to maintain situational awareness and assess potential impacts of Traffic Management Initiatives (TMIs) under consideration at any time.

The high level architecture of C-ATFM system is shown below.

Architecture Type
India’s ATFMS shall be designed as an open architecture system of systems. The intent is to provide as flexible a system as possible to allow the system to grow and evolve as the operations, technology, and environment evolves in India. Therefore, the open architecture and the system of systems approach will allow the integration of future ATFM capabilities into this system’s architecture.

Components of the ATFM Concept of Operation
There are three primary components to the Indian ATFM Concept of Operation that will increase its effectiveness and acceptance by the user community.

• Developing effective CDM mechanisms

• Establishment of C-ATFM function for balancing demand and capacity

• An efficient ATM System for providing capacity at airports and in airspace

Effective Use of Collaborative Decision Making (CDM)
The effectiveness of CDM is greatly improved by all units and stakeholders sharing the same situational awareness and using common flow planning tools to arrive at optimal Traffic Management Initiatives (TMIs). TMIs are actions taken to balance current or anticipated demand with available capacity. Examples
include imposing a minimum Miles-in-Trail (MIT) between aircraft in an en route flow or stopping departures of all aircraft destined for a particular city (a Ground Stop, or GS). TMIs work best when all participants work together to create technological and procedural solutions to traffic flow problems, and respond collaboratively to real-time operational constraints.

CDM provides a unified approach to improve the ATM system and services through increased information exchange and a common situational awareness among stakeholders resulting in enhanced options, improved decision making, and stakeholder acceptance and support.

Establishment of an Air Traffic Flow Management Function

The ATFM function includes staff at every appropriate level of the ATC system: Airport, Approach, Area Control, and a newly established ATFM Central Command Center. These staff plus representatives from military organizations, Airline Operations Centers (AOCs), and airports are responsible for facilitating and implementing TMIs.

The ATFM function utilizes advanced tools for strategic planning, as well as pre-tactical and tactical management of traffic flows within the available capacity of the ATM system. The system provides AAI with comprehensive ATFM capabilities to model, implement, and analyze all traffic management initiatives for both airport and airspace volumes in India. TMIs are used to dynamically balance air traffic demand with capacity to keep traffic flowing as smoothly and efficiently as possible.

As a minimum, implementing ATFM will require seamless voice and data communications between all participants in the system:

- Ground to ground voice and data communications between AAI and the numerous stakeholders (e.g., AOCs, military, airports) in order to implement ATFM CDM;
- Seamless surveillance that provides a digitized national aircraft position mosaic for use by all participants in the ATFM process; and
- Automation and display tools to aid all ATFM and CDM participants to maintain situational awareness and assess potential impacts of TMIs under consideration at any time.
- A national weather picture that includes integrated weather sensor data and FORECASTS

6.4. PHASES OF OPERATION

At the top level, ATFM is an iterative process that can be divided into four phases to gain a better focus on its particular tools. This iterative process will increase the effectiveness and efficiency of air traffic operations. Each phase is differentiated by factors including time, scale, focus, and goals. Regardless of the phase, it is important to note that adjustments in one phase or area may potentially impact other phases in the ATFM system.

Strategic Management:

The strategic management phase occurs prior to events up to one week before the execution date. Its management focus is mainly on scheduled flight plans. The goals are to pre-arrange scheduled flight plans,
based on the system’s general capacity, to avoid planned flow demands exceeding capacity, develop ATFM schemes for large airspace use events, and offer suggestions on improving long-term development of ATC methods and airspace design.

The ATFM strategic phase seeks a greater dialog between ATFM partners and capacity “providers” in order to analyze airspace, airport and ATC restrictions, seasonal weather changes and significant meteorological phenomena. It also seeks to identify, as soon as possible, any possible discrepancies between demand and capacity in order to jointly define possible solutions with the least impact on traffic flows. These solutions would not be frozen in time, but would be applicable according to the demand foreseen in this phase.

The main output of this phase is the creation of a list of hypotheses, some of which are disseminated in aeronautical information publications that, through capacity forecasts, allow planners to find solutions for problem areas while improving support to ATFM by anticipating the solution to possible traffic configurations.

The strategic phase may be divided into two parts:

- A continuous data collection and interpretation process, with a systematic (information quality control) and regular review of procedures and measures.
- A process of coordination with the units or positions (TMUs) with a view to ensuring the compatibility and efficiency of national requirements.

The ATFM strategic phase has the following objectives:

- Identify demand/capacity imbalances in ATC systems, whether in underutilized or saturated areas.
- Use that information to recommend measures leading to the achievement of additional capacity or to an effective use of the existing one.

Regarding the above, a comparison between available traffic forecasts and known capacity data is a method that could be used to detect demand/capacity imbalances.

Gathering of demand and capacity data

DEMAND data can be obtained from different sources, such as:

- Demand-adjusted databases.
- Recent traffic history, comparable to the one to be analyzed (the same day of the previous week or of some high-demand period).
- Traffic trends provided by national authorities, user organizations (e.g., IATA), etc.
- Repetitive flight plans (RPL) filed by the AOs.
- Other related information (air shows, major sports events, military maneuvers) and, in general, events or situations that might entail an additional or extraordinary demand that affects available ATC capacity.

CAPACITY data is provided by the different ATCs. Despite that, it is important to have close coordination among ATFM components to make sure that available capacity is distributed in such a way that it meets the existing demand. The ATFM specialists should also consider factors such as personnel availability forecasts, possible medium-term changes in ATC procedures; installation of new equipment, airport infrastructure works that affect runways or parking positions, etc.
Pre-tactical Management:
The pre-tactical management phase occurs about seven days to one day before the execution date. Its management focus is mainly on non-scheduled flight plans, planned large (special) events, and applying forecast airspace constraints to the ATFM models. The goals are to avoid flow demands exceeding capacity given the forecast conditions of the existing flight plan and predicted system capacity, and to adjust the schemes of large (special) events.

Measures to be taken from one day to six hours prior to the operation, a definition which differs from the one described in the Procedures for Air Navigation Services - Air Traffic Management document (PANS-ATM), which specifies that the measure has to be taken more than one day prior to the date in which it will become effective. The pre-tactical phase involves the study of the demand for the day of the operation (since 48 hours before), comparing it with the capacity available on that day, adjusting the plan developed in the ATFM strategic phase, or determining different measures as necessary.

The main objective of the pre-tactical activity is to optimize capacity through a more effective organization of resources, based on the foreseen traffic demand (for example, sector configuration management, use of alternate flight procedures, etc.).

The work methodology consists in maintaining an optimum collaborative capacity (CDM) and is based on a close relationship between the ATFM unit, the air traffic management positions (TMUs) at the air traffic control centers or ATC units and the other corresponding partners (airspace managers, airlines).

The final result is a plan that describes the necessary capacity resources and the measures still pending for regulating traffic. This activity uses hypotheses developed in the strategic phase and adjusts them to the expected situation. The time limits of the activity are related to the precision of the forecasts (one week at the most) and to the capacity of the different partners.

The flight intention of air operators should be consistent with the plan developed during the strategic phase and with the adjustments made during the pre-tactical phase. The success of the activity depends to a large extent on the quality of human relations and mutual trust, as well as on the precision, reliability and timeliness of the information exchanged. All this requires an effective combination of technical and diplomatic abilities to attain optimum results.

Once the process has been completed, the agreed measures, including restrictions, should be disseminated through an ATFM or ANM message, which may be distributed through the AFTN or the various aeronautical communication networks.

The tasks to be performed during this phase may include the following:

- Determine the capacity available in the various areas, based on the particular situation that day.
- Estimate the existing demand.
- Conduct a comparative demand/capacity study.
- Study the sectors that are expected to have saturation, flows affected, calculating the acceptance rates to be applied according to system capacity.
- Prepare a summary of ATFM measures to be proposed and submit them to the ATFM community for CDM.
Twenty four hours before the operation, a last review should be carried out in consultation with the affected ATC units, in order to determine the definitive ATFM measures, which shall be published through the corresponding ATFM messaging before the operations are affected.

Acceptance rates may be established taking into consideration the following:

- They should be expressed as the number of flights in a period of time over a given point.
- Acceptance rates that are applied for extended periods of time must be periodically calculated.
- It is advisable to conduct a subsequent study to assess the impact of the measures and to adjust them, inasmuch as possible, based on the information received from the various units that make up the system, and to be able to make the necessary tactical adjustments.

Tactical Management:

Tactical management generally starts on the day of execution and lasts to the completion of the day’s ATFM initiatives. Since traffic flow projections increase in accuracy as they approach the real time event, often the tactical phase has a rolling boundary between it and the pre-tactical or strategic phase of only hours. Its management focus is on executing flight plans, monitoring air traffic, evaluating capacity and demand issues/constraints, and implementing TMIs. The goal is to avoid flow demands exceeding capacity by recognizing and managing the differences that occur between the proposed flight plans, the Filed Flight Plans (FPL), and the active, in-the-air flight paths.

During this phase, measures are adopted six hours in advance of the operation. Tactical management of traffic flows and capacity involves considering, in real time, those events that affect the plan, and making the necessary modifications.

The main objective is to minimize disturbances and take advantage of any opportunities that may arise. The need to adjust the original plan may result from staffing problems, significant meteorological phenomena, crises and special events, unexpected opportunities or limitations related to ground or space infrastructure, more precise flight plan data (FPL), the revision of sector capacity values, etc.

The provision of real information is of vital importance in this phase, since it permits short-term forecasts, including the impact of any event. There are different types of solutions that may be applied, depending on whether the aircraft are already airborne or about to take off. Interaction with traffic synchronization is essential to reach the best compromise.

Proactive planning and management phases use all the information available on forecasts. It is also of vital importance to make improvements to the aforementioned phases based on relevant information.

The tactical activity is aimed at ensuring that the measures taken during the strategic and pre-tactical phases solve the demand/capacity problems in the flows or areas of application, and that the measures taken are the minimum required and unnecessary measures are avoided. It also seeks to ensure that ATC resources are properly used and that the existing capacity is maximized without jeopardizing safety.

It should also be borne in mind that existing delays are equitably distributed among operators. To this end, real-time monitoring of the ATFM Plan is required in close contact with the ATC.
In this tactical phase, the main ATFM measure is the application of ATFM slots, trying to avoid major penalties for the operators.

Post Analysis:

Post analysis begins after the completion of the day’s ATFM process. Its analysis object is executed flights. The goal is to record, collect, and analyze the air traffic operations and ATFM process. Analysis of ATFM allows for ongoing review of ATFM initiatives and results. This phase feeds relevant information regarding airspace management, ATC, and ATFM back to all levels of the ATFM team and system stakeholders. Post-analysis is also a static process since it aims at statistics and analysis of existing facts.

However, from the perspective of the airspace users, the requirement to file accurate flight plans early in order to solve flow problems during the strategic and pre-tactical phases conflicts with the requirement of using airspace flexibly. Therefore, while developing the ATFM system, emphasize ATFM in the strategic and pre-tactical phases, but keep in mind that the tactical phase is the most important phase. In fact, the tactical ATFM process is by far the most diversified and complicated and will be the focus of this Concept of Operations. This operational concept will explore the tactical ATFM in detail and briefly describe the process of strategic management, pre-tactical management, and post analysis.

Because the time boundaries between most phases are difficult to distinguish in actual operations, detailed attention should be given to the management processes and methods rather than trying to identify a particular management phase. In fact, as automation technology allows greater collaboration between different ATFM elements, pre-tactical and even tactical decisions can be made with a greater awareness of the strategic plan for an overall system approach to solutions.

Regardless of the phase, the important concept is that Traffic Management Specialists (TMSs) may take various ATFM initiatives, based on their awareness, at different times to adjust the balance of system capacity and traffic demand. Some initiatives are best suited for the earlier phases, and many are only suited for the tactical phase. For example, an airspace user requests to add a scheduled flight from this week and continue it till the end of the flight season. On such a request, TMSs should arrange the corresponding scheduled time of takeoff and landing as well as routes, in accordance with existing ATFM principles and procedures at the strategic level, but also in coordination with all impacted areas of flight—from the airport to terminal to en route—at the pre-tactical level of forecasting capacity and demand. Another example, flight plan adjustments are normally initiated in the tactical phase (i.e., on the day of execution, during severe weather, etc.). However, in special weather conditions, like a typhoon that moves slower and affects a larger scale area, airspace users will usually file adjusted flight plans to combine flights or revise flight routes one or two days before the execution date. As a result, some ATFM initiatives will be continued from the pre-tactical phase through the tactical phase since integrated management should be performed on these kinds of large-scale route changes. The above-mentioned phases constitute an integrated ATFM process across time. While TMSs should take ATFM initiatives as soon as possible to achieve orderly.

6.5. ATM PLANNING

In order to optimise ATM system performance in the ATM Planning phase, available capacity is established and then compared to the forecasted demand and to the established performance targets. Measures taken in this step include:
a) reviewing airspace design (route structure and ATS sectors) and airspace utilisation policies to look for improvements;

b) reviewing the technical infrastructure to assess the possibility of improving capacity through upgrading various ATM support tools;

c) reviewing and updating ATM procedures as required by changes to airspace design and technical infrastructure;

d) reviewing staffing practices to evaluate potential for matching staffing resources with workload and the eventual need for an increase in staffing levels; and

e) Reviewing the training that has been developed and delivered to ATFM stakeholders.

Such analysis will provide an idea of the magnitude of a possible imbalance between demand and capacity and based on the imbalance, mitigating measures may need to be developed. However, before this is done, it is very important to:

a) Establish an accurate picture of the expected traffic demand through the collection, collation, and analysis of air traffic data.
   - In order to identify a demand excess, airports and airspaces should be monitored in order to identify significant changes in:
     - forecast demand;
     - ATM system performance targets;
   - Demand data can be obtained from different sources, such as:
     - Comparison of recent traffic history (e.g., comparing the same day of the previous week or comparing seasonal high-demand periods);
     - Traffic trends provided by national authorities, user organizations (e.g., IATA), etc.; and
     - Other related information (e.g., air shows, major sports events, large scale military manoeuvres).

b) Take into account the complexity and cost of these measures in order to ensure optimum performance, not only from a capacity point of view but also from an economic perspective.

The analysis made and the measures taken will result in a declared ATC capacity, and only in those cases where demand exceeds the declared capacity should there be a requirement to consider the utilisation of ATFM measures in the next phase, ATFM execution.

6.6. Identification and General Guidelines to traffic flow management

The basic aim is integrate ATFM with ATM at all levels and phases of operation. Even though the problems of demand capacity imbalance appear local, the solution may have ramifications across the network. Therefore the traffic management personnel (or the Traffic Managers) must keep in mind the following.
- Be aware of the traffic flow situations in the areas under their jurisdiction;
- Be aware of predicted flow, capacity, and the operational conditions of their areas of responsibility;
- Take account of the operational status of neighboring areas and other areas around India;
- Possess the ability and methods to collaboratively take effective measures to identify various traffic factors in order to eliminate the imbalance between air traffic demands and system capacity utilizing the least severe measures required;
- Continually monitor and adjust those measures as the situation requires; and
- Document all significant activity and actions to assist in post event analysis.

6.7. Types and Identification of Flow Management Problems

There are generally three types of flow management problems

- Airport capacity/demand imbalance;
- Airspace capacity/demand imbalance; and
- Avoidance of unusable and undesirable air space.

These three problems, at both the terminal and en route levels, exist throughout the ATFM process and are often interrelated. TMSs need to spend most of their time identifying and solving these problems as a whole—a problem in one may generate a problem in another. Identifying the problem and seeking solutions are the main responsibilities of all ATFM specialists at different levels.

During daily operations, flow managers monitor system capacity and demand and are regularly alerted to potential airport capacity/demand imbalances and their severity from automation systems or other channels. When TMSs find this kind of imbalance, they should figure out the cause and impact of the imbalance through analysis and collaboration with other levels of flow control, and then work out preliminary solutions and collaboratively develop successive ATFM initiatives. In order to clearly identify the cause of potential flow problems, flow managers should have continual situational awareness of air traffic flow, which requires that TMSs be provided with accurate and timely knowledge of flight movements and system operation conditions pertaining to their areas of responsibility. This allows TMSs to estimate the scope, duration, and features of ATFM problems as soon as possible, and identify the range of flights that might be affected when they solve these problems. While individual situational awareness is an important precondition to identify all air traffic flow problems and can help solve minor, local issues, collaboration of ATFM specialists from multiple Traffic Management Units (TMUs), and other system stakeholders, is required to solve complicated flow problems. These specialists should have common situational awareness, (i.e., the same timely and accurate knowledge of air traffic flow situation and operation conditions) in order to effectively solve large scale flow problems through collaborative analysis, decision-making and action.

6.7.1. Airport Demand-Capacity Balancing

Airport capacity/demand imbalance or terminal area imbalance can be predictors or symptoms of arrival or departure delays. Automation system predictions, mental calculations of experienced TMSs, stakeholder collaboration, clear and timely communication, and ongoing coordination between the different levels of ATFM are all indispensable factors to estimate whether the current airport capacity will affect airport arrival
and/or departure flows. These processes are critical in determining if airport constraints will result in delays at some point in the future.

The allocation of runways between arrival and departure flows is a major factor in determining whether arrival and departure flows will result in delays. Overall airport arrival and departure capacity is determined by the airport configuration (i.e., utilization of runway(s) and arrival/departure procedures, navigational aids, runway/taxiway availability) and is adjusted as conditions change. Since a runway may be shared by arrival and departure flows, the two kinds of flows are related. Excessive demand of one flow may cause the restriction on using or taxiing across a busy runway and result in the delay of another flow. Therefore, traffic flow managers should weigh the two flows separately, but consider them together, when evaluating the traffic capacity or demand of an airport.

During non-constrained operations, an important principle in the airport ATFM process for safety, fuel saving, and environmental protection purposes is that arrival flow typically has priority. In fact, an optimum arrival flow would occur when ATC spaces aircraft, so that just as a preceding aircraft vacates the runway, the trailing aircraft crosses the runway threshold. However, over time, this can lead to serious ground delays as no room exists for departures. The results are excessive wait times, long lines of aircraft awaiting departure, passenger crowding as they wait for delayed aircraft, and in the worse case, an airport gridlock where no room exists to taxi or get into or out of a gate. This is in fact what often occurs, as airport TMSs usually minimize arrival delays at the cost of increasing departure delays, with the departures being released when adequate space between arrivals can be provided. In addition, long departure delays can also occur if the overhead stream of en route traffic is too congested to allow for departures to fit into the stream. Without adequate en route slots, departure aircraft remain on the ground, leading to the same type of ground delays as with too many arrivals.

Both of these problems have the same symptoms, i.e., departure delays, but are solved in different manners. Thus, traffic managers must coordinate among levels of control to determine the cause before taking action. To reduce arrival rates, lower average arrival rates or increased arrival spacing can be adopted to reduce arrival demand and increase the departure rate. To increase departures into a congested overhead stream, coordination between terminal and en route TMSs can lead to the en route structure building slots, either manually or via time-based metering. Departure traffic can be accommodated by TMSs applying TMIs en route or from feeder airports.

6.7.2. Airspace Demand-Capacity Balancing

The route capacity is usually weighed from the capacity of its minimal operation unit, namely the control sector. The sector capacity threshold is a maximum capacity value obtained from capacity evaluation calculation, known constraints, and personnel experience. It represents the level of system capacity when no tactical flow problem occurs and is related to factors such as airspace structure, communication, navigation and surveillance/ATC automation system, ATC methods, controllers’ human factors, and so on. Its capacity is ultimately determined by evaluating the ability of controllers to handle aircraft in this sector within a certain period of time (Ref 3).
The ATFM automation system uses the pre-estimated static threshold values of various sectors. It will give an alarm when it predicts the future sector flow exceeds the threshold. Since the threshold has been evaluated in advance under some ideal condition, while the internal features of the traffic flow are relatively simple (e.g., flow direction is consistent or no climbing and descending), the controller might still be able to deal with the existing or predicted flows when the system alarms. However, when receiving a sector capacity alarm, the TMS should coordinate with the sector supervisor to confirm whether ATFM initiatives should be taken.

When the TMS determines ATFM initiatives are required, they should coordinate with other sector/en route center specialists as well as with terminal specialists to decide on the best measures for implementation. A system approach should be part of this process. Executing the wrong measure may solve the specific sector issue, but cause greater delays in adjacent centers or terminal areas. Collaboration, coordination, communication, and automated modeling can help TMSs determine the best course of action. Once measures are instituted, the TMS should monitor and periodically coordinate with the sector supervisor to adjust those measures, as needed. All significant activities and actions should be documented to assist in post event analysis.

6.7.3. Problems Due to Avoidance of Unusable or Undesirable Airspace (Constrained Airspace)
A route or airspace may sometimes be unusable due to severe weather (e.g., thunderstorm or air turbulence), a dangerous situation (e.g., volcanic ash) or Special Use Airspace (SUA) activities (e.g., military activities). The pilots sometimes are also unwilling to use airspace with air turbulence or strong headwind.

Most cases of unusable or undesirable airspace are quite difficult to forecast in the strategic and pre-tactical phase, becoming key issues to be resolved in the tactical phase. Pilots, controllers, and TMSs may obtain information on unusable or undesirable airspace by monitoring weather conditions, contacting the military, and so on. The CCC should be aware of and monitor these selective constrained areas as well.

Regardless of who obtains the information and from which source, the important element in effective handling of these problems is dissemination of information. As a result, all levels of ATFM, ATC, the military, and the users (pilots, airlines, etc.) have the same situational awareness of changes in the airspace system due to unusable or undesirable (constrained) airspace. With this information, a coordinated approach to route aircraft around unusable or undesirable airspace can be taken. Changing flight levels (FLs) and radar vectoring are the most commonly used control measures when unusable or undesirable airspace appears in an area. Since these measures will increase the workload of the controller, lower the capacity of the sector, and eventually cause flow restrictions, the TMS should use a “traffic preview tool” to assess and determine the result of ATFM initiatives to confirm and model the outcome of different TMIs allowing selection of the least restrictive initiative to accomplish the impact mitigation.
7. **C-ATFM SYSTEM COMPONENTS - ROLES AND RESPONSIBILITIES**

7.1. **CCC – OPERATIONS**

A new centralized ATFM facility (the Central Command Center, or CCC) will be established at Delhi where all capacity and demand data and information can be acquired, merged, displayed, and distributed to participating CDM partners and ATFM units.

The ATFM CCC will continually make decisions to hold or cancel flights at airports because of delays, traffic congestion, weather problems, emergencies, and other conditions. This will require an ability to communicate with any impacted air traffic control facility and all affected AOCs, allowing the AAI to collaborate on optimizing mitigating responses before a final decision. The airports/AOCs need to efficiently coordinate all airport operational activities and ensure security of the airport infrastructure at all times. Up-to-date information needs to be shared between various shareholders (airlines, airports, military, and AAI) in order to maximize throughput capacity, maintain safety and minimize delays and impact on the environment.

CCC decision support tools can propose optimized arrival and departure sequences for maximum inbound and outbound punctuality, while reducing runway queues. By considering separation requirements for the successive arrivals and takeoffs at all planning stages, these decision support tools ensure maximum safety.

**Coordination**

A typical coordination hierarchy could consist of the following:

- Control towers (TWR) coordinate with Approach Control Facilities (APP).
- Approach Control Facilities (APP) coordinate with an Area Control Center (ACC).
- Area Control Centers coordinate with ATFM authority.
- ATFM authority would be responsible for dissemination within their respective region.

Responsibilities of CCC include:

- The central unit for ATFM shall ensure that detailed procedures governing the provision of the ATFM measures and services within the area of responsibility of the central unit for ATFM are prescribed in a consolidated ATFM Handbook.
- The central unit for ATFM shall ensure that ATFCM is carried out in four phases:
  - Strategic Flow Management which takes place seven days or more prior to the day of operation and includes research, planning and coordination activities.
  - Pre-Tactical Flow Management which is applied during six days prior to the day of operation and consists of planning and coordination activities.
Tactical Flow Management which is applied on the day of operation. This phase updates the daily plan according to the actual traffic and capacity. The management of the traffic is made through slot allocation and/or ad-hoc routings.

Post Operations Management which is applied following the day of operation. This phase analyses the day of operation, and feeds back into the previous three phases.

- The central unit for ATFM shall ensure that procedures for the management of critical events within the Indian Airspace are agreed and published in coordination with local ATFM units within their area of responsibility and in cooperation with operators, ATS units, airport managing bodies and entities involved in airspace management.

- When planning for or reacting to critical events, the central unit for ATFM shall ensure that:

  - Procedures are established and agreed during the strategic phase;

  - The application of these procedures shall be decided upon and performed during the pre-tactical and tactical phases as appropriate;

  - The procedures relevance shall be assessed during the post-operational phase

- The central unit for ATFM shall ensure that ATFM and capacity management measures are provided to ensure an optimum flow of air traffic to, from, through or within defined areas during times when demand exceeds, or is expected to exceed, the available capacity or monitoring value of the ATS system, including relevant aerodromes. (However this should not preclude the need for planning airspace to adequately meet demand.)

- The central unit for ATFM shall balance demand and capacity by coordinating the optimum use of available resources, utilizing ATC capacity to the maximum extent possible and coordinating adequate measures in order to enhance the quality of service and the performance of the ATM system.

- The central unit for ATFM, together with local ATFM units, shall ensure:
  - timely collection and collation of data on the air navigation infrastructure and on the capacities of the ATC system and of aerodromes with their area of responsibility;
  - determination of a coherent picture of expected traffic demand, comparison with available capacity and identification of areas and time periods of expected critical loadings;
  - coordination with the appropriate authorities in order to make every possible attempt to increase available ATC capacity where this is required, and;
  - in agreement with ATS units concerned, where ATC capacity shortfalls cannot be eliminated, determination, coordination (including local ATFM units and operators) and timely implementation of appropriate measures to be applied throughout relevant portions of their area of responsibility. Based on performance analyses.

- The central unit for ATFM, together with local ATFM units, shall use continuously updated data reflecting expected and current traffic demand and capacity within their areas of responsibility.
The central unit for ATFM shall involve AOs in the definition of ATFCM measures during all ATFCM phases by application of the Collaborative Decision Making (CDM) process.

To facilitate the integration of the AOs into the operations, the central unit for ATFM shall establish an Aircraft Operator Liaison Cell, to be staffed by representatives of the aircraft operators.

The central unit for ATFM shall ensure that the Cell provides the focal point for the AOs for coordination and information about the airspace and ATFCM situation in the area of responsibility of the central unit for ATFM.

In the strategic phase the central unit for ATFM shall ensure that the Cell liaises with the central unit for ATFM, AOs and ATM providers in order to:

- propose developments to the central unit for ATFM processes and measures for benefit airspace users and ATM providers,
- follow up on any repetitive problems affecting the AOs, and monitor the equity of the flow management process.

In the pre-tactical phase the central unit for ATFM shall ensure that the Cell contributes to the preparation of the ATFCM Daily Plan by forwarding views of AOs and coordinating ATFCM measures (e.g. re-routeing scenarios) with them.

In the tactical phase the central unit for ATFM shall ensure that the Cell acts as the main point of contact with the AOs concerning any ATFCM measures.

The central unit for ATFM shall ensure that the Cell leads coordination with AOs in the event of any crisis situation in the area of responsibility of the central unit for ATFM.

When the traffic demand exceeds, or is predicted to exceed, the capacity or monitoring value of a particular airspace or aerodrome, the responsible ATS unit or central unit for ATFM, as defined in the LoA, shall advise the responsible local ATFM unit.

The responsible ATS unit shall ensure that a decision to implement and execute ATFCM measures within the Area of Responsibility of a local ATS unit is preceded by coordination between the central unit for ATFM, local ATFM unit and that local ATS unit.

This process shall be conducted by the principles established for the concept of Collaborative Decision Making (CDM).

Once the choice of ATFCM measures applied to airports has been coordinated with the central unit for ATFM (through local ATFM units), the ATS unit at the airport concerned shall coordinate the measures with the airport managing body.

In case of particular events which have a negative impact on the declared capacity or monitoring value of an airspace or aerodrome, ATC units shall determine the value of the reduced capacity or monitoring value of the airspace or aerodrome concerned, for the required time period.

ATC units shall advise the local ATFM unit of negative impact and consequential reduction of capacity or monitoring value.
The local ATFM unit shall coordinate appropriate ATFM measures with the central unit for ATFM.

### 7.2. TMU – OPERATIONS

The CCC Supervisor is responsible for the day to day monitoring, planning and co-ordination of all ATFM measures affecting traffic entering, leaving, overflying or remaining within the Indian Airspace.

- The TMU is responsible for all co-ordination between ATC and the CCC and for providing ATFM support to Aircraft Operators.
- TMUs monitor and balance traffic flows within their areas of responsibility in accordance with air traffic flow management directives. They also direct traffic flows and implement approved traffic management measures. TMU duties may include:
  - collecting all relevant information, such as meteorological conditions, capacity constraints, infrastructure outages, runway closures, automated system outages, and procedural changes that affect ATS units. This may be accomplished through various means available, such as teleconferences, e-mail, internet, automated data gathering, etc.;
  - documenting a complete description of all ATFM measures (for example, ground delay programs, miles-in-trail) in a designated log. It should include, among other data, the times of start and end, the affected stakeholders and flights, and the justification;
  - coordinating procedures with the affected stakeholders;
  - conducting daily telephone and/or web conferences, as required; and
  - continuously monitoring the ATM system, make service delivery adjustments where necessary, manage ATFM measures and cancel them when no longer required.
- The local ATFM unit (TMU) manager shall be responsible for all ATFCM activities in the designated area and within its area of responsibility and shall act as the focal point for administrative and organizational matters in dealings with the central unit for ATFM.
- The local ATFM unit (TMU) manager shall be required to meet the following criteria:
  - have extensive knowledge of the overall ATC/ATFCM operation in the area of responsibility of the designated area;
  - have an extensive understanding of the ATC/ATFCM operations in adjacent designated areas;
  - have a comprehensive knowledge of the central unit for ATFM organisation and its systems;
  - have undergone appropriate ATFCM training
  - have an extensive understanding of the factors influencing Aircraft Operations in so far as they may affect ATFCM.
- Local ATFM (TMU) units shall:
  - act as the interface between the central unit for flow management and:
designated areas and their associated aerodromes and ATS units (military and civil) within their area of responsibility aircraft operators

- inform local AOs of their role in providing advice and information by arranging for the relevant TMU telephone numbers to be published in the National AIP with a short description of the service provided.

- establish local ATFM unit procedures and practices to ensure that local ATFM unit staff are fully conversant with the latest central unit for ATFM operational procedures and any ATFM local instructions or Temporary Instructions applicable to their local ATFM unit.

- monitor the effectiveness of such procedures and, where necessary, recommend changes.

- act as the point of contact within an designated area for coordination on ATFM matters

- ensure that the central unit for flow management has all the data and information required in each of the ATFM phases to make the most effective use of available capacity in order to implement the most effective ATFM plan and for checking the accuracy of that data

- ensure the local promulgation, by the appropriate means (national NOTAM, AIP, ATC operational instruction, etc.), of procedures which affect ATC Units or aircraft operators within the local ATFM unit’s area of responsibility.

- include the provision of all the relevant updated information and documentation so that information and advice passed to AOs by the local ATFM unit is relevant, up-to-date and fully conforms with current ATFCM manual operating procedures.

- act as the local ATFCM partner for the designated area, other ATS units (military and civil) within the local ATFM area of responsibility and local AOs.

7.3. Responsibilities of the TMU (PHASE I)

In the Phase I C-ATFM roll out the following TMU (TMU) will be established

<table>
<thead>
<tr>
<th>TMU</th>
<th>Location</th>
<th>Area of Responsibility</th>
<th>ACC Served</th>
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<tbody>
<tr>
<td>Delhi</td>
<td>Delhi ACC</td>
<td>Delhi FIR</td>
<td>Delhi ACC</td>
</tr>
<tr>
<td>Mumbai</td>
<td>Mumbai ACC</td>
<td>Mumbai FIR</td>
<td>Mumbai ACC</td>
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<tr>
<td>Chennai</td>
<td>Chennai ACC</td>
<td>Chennai FIR (excluding Hyderabad and Bangalore TMA)</td>
<td>Chennai ACC</td>
</tr>
<tr>
<td>Kolkata</td>
<td>Kolkata ACC</td>
<td>Kolkata FIR</td>
<td>Kolkata ACC</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>Hyderabad ACC</td>
<td>Hyderabad TMA</td>
<td>Hyderabad ACC</td>
</tr>
<tr>
<td>Bangalore</td>
<td>Bangalore ACC</td>
<td>Bangalore TMA</td>
<td>Bangalore ACC</td>
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</table>
Contact information of the TMU Flow Managers will be published in due course.

7.4. **Responsibilities of ACC TMU**

ACC TMU, as a second level of the AAI ATFM organization, is responsible for helping the CCC to organize relevant ACC, terminal, airport ATC towers, and other ATC facilities within its geographical area to conduct ATFM. The ACC TMU duties include communication, collaboration, and coordination of ATFM issues with surrounding and internal air traffic facilities. All ACCs also have Initial Flight Plan Management Positions, Operation Coordination Positions, and Flight Plan Processing Positions to fulfill relevant ATFM responsibilities.

**General responsibility of ACC TMU**

- Create and distribute the action plan prior consultation with the designated facilities and customers.
- Collect all relevant information, such as meteorological conditions, delays, interruption of nav aids/radar, runway closures, telecommunication failures, deficient operation of computers, and procedural changes affecting air traffic facilities. This may be accomplished through various means available, such as teleconferences, e-mail, internet, etc.
- Analyze and distribute all data.
- A complete description of all TMIs (for example, ground delay programs, miles in track - MIT) is recorded in a designated log, which must include, among other data, the time of start and end, the affected facilities/operations and the justification.
- Coordinate procedures with the parties involved.
- Create an structure for dissemination of information; for example, a website.
- Conduct daily teleconferences, as required.
- Monitor/review the flow management system, make adjustments where necessary, and cancel when no longer required.

In general, the ACC TMU is responsible to monitor air traffic operations within their area, participate in periodic nationwide planning conference calls for ATFM, help CCC develop and adjust TMIs, communicate with area airspace users and airports on flow problems. Specific responsibilities include:

- Identify and assess sector capacity decline due to weather, defense activity, aircraft operation, ATC facilities operation, ATC equipment outages, airport impacts, etc.
- Help APP TMUs in its area study capacity changes of relevant sectors, departure and arrival fixes, and airports.
- Collaborate with CCC to adjust the capacity threshold of sectors and arrival/departure rates at threshold airports.
- Analyze capacity/demand imbalance of area sectors based on flight plan and traffic in the air.
- Plan TMIs within its area of responsibility and inform relevant ATC positions.
Feedback status of TMIs, planned and executed, to CCC. Suggest adjustment or termination of implementation.

- Carry out post evaluation of daily ATFM, and report evaluation results as required to the CCC.

### 7.5. Responsibilities of APP TMU

APP TMU: As appropriate, APP TMUs should be established in Terminal (Approach) where ongoing capacity and demand issues require regular ATFM initiatives. AAI should set up APP TMUs in main Terminal (Approach) control facilities according to flow and environment status and set up ATFM terminal in other approach control units, as needed. The MIC of the facility will take charge of ATFM in Terminal (Approach) control facilities without APP TMUs. The Tower MIC or local controller in airport ATC tower will fulfill the relevant responsibilities in airports without APP TMU facilities.

General responsibility of APP TMU

- In general the APP TMU is responsible to manage air traffic demand and constraints within their area of responsibility. Specific responsibilities include:
  - Identify and assess sector capacity decline due to weather, defense activity, aircraft operation, ATC operation, ATC equipment outages, airport impacts, etc.
  - Collaborate with relevant ACC TMU and TWR TMU to adjust the capacity threshold of sectors and arrival/departure rates threshold of airports.
  - Collaborate with TWR(s) and ACC TMU to identify Airport Arrival Rate/ Airport Departure Rate (AAR/ADR), arrival and departure fix demand/capacity, and monitor the changes due to weather, military information, aircraft operation, ATC operation, ATC equipment, airport operation or other reasons.
  - When required participate in nationwide ATFM decision making organized by CCC on its own initiative, invited by ACC TMU or invited by the CCC.
  - Participate in decision making organized by ACC TMU for regional TMIs complying with flight plan and airport operation.
  - Support relevant ACC TMUs in the development of regional TMIs.
  - Feedback implementation status of TMIs and recommend operation plans to ACC TMU.
  - Inform the relevant ATC position of ATFM initiatives.
  - As required report statistical data to ACC TMU.

### 7.6. Responsibilities of TWR TMU

To set up TWR TMU in some large airport ATC towers according to traffic amount and operation environment of the airport. At middle size towers, a traffic management position may be established and supported with an ATFM automation system terminal. There are full-time TMSs in these
towers during busy time periods. The MIC or local controller will take ATFM charge during non-busy time periods. The controllers on duty take charge of ATFM in small airport towers. Towers without APP TMU facilities take the ATFM charge of ATFM in that terminal area.

General responsibility of TWR TMU

- In general, the TWR TMU has the responsibility to assist in the management of air traffic demand and constraint issues at the tower. Specific TWR TMU responsibilities include:
  - Collaborate with APP TMU to identify AAR/ADR changes due to weather, military information, aircraft operation, ATC operation, ATC equipment, airport operation or other reasons.
  - Collaborate with APP TMU and/or ACC TMU to properly adjust threshold of AAR/ADR and departure fix demand issues.
  - When required participate in nationwide ATFM decision making organized by CCC on its own initiative, invited by ACC TMU, or invited by the CCC.
  - Participate in decision making organized by ACC TMU for regional TMIs complying with flight plan and airport operation.
  - Inform the relevant ATC position of ATFM initiatives
  - Feedback implementation status to ACC TMU.
  - Carry out post evaluation of daily ATFM, and report statistical data to ACC TMU.

7.7. Responsibility of ATC Units

ATS Units shall be responsible for ATFM slot compliance at departure aerodromes. Whereas the exact procedures to be followed will depend on the way ATS is organized at each aerodrome, the following requirements shall apply in all cases, unless otherwise coordinated:

a) a slot tolerance (-5' to +10') is available to ATS units to organize the departure sequence;

b) ATS units shall provide all possible assistance to operators to meet ATFM slots or to coordinate a revised ATFM slot.

The ATC unit at the departure airport, when in receipt of a notification of a rejected or suspended flight plan, shall not give take-off clearance to the affected flight.

The ATC unit at the departure airport shall ensure that procedures are in place to enable it to be aware of current expected off blocks times for flights operating from that airport and does not give take-off clearance to those flights that have missed its estimated off blocks time, taking into account the established time tolerance.

ATC shall deprioritize the flights that are non-compliant behind flights that are compliant and the flights that are exempt from ATFM measures. This re-prioritization will be applied only once at departure airports (which are subject to ATFM regulations) or at arrival airports.
ATS units shall provide the central unit for ATFM with the necessary data concerning the progress of airborne flights including actual take-off time and significant deviations from the flight plan route.

ATS units shall provide the central unit for ATFM with the following data and subsequent updates, in a timely manner and ensuring its quality:

(f) updated flight positions,

(g) deviations from flight plans,

(i) actual flight take-off times.

The data shall be made available to parties referred to in Article 1(3) and provided free of charge to, and by, the central unit for ATFM.

7.8. Responsibility of Airspace Users

TBD

7.9. Responsibility of Airport Operators

TBD
8. C-ATFM OPERATIONS & COLLABORATIVE DECISION MAKING (CDM)

8.1. Introduction

8.1.1. CDM is a work methodology that allows the participants in the system to optimize their decisions in collaboration with others, learning about their preferences, limitations, and the actual and foreseen situation. To that end, each participant must be committed with the collaborative effort, sharing responsibility, information, resources, objectives and mutual trust. CDM is, therefore, a key element for maximizing airport and air operations, since it takes into account all the elements involved in the coordination between air navigation service providers, like flow management units (FMUs), and the recipients of such services, like aircraft and airport operators. The CDM strategy is to include all the stakeholders in the planning process, sharing information about the position of the aircraft, predictions, weather forecasts, traffic forecasts and, in general, any aspect that will contribute to the efficient operation of a regional airspace system.

8.1.2. The benefits of using Collaborative Decision Making (CDM) for enhancement of network management are very wide and varied in nature. Even at the most basic level of purely improving the distribution of existing information amongst users and stakeholders, thereby creating common situational awareness, significant benefits can be achieved with relatively low investment.

8.1.3. Common situational awareness requires a new approach to information sharing; however its initial implementation does not require major investment in information networks. It can be achieved initially by simply interfacing existing systems to provide better quality data based on common information elements and interactions. This interfacing can start on an ad-hoc basis initially, but will require the progressive development and introduction of commonly agreed standards and procedures – ultimately leading to the development of an integrated system wide information management (and distribution) capability, supported with enhanced (aeronautical) information management.

8.1.4. The operational concept also assumes that the existing data (situational awareness and decision making) and information management infrastructure will remain, with changes to existing systems (or deployment of new systems) kept to the minimum required to support the implementation of the components. In all cases, cost-effectiveness must be a primary consideration.

8.1.5. Providing information and better quality network management induces costs for all stakeholders that should be balanced by higher benefits. Arguably, the provision of information by one party that improves network overall management has a value, and that value should be reflected through quantifiable and measurable benefit both to the provider (return on investment), and to the other network stakeholders (cross-industry business case).

8.1.6. Accordingly, in order to quantify the benefits it is important to obtain an agreement on Key Performance Indicators and the use of recorded data for evaluation purposes. Post-tactical data analysis is an important, required activity with a view to monitoring and improving all CDM related activities.
8.2. **CDM with a view of network optimization**

8.2.1. In addition, for all components, appropriate procedures are needed to enable CDM stakeholders to discuss issues and improvements and to agree on action if a partner does fulfill its commitment. Enhancement of network management is essentially a user-driven performance expectation. In developing network management collaborative decision making strategies it is critical to understand the customer’s operating model, and, working with the customer and other stakeholders, to sustain customer value. This is not simply about collaboration in the days and hours before a flight – it is about integrating planning processes and cycles at all points in the customer planning cycle – from Very Strategic through Strategic, Pre-tactical, Tactical and importantly Post-Tactical for performance analysis.

8.2.2. At present, the collaborative interaction between ANSPs and the user tends to occur in the Tactical and Pre-Tactical timeframe. In the evolution of network management, the collaborative processes will extend through all phases of the customer planning cycle.

8.2.3. It’s also important to understand the key performance context – i.e., why airlines (and users in general) want or expect improvements in network operation. Most current performance goals around flow and network management centre on delay reduction and ‘on-time’ performance. These are important factors for airlines, as they relate directly to schedule maintenance, which in turn responds to two drivers – passenger expectations, and critically for an airline, aircraft utilization.

8.2.4. An airline’s investment in aircraft is substantial, and it is critical that the airline can operate its schedule as predictably and reliably as possible, with as few aircraft as possible.

8.2.5. ANSPs contribute to this improvement in cycle time in three ways. The first is by improvements to operational trajectories – moving towards User Preferred Trajectories through an ATM Improvement program.

8.2.6. The second and more significant contribution will come from improvements to network management, improving predictability and consistency, so that airlines will have confidence to reduce scheduled off-block to on-block times or in other words “buffer” time loading. In addition, by reducing the need for ground holding, there will be a small contribution to the reduction in on-block to off-block time.

8.2.7. The third contribution will be in the provision of collaborative decision making capabilities to facilitate improvements to airport management – most significantly optimization of airport turnaround.

8.2.8. The airline expectation is that a cumulative improvement in the three areas – ATM, Network and Airport performance – will allow an increase in aircraft utilization – or significantly a reduction in the number of aircraft required to operate a schedule.

8.3. A key part of the C-ATFM concept is Collaborative Decision Making (CDM) which helps ATC achieve its goal of managing the ATC system and the operators achieve their goal of managing their schedules. The result of CDM is a shared situational awareness and collaborative resolutions for “win-win” solutions for both ATC and stakeholders. Collaboration leads to enhanced options,
resulting in improved decision making, stakeholder acceptance and support, and increase service performance.

8.3.1. CDM benefits AAI by helping to:

- Ensure safe separation;
- Maximize throughput;
- Make efficient use of available capacity;
- Manage controller workload;
- Provide equitable service; and
- Achieve environmental efficiencies.

8.3.2. Stakeholders receive benefits through:

- Enhanced flight safety;
- Improved on-time arrivals;
- Improved accomplishment of mission objectives;
- Minimizing delays;
- Optimizing passenger/crew/aircraft connections;
- Minimizing turn times; and
- Fuel savings

8.4. Collaborative Decision Making Preparation

8.4.1. The effectiveness of CDM is greatly improved by all units and stakeholders sharing the same situational awareness and using common flow planning tools to arrive at optimal Traffic Management Initiatives (TMIs). TMIs are actions taken to balance current or anticipated demand with available capacity.

8.4.2. Examples include imposing a minimum Kilometers-in-Trail (KMIT) between aircraft in an en route flow or stopping departures of all aircraft destined for a particular city (a Ground Stop, or GS). TMIs work best when all participants work together to create technological and procedural solutions to traffic flow problems, and respond collaboratively to real-time operational constraints.

8.5. Collaborative decision-making (CDM) in the context of ATFM

8.5.1. CDM is the process which allows decisions to be taken by amalgamating all pertinent and accurate sources of information, ensuring that the data best reflects the situation as known, and ensuring that all concerned stakeholders are given the opportunity to influence the decision. This in turn enables decisions to best meet the operational requirements of all concerned.

8.5.2. The CDM process is a key enabler of an ATFM strategy allowing the sharing of all relevant information between the parties involved in making decisions and supporting an on-going dialogue between the various stakeholders throughout all phases of flight. This enables the various organisations to update each other continuously on events from the strategic level to real-time.

8.5.3. CDM is a supporting process applied to activities such as airspace management and demand/capacity balancing and can be applied across the timeline of activities from strategic planning to tactical operations. CDM is not an objective in itself, but rather a way to reach the
performance objectives of the processes it supports. These performance objectives are expected to be agreed upon collaboratively.

8.5.4. Although information sharing is an important enabler for CDM, the sharing of information is not sufficient to realize CDM and the objectives of CDM. Successful CDM also requires agreed upon procedures and rules to ensure that collaborative decisions will be made expeditiously and fairly.

8.5.5. CDM ensures that decisions are taken transparently based on the best information available as provided by the participants in a timely and accurate manner.

8.6. **CDM Organization and Structure**

8.6.1. The organization and structure of the CDM process depends on the complexity of the ATFM system in place. The structure must be designed to ensure that the affected stakeholders, service providers and airspace users alike, can discuss airspace, capacity and demand issues through regular sessions and formulate plans that consider all pertinent aspects and points of view.

8.6.2. Frequent tactical briefings and conferences can be used to provide an overview of the current ATM situation, discuss any issues and provide an outlook of operations for the coming period. Traffic patterns and the gravity of the envisaged ATFM events will dictate the frequency of those meetings. They should occur at least daily but may also be scheduled to occur more frequently depending on the traffic and capacity situation (e.g. an evolving meteorological event may require that the briefing frequency be increased). Participants should include involved ATFM and ATS units, chief or senior dispatchers, affected military authorities and airport authorities, as applicable.

8.6.3. The output of these daily conferences should be the publication of an ATFM daily plan (ADP) and subsequent updates. The ADP should be a proposed set of tactical ATFM measures (e.g. activation of routing scenarios, miles-in-trail, etc.) prepared by the ATFM unit and agreed to between all partners concerned during the planning phase. The ADP should evolve through the day and be periodically updated and published.

8.6.4. Feedback and review of the ADP received from ANSPs, AUs, and from the ATFM unit itself represent very important input for further improvement of the Pre-Tactical planning. This feedback helps the ATFM unit identify the reason(s) for ATFM measures and determine corrective actions to avoid reoccurrence. Systematic feed-back from AUs should be gathered via specifically established links.

8.6.5. In addition to the daily conferences, the ATFM unit should consider holding periodic and event specific CDM conferences, with an agenda based on experience. The objective should be to make sure that ATFM measures to be applied are decided through a CDM process and agreed to by all affected stakeholders.

8.7. **CDM Requirements and Benefits**

8.7.1. Through the application of a transparent CDM process, the involved stakeholders will gain the necessary situational awareness and ensure that the optimum measures are applied in any given situation. CDM will also create an environment where stakeholders better understand the issues of all concerned.
8.7.2. Regular CDM conferences provide stakeholders with the opportunity to propose enhancements that could benefit them, to follow up on any issue, and to monitor the equity of the flow management process.

8.8. ATFM, CDM, and Civil/Military Coordination

8.8.1. ATFM principles are equally applicable to both civil and military flights operated in accordance with civil rules. Civil/military coordination will provide more flexibility to AUs, thanks to the greater availability of both information and airspace. It is, however, essential to integrate that some missions will remain incompatible with civil aviation. These missions may be military operations, operations conducted in support of security requirements, live weapons firing, space operations or others. National policies will establish the degree of civil/military coordination in terms of air traffic management within each State. Military participation in a regulated aeronautical information infrastructure will therefore remain subject to national considerations.

8.8.2. The processes aiming to a flexible use of airspace involves an optimum sharing of airspace under appropriate civil/military coordination to achieve the proper separation between civil and military flights, thus reducing the need for permanent airspace segregation.

8.8.3. Benefits of civil/military coordination include:

   a) operational savings for flights thanks to reductions of flight time, distance flown and fuel consumption;

   b) route network optimization for the provision of ATS and the associated sectoring, providing ATC capacity increases and a reduction of delays of air traffic in general;

   c) more efficient air traffic flow separation procedures;

   d) reduced ATC workload through a reduction of airspace congestion and choke points;

   e) real-time provision of capacity in line with AUs operational requirements; and

   f) definition and use of temporary reservation of airspace more in keeping with operational military requirements, in a way that responds optimally to their specific requirements.

8.8.4. APAC Recommendation:

8.8.4.1. It is recommended that States and/or service providers develop and document a collaborative process with users of airspace that are placed under restrictions or reservations. It should increase efficiency by enabling the use of these airspaces by civilian traffic whenever they have not been activated by the primary airspace user.

8.8.4.2. When applicable, such agreements and procedures should ideally be established on the basis of a regional air navigation agreement. The agreements and procedures aiming to a flexible use of airspace should specify, inter alia:

   a) the horizontal and vertical limits of the airspace concerned;

   b) the classification of any airspace made available for use by civil air traffic;

   c) units or authorities responsible for the airspace;
d) conditions for transfer of the airspace to/from the ATS unit concerned;

e) periods of availability of the airspace;

f) any limitations on the use of the airspace concerned;

g) the means and timing of an airspace activation warning if not permanently active; and

h) any other relevant procedures or information.

8.8.4.3. It is recommended that States and/or service providers develop a letter of agreement (LOA) with their military customers that describes how military special use airspace can be utilized when not in use and/or during peak civilian periods in order to increase efficiency.

8.8.4.4. ATFCM principles are equally applicable to both civil and military flight operations and will provide more flexibility to air operations, thanks to the greater availability of both information and airspace. However, there will continue to be operational, training missions, which, by nature, could be incompatible with civil requirements or practices. The degree of civil/military integration in terms of air traffic management within each State continues to be a matter of national competence and, therefore, military participation in a regulated aeronautical information infrastructure will be subject to national security considerations.

8.8.4.5. The flexible use of airspace concept permits an optimum sharing of airspace under appropriate civil/military coordination to achieve the proper separation between civil and military flights, thus reducing the need for airspace segregation.

8.8.5. CDM with the Military is primarily focused on the availability of Special Use Airspace. This coordination will permit the civil ATM system to use this airspace when it is not being used by the Military. In addition all TMIs issued by the ATFMS will be coordinated with the Military.

8.9. CDM with Domestic Carriers

8.9.1. All TMIs developed by the ATFMS will be coordinated with India’s domestic air carriers in order to assist them in their planning and to receive input with respect to potential impacts on their operations and possible alternative recommendations concerning the TMIs. International Carriers CDM

8.9.2. All TMIs developed by the ATFMS will be coordinated with India’s international air carriers in order to assist them in their planning and to receive input with respect to potential impacts on their operations and possible alternative recommendations concerning the TMIs.

8.10. En Route CDM

8.10.1. ACCs are responsible for developing TMIs within their area of responsibility. These TMIs must be coordinated with the CCC and with the affected APP TMUs and TWR TMUs within the ACC’s area of responsibility. In the event that TMI’s are required across ACC boundaries, the CCC is responsible for coordinating these TMIs with the affected ACCs. Feedback among the CCC, ACCs, APP TMUs and TWR
8.10.2. TMUs is expected and encouraged in order to create the most efficient TMIs that have minimal impact on traffic operations. This feedback and coordination also extends to the ATC personnel that are responsible for implementing the TMIs.

8.10.3. The APP TMUs receive TMIs from their ACC. They may also recommend TMIs to their ACC. These TMIs must be coordinated with the ATC personnel that are responsible for their implementation.

8.10.4. The TWR TMUs receive TMIs from their ACC and the APP TMUs. They may also recommend TMIs to their ACC and the APP TMU. These TMIs must be coordinated with the ATC personnel that are responsible for their implementation.

8.11. User Web Based Interface/Portal

8.11.1. The CATFM System should have a web user interface for all aircraft operators to have access for CDM and schedule adjustments. Advanced functionality can be provided via other mechanisms for large operators.

8.11.2. Issues are logged and tracked using a dedicated web-based customer portal. The portal provides customer personnel the ability to log or access the status of an Issue on a 24x7x365 basis. Entering an Issue into the Customer portal provides an immediate alert to the entire support team and is the most effective way to report an issue.

8.11.3. Summary issue tracking reports are available for downloading through the Customer portal. Lastly, this portal serves as a repository for the CATFM System documents including the User’s Guide, Training Packages, Administration Manual, Monthly Status Reports, and other user documentation.

8.11.4. Central Traffic flow supports multiple methods of aircraft operator users participate in CDM and interact dynamically with the ATFM system.

8.11.5. A web-based capability provides fundamental CDM for a wide range of operators. ESM provides the same functions as the web-based capability but also provides more advanced operations that may be more appropriate for some aircraft operators.

8.11.6. Central Traffic flow supports CDM participants with a web-based interface to increase the access to CDM is controlled via a login screen. The user login are the same between both interfaces. The web-based CDM functionality includes the following capabilities:

- Flight List
- Dynamic Flight changes
- Flight substitution requests
- Flight suspend / De-suspend
- Airline Flight time updates
- Flight schedule upload
- Individual flight creations
• Flight schedules
• Post operational flight times
• Runway configuration Alerts
• Access to the real time and Post analysis reports
• System Administration.
9. **C-ATFM OPERATIONS - ATFM MEASURES (TRAFFIC MANAGEMENT INITIATIVES)**

9.1. ATFM is a process applied on the whole national airspace system for a network optimization. The application of ATFM generally follows an iterative process as below:

- Determine capacities: Review/assess airport/ATC sector capacities for accuracy
- Assess demand: Determine foreseen demand for a specific time frame, 15-minute period(s), hour(s), etc.
- Analysis and comparison: Compare and analyze demand and capacity levels, as well as the periods in which the demand exceeds the available capacity.
- CDM model: Communicate the situation to the facilities/parties involved through the means available, using the CDM methodology.
- Action required for mitigating a demand imbalance: After collecting and requesting information, determine the traffic management initiatives (TMIs) that are appropriate for the situation.
- Disseminate information: Inform the parties involved about the TMIs applied using the means available to that end.
- Monitor the situation: Examine the situation periodically, as necessary, to make sure that the TMI applied is mitigating the imbalance. If necessary, reassess and make the corresponding adjustments.
- Conduct an analysis after the event: Following the event, conduct an analysis to determine the effectiveness of the TMI, and catalogue the best work practices. This analysis may be conducted by reviewing the weekly or monthly report of the CCC.

9.2. Demand and Capacity balancing by the application of Tactical ATFM measures will follow the following hierarchy

- ATM Resource Management
- Enroute Spacing/ Delay/ Rerouting / Level Capping Scenario
- Ground Delay Scenario
- Ground Stop Scenario

9.3. **Application of ATFM Solutions**

ATFM continuously and pro-actively considers all possible air traffic flow management solutions through an iterative process that spans from the strategic planning phase to the execution of operations. Any new element of information can therefore be integrated immediately. Anticipating events makes it possible to minimize their impact on the ATM system. It also gives the chance to use every opportunity to refine and fine tune the plan further.

A variety of air traffic flow management solutions may have to be considered to resolve capacity shortfalls and improve the management of the system while minimising constraints. Examples are shown in Figure below.
9.4. ATFM measures shall aim at:

- preventing air traffic control sectors and airports overload;
- Use network capacity to the maximum extent possible in order to optimise efficiency and minimise adverse effects on operators;
- supporting the management of critical events

There are many types of ATFM measures. Their lifetime typically spans over the pre-tactical and tactical phases of the ATFM time horizon. The list below is not exhaustive and provides guidance on where the various measures fall on the ATFM timeline.
9.5. Strategic and Pre-tactical ATFM

The strategic and pre-tactical phases of ATFM are the foundation of steady operation in the tactical phase. Their main objective is management of flight plans and can be divided into four aspects:

- Scheduled flight management;
- Non-scheduled flight management;
- Large (special) event air traffic operation management; and
- ATFM fixed scheme.

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<td>Slot swapping, Ground delay program, Ground stop, Airborne holding</td>
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Figure below summarizes these ATFM measures.
The precision of estimating air traffic flow and system capacity varies and generally improves when approaching the execution date. Management methods vary accordingly, depending on the accuracy of these estimates.

### 9.5.1. Scheduled Flights

The management of scheduled flights is mainly realized by coordination and adjustment of airport takeoff/landing times and air routes. Detecting and eliminating congestion, such as scheduled flights in a segment of airspace and/or airport, can avoid demand exceeding capacity.

#### Coordination of Takeoff/ Landing Times

- The takeoff/landing times (also called airport slots) of scheduled flights are adjusted four times a year corresponding to major changes in weather and traffic patterns and volumes. The international and domestic flights are coordinated separately. The International Air Transport Association (IATA) conducts the coordination of airport slots for international flights and AAI conducts the coordination for domestic flights. There are sufficient slot resources in most airports. Therefore, slots can easily be arranged according to the demand of airspace users. However, slot resources are deficient in a few airports, due to various reasons. In these airports, an ATFM measure, such as repetitive adjustment of newly added flights, should be taken in order to achieve the result agreeable to most parties. AAI scheduled flight arrangements should meet the following requirements:

  - AAI has developed relevant regulations and policies for the purpose of safety, fair use of scarce resources, and so on. AAI should ensure the result of the scheduled flight time arrangement complies with these regulations and policies. For instance, AAI promulgated a restriction policy on daily operation volume of some large airports such as Indira Gandhi International Airport. AAI should ensure the hourly operations volume of these airports never exceeds the restriction limit.

  - There is a priority order in coordination of scheduled flights. For instance, past-year flights operated during the same season have priority over newly added flights and international flights have priority over domestic flights. AAI should ensure the result of slot arrangement for all scheduled flights complies with these priority principles.

  - AAI develops relevant regulations and policies that ensure safe and orderly air traffic, as well as the equal rights of airspace users in airspace utilization.

#### Route Management of Scheduled Flights

- AAI usually asks all scheduled flights to use the same city pair routes to reduce the errors in ATM. However, in special conditions, AAI encourages or permits scheduled flights to use different city pair routes. These special conditions include:

  - For aircraft performance restrictions or emergency situations, such as high-level depressurization in a mountainous areas and en route one engine failure.

  - Newly added flights use another city pair route when the existing route is overly busy.
• When the route can only be determined by tactical conditions, such as severe weather conditions, the flight is entitled to plan two or more city pair routes at the same time for scheduled flight. It should then choose the route according to FPL before executing.

• Outside of these conditions, when scheduled flights use relatively fixed city pair routes, the TMSs can judge and stay informed of airspace flight accumulation during the strategic phase, use it as a background basis (information) during the pre-tactical phase, then make timely adjustments in the tactical phase.

9.5.2. Non-scheduled flights:
The ATFM solution to handle non-scheduled flights is to allocate airport and airspace slots in a similar way to scheduled flights but with a lower priority than the scheduled flights. The pre-tactical window for handling non-scheduled flights is small leading to complexities of overall ATFM system. Sometimes exemptions may need to be granted to such flights due to medical, search and rescue reasons which will change the tactical ATFM scenario.

9.5.3. Large (Special) Event Air Traffic Flow Management
The large (special) events mentioned here include, but are not limited to, large sports games, international conferences, state conferences, large religious activities, and air shows. These events may greatly increase or severely restrict air traffic in some areas. The ATS and safety are integral parts of a whole event. Any small error may affect the whole activity.

Air traffic operation management for large (special) events runs throughout the ATFM process, with a key step developing reasonable solutions in the strategic and pre-tactical phases.

The most important step to resolve large (special) event air traffic flow problems is to correctly identify potential problems well before the event and evaluate them. TMSs at terminal, en route, regional, and national levels should collaborate to determine potential causes of air traffic flow problems and study and analyze which airspace, airport, time period, and main flow will cause possible demand increases. Only after a clear understanding of the above is achieved, can large (special) event organizers, airspace users, airports, and other units collaboratively plan and implement effective ATFM initiatives.

There are two classes of large (special) event TMIIs. For common large (special) events, the submission of the initial flight plan by an airline is the starting point for ATM. The process is complete once the plan is evaluated and adjustments are made as needed to address system capacity issues. For special large (special) events, capacity and demand issues may be addressed with airspace reorganization/modification, and control methods updates/modifications. These actions will likely occur months or even years in advance to address high demand events.

9.5.4. Fixed ATFM Plans (Schemes)
Similar flow problems may occur repeatedly in some areas. Therefore, developing relatively the same solutions for these problems in advance and providing relevant ATC operation facilities and airspace users with these standard solutions is namely a fixed ATFM scheme. Fixed ATFM schemes are agreed upon by ATFM, ATC operations, airlines, military authorities, and other stakeholders well in advance of implementation. When problems occur, the fixed ATFM scheme can be implemented to resolve these problems without engaging in complicated discussions and decision-making. During the process, the
conditions for implementation should be adjusted according to the situation and the database should be updated regularly.

The following reasons support the need for developing fixed ATFM schemes:

- The military activity needs to use fixed airspaces and civil routes go through these airspaces. In most cases, the military does not occupy these airspaces at all times, therefore, corresponding fixed ATFM schemes can be developed. When a military activity needs these airspaces, the civil flights will perform airspace avoidance and flow control using pre-agreed fixed ATFM programs.
- The fixed ATFM scheme can also be developed for certain severe weather that frequently appears in some areas. When the influence of severe weather reaches a certain level, the fixed ATFM scheme should be started. For instance, to avoid typhoons, a fixed avoidance route can be determined for different typhoon paths.
- Routine seasonal closures to air traffic facilities for preventative maintenance (e.g. painting, paving and de-rubberizing runways).
- Note that actual operations vary greatly and it requires careful studies of actual situations before implementing the fixed ATFM scheme. When necessary, the decision-maker may need to adjust the fixed ATFM scheme before its implementation. It is also very important to document significant activities and actions so that these fixed management schemes can be analyzed and adjusted routinely for future use.

9.6. Tactical ATFM Measures

In the strategic and pre-tactical phases, the ATFM system uses static capacity values that come from evaluations, experiences, statistical analysis etc., as threshold values to adjust demand. As we near to the tactical phase, both capacity and demand become dynamic values that need tactical measures to maintain demand capacity balance across the ATM system. The ATFM Tactical Measures are also known as Traffic Management Initiatives (TMI). TMIs are techniques used to manage air traffic demand according to system capacity. Some TMIs must be considered as control instructions or procedures. The determination is based on the size of the event, the coordination process, and the duration of the event.

9.6.1. Purpose of TMIs

TMIs are important techniques for managing the air traffic system when they are coordinated and applied properly. TMIs are applicable when it is necessary to manage fluctuations in the air traffic demand, but they do cause an impact to the customers. It is important to consider this impact and implement only the initiatives that are necessary for maintaining the integrity of the system. Therefore, traffic management personnel should employ the least restrictive methods available in order to minimize delays.

Note: In certain instances it may be necessary to apply combinations of TMIs in order to maintain system integrity while applying the least restrictive measures; i.e., miles-in-trail with holding in lieu of ground stopping aircraft.

9.6.2. Why do imbalance occur?

However, in the tactical phase, most flow problems can be attributed to system capacity decreases that cannot be predicted accurately. Others may be induced by the amendment of flight plans by airspace users or failures of traffic flow arrangement in the pre-tactical phase.
In the tactical phase, airspace users may desire to change the original flight plan because of aircraft, aircrew, passengers, and so on. However, this kind of tactical change usually will not cause severe flow problems. In the same way, a collaborative planning cycle in the pre-tactical phase amongst all levels of ATFM will minimize flow arrangement errors. Capacity decreases stemming from unpredictable system constraints is the main focus of ATFM specialists in detecting air traffic flow problems in the tactical phase.

The capacity can be impacted due to:

- **Weather:** Convective weather, low altitude wind shear, airport fog, air turbulence, strong wind or gale, sand storm, mountain wave, or other severe weather conditions.
- **Airport:** Runway or taxiway problems or construction/repair work in progress, runway or taxiway contamination, airport clearance, apron parking limitations, etc. In addition, although not directly related to airspace or air traffic capacity, failure of automatic airport luggage sorting systems, expressway traffic jams from the airport to downtown area, or other air-side and land-side airport problems may impact aircrews, passengers or freight operations and therefore air traffic operations. Although these types of airport problems impact capacity, their solutions will be covered in more detail in the airport section of this Operations Concept.
- **Military:** Military activities that are not notified or not implemented according to plans in pre-tactical phase.
- **Equipment:** Lowering safety level due to failure of communication/navigation/surveillance equipment, ATC automation system, weather equipment (accompanied with severe weather), or other equipment.
- **Abnormal In-flight Conditions:** Communications interference or limitations, airborne interference, terrorism attack, Unidentified Flying Object (UFO), special conditions of aircraft in flight, or other abnormal conditions in the air requiring avoidance or other measures.

**9.6.3. Process of Determining Tactical ATFM Measures**

A general flow diagram showing the processes involved in identifying ATFM measure is shown below. The Traffic Flow Managers in coordination with relevant TMUs should follow these steps in arriving at a decision.
9.6.4. **Resolutions of Tactical Flow Problems**

Two primary sets of solutions exist for solving ATFM problems in the tactical phase:

**Spacing measures** are a series of techniques to allow aircraft to avoid areas with reduced capacity when flow problems occur. Basic spacing measures are changing FLs, small scale radar vectoring deviations and, in more severe cases, large scale deviations or even alternative routes. Air traffic specialists usually prefer spacing measures to accomplish problem resolution. However, at some point, no additional airspace exists for spacing maneuvers. At this time, TMSs need to employ timing measures.

**Timing measures** are also a series of techniques to adjust air traffic demand when flow problems occur. Timing measures may include de-peaking in pre-time scheduling, flow control, call for release (CFR), ground delay programs, airline decisions to cancel or substitute flights, ground stop, airborne holding, time-based metering of airborne aircraft, and so on. These time measures usually can adjust the air traffic flow in order to meet capacity restrictions.

**Spacing Measures**

Some of the spacing measures are:
• Altitude adjustment: Capping, Tunneling
• Airborne Holding
• Route Adjustment

**Time Measures**

Some of the time measures are:

• In–Trail Spacing Restrictions
• Call For Release
• Airborne Holding
• Route Adjustment
• Ground Delay Program
• Ground Stop
• User Initiated Cancellation and Substitution

**Spacing Measures:**

**Miles-in-trail (MIT).**

A tactical ATFM measure. It is expressed as the number of miles required between aircraft (in addition to the minimum longitudinal requirements), to meet a specific criterion. The criteria may be separation, airport, fix, altitude, sector, or route specific. MIT are used to organize traffic into manageable flows, as well as to provide space to accommodate additional traffic (merging or departing) in the existing traffic flows.

The number of miles required between aircraft that meet a specific criteria. The criteria may be separation, airport, fix, altitude, sector, or route specific. MIT are used to apportion traffic into manageable flows, as well as to provide space to accommodate additional traffic (merging or departing) in the traffic flow.

Implement Miles In Trail (MIT) restrictions between centers and nationally

A specified interval between aircraft expressed in nautical miles that meet a specific criteria. The criteria may be separation, airport, fix, altitude, sector, or route specific. MIT are used to apportion traffic into manageable flows, as well as, provide space for additional traffic (merging or departing) to enter the flow of traffic.

**Minutes-in-trail (MINIT).**

A tactical ATFM measure. It is expressed as the number of minutes required between successive aircraft. It is normally used in airspace without air traffic surveillance, or when transitioning from surveillance to non-surveillance airspace, or even when the spacing interval is such that it would be difficult for a sector controller to measure it in terms of miles.
The number of minutes required between successive aircraft. It is normally used in a non-radar environment, or when transitioning to a non-radar environment, or when additional spacing is required due to aircraft deviating around weather.

**Fix balancing.**

A tactical ATFM measure, aiming at distributing demand and avoiding delays. The aircraft is assigned a different arrival or departure fix than the one indicated in the flight plan. This can also be used, for example, during periods of convective weather where a standard instrument arrival (STAR) or a standard instrument departure (SID) is unusable.

Assigning an aircraft a fix other than that in the filed flight plan in the arrival or departure phase of flight to equitably distribute demand

**Rerouting.**

A tactical ATFM measure. It consists of an ATC-assigned routing different from the one indicated in the filed flight plan. Rerouting can take a variety of forms, depending on the tactical situation. Reroutings are ATC routings other than those shown in the filed flight plan. They are issued to: a. Make sure that aircraft operate along the traffic “flow”. b. Remain clear of special use airspace. c. Avoid congested airspace. d. Avoid areas known for their difficult weather conditions, and which aircraft are circumventing or refusing to fly.

Mandatory Rerouting scenarios: Mandatory diversion of flows to offload traffic from certain constrained areas.

Level capping scenarios: Carried out by means of flight level restrictions (e.g., flights from London to Paris TMA shall file below FL285, with departures limited to FL 245 until they exit the TMA).

Alternative or advisory routing scenarios: Routes which are made available to AUs on an optional basis to offload traffic from certain areas.

A rerouting is normally issued to:

a) ensure that aircraft operate along with a required flow of traffic;

b) remain clear of airspace under restrictions or reservations;

c) avoid excessively congested airspace; and

d) avoid areas of known meteorological conditions of such nature that aircraft have to circumvent it, or cannot fly through.

**Altitude Adjustment**

Used for segregating different traffic flows, or to distribute the number of aircraft requesting access to a specified geographic region.

a. **Capping:** Term to indicate aircraft will be cleared to an altitude lower than their requested altitude until they are clear of a particular airspace. Capping may apply to the initial segment of the flight or for the entire flight.
b. **Tunneling**: Term to indicate traffic will be descended prior to the normal descent point at the arrival airport to remain clear of an airspace situation; e.g., holding. Capping and Tunneling are techniques commonly used to keep aircraft from entering busy and complex sectors and still permitting them to depart with minimal delays.

**Sequencing Programs**

These programs are designed to achieve a specified spacing between aircraft. They may be software-generated or determined by ATFM personnel. Different types of programs accommodate different phases of flight.

a. **Departure Sequencing Programme (DSP)** - Assigns a departure time to achieve a constant flow of traffic over a common point. Normally, this involves departures from multiple airports.

b. **En route Sequencing Programme (ESP)** - Assigns a departure time that will facilitate integration in the en route stream. This is accomplished by instructing an air traffic control tower to call the traffic management unit for release -- “Call For Release.”

c. **Arrival Sequencing Programme (ASP)** - Assigns fix crossing times to aircraft destined to the same airport.

d. **Minimum Departure Intervals (MDIs)**. A tactical ATFM measure. Carried out when ATC sets a departure flow rate of, for example, 3 minutes between successive departures. MDIs are typically applied for no more than 30 minutes at a time and are typically applied when a departure sector becomes excessively busy or when capacity is suddenly reduced (e.g., equipment failure, meteorological conditions, etc.).

**Slot Swapping.**

A tactical ATFM measure. Can be applied either manually or via automated means. The ability to swap departure slots gives AUs the possibility to change the order of departure of the flights that should fly in a constrained area. This measure provides AUs with the ability to manage and adapt their business model in a constrained environment.

**Playbook routes. (Coded Departure Routes)**

A strategic, pre-tactical, or tactical ATFM measure. It is composed of a set of collaboratively developed, published, pre-defined routes to address reoccurring route scenarios. The playbook is an assistance tool that allows efficient route coordination to be held during periods of system constraint.

**Ground delay programme (GDP).**

A strategic, pre-tactical, or tactical ATFM measure. A GDP is an air traffic management process where aircraft are held on the ground in order to manage capacity and demand in a specific volume of airspace or at a specific airport. In the process, departure times are assigned. They correspond to available entry slots into the constrained airspace or arrival slots into the constrained airport. A GDP aims at, among others, minimizing airborne holding. It is a flexible programme, and its forms may vary depending on the needs of the air traffic management system. GDPS are developed in a collaborative manner and are typically administered and managed by a FMU or a national/international ATFM centre. When a GDP is scheduled
to last for several hours, slots might have to be revised because of changing conditions. There must therefore be a system in place to advise pilots of departure slots and of any changes to the GDP.

A GDP is a TM process administered by the FMU, when aircraft are held on the ground in order to manage capacity and demand at a specific location, by assigning arrival slots. The purpose of the programme is to support the TM mission and limit airborne holding. It is a flexible programme and may be implemented in various forms depending upon the needs of the air traffic system.

Implement Ground Delay Programs (GDPs).

A GDP is a TFM process administered by the CCC; when aircraft are held on the ground in order to manage capacity and demand at a specific airport, by assigning arrival slots. The purpose of the program is to support the TFM mission and limit airborne holding. It is a flexible program and may be implemented in various forms depending upon the needs of the air traffic system. The CTOT (EDCT) is calculated based on the estimated time en route and the arrival slot. It is important for aircraft to depart as close as possible to the CTOT (EDCT) to ensure accurate delivery of aircraft to the impacted location. GDPs provide for equitable assignment of delays to all system users.

**Ground stop (GS).**

GS is a process that requires aircraft that meet specific criteria to remain on the ground. Since this is one of the most restrictive methods of traffic management, alternative initiatives should be explored and implemented if appropriate.

GS should be used:

- In those cases in which capacity has been severely reduced at airports/runways closed for weather, or due to aircraft accidents/incidents;
- To preclude extended periods of in-flight holding;
- To preclude sector/centre reaching near saturation levels or airport grid lock;
- In the event a facility is unable or partially unable to provide ATC services due to unforeseen circumstances; and
- When routings are unavailable due to severe weather or catastrophic events.

A tactical ATFM measure. Some selected aircraft remain on the ground. Due to a ground stop’s potential impact on AUs, alternative ATFM measures should be explored and implemented prior to a GS, time and circumstances permitting. The GS is typically used:

a) in cases where capacity has been severely reduced at airports due to significant meteorological events or due to aircraft accidents/incidents;

b) to preclude extended periods of in-flight holding; to preclude sector/centre reaching near saturation levels or airport grid lock;

c) in the event a facility is unable or partially unable to provide air traffic services due to unforeseen circumstances; and

d) when routings are unavailable due to severe meteorological or catastrophic events.

Implement Ground Stops (GSs)
The GS is a process that requires aircraft that meet a specific criteria to remain on the ground. The criteria may be airport specific, airspace specific, or equipment specific. GSs normally occur with little or no warning. Since GSs are one of the most restrictive methods of traffic flow management, alternative initiatives should be explored and implemented if appropriate. GSs should be used:

a. In severely reduced capacity situations (below most user arrival minimums, airport/runway closed, or aircraft accidents/incidents);

b. To preclude extended periods of airborne holding;

c. To preclude sector/center reaching near saturation levels or airport grid lock; In the event a facility is unable or partially unable to perform ATC services due to unforeseen circumstances;

e. When routings are unavailable due to severe weather; and

f. When routings are unavailable due to catastrophic events.

Airborne Holding.

A tactical ATFM measure that has been designed strategically. It is a process that requires aircraft to hold at a waypoint in a pre-defined standard holding pattern. It is generally used to cope with short notice demand and capacity imbalances. It can also allow to establish an inventory of aircraft that would be in a position to take advantage of short notice temporary increases in capacity such as during certain types of meteorological events.

In-flight holding of aircraft is a commonly used TMI, especially when its use is foreseen due to traffic volume, weather conditions, power outages, unexpected events, etc. When in-flight holding is expected, AT facilities and customers can make appropriate adjustments and alert personnel as to the reasons and length of holding. Airborne holding is normally done when the operating environment supports holding and the conditions are expected to improve shortly; this ensures aircraft are available to fill the capacity at the airport.

During the strategic planning phase, stakeholders collaborate to determine suitable locations for the holding patterns. Analysis has shown that the optimal flight levels for airborne holding, from a fuel efficiency perspective, are FL200 – FL280. These flight levels strike the right balance between lesser fuel consumption for turbine-powered aircraft, and the size of the holding area. Although inefficient holds at low altitudes should be avoided, there are however cases where lower altitude holding areas can be designed to provide for a small ready supply of holding aircraft: they would be in a position to take advantage of a short notice opportunity. In any case, holding altitudes should be compatible with normal descent profiles in order to avoid excessive rates of descent and airspeeds.

Airborne holding is complementary to ground delay programmes and ground stops. Airlines may, in collaboration with the ANSP, choose to use it to keep a small inventory of holding aircraft, during periods of congestion, to maintain demand pressure on the approach. The supply of available aircraft can prevent losing opportunities when departure demand is not constant or when meteorological conditions vary.

Airborne holding generates high workload for air traffic controllers and pilots. Every effort must therefore be made to simplify the procedures and to minimize communications during the process. Consideration must also be given to reducing sector capacity during airborne holding periods.
Implement Call for Release.

This is an easily implemented TMI that requires verbal coordination initiated by a terminal facility to secure ACC approval for releasing a departure into the en route environment. It is imposed by an APP TMU on an underlying Tower as a tactical TMI to control departure times of departing aircraft so as to optimize the departure flow.

User Initiated Cancellation and Substitution:

In GDP, ATFM will inform airspace users affected by their incoming delays. If there is sufficient time, the airlines reserve the right to cancel flights or find substitutes. The users may cancel or substitute flights in order to maximize their passenger number at departure airport, or optimize aircraft or crew arrangement in their system to ensure connections for key flights. There is no restriction on flight cancellation. The substituted flights should be those affected by the ground delay program. If an airline initiates a flight cancellation but provides no additional flight to fill the cancelled flight slot, then its right to provide a substitution flight for that slot may be assigned to the following flight, regardless of the airline.

9.7. ATFM Measure Approval Authority

The coordination and approval of ATFM measures must conducted be in accordance with the collaborative decision-making process established for the provisions of the ATFM service. The designated FMU/FMP for each service provider and/or State is the approval authority for all TMIs that impact their airports, TMAs, and en route airspace system. Publication in national AIPs and/or regional supplementary procedures is recommended.

9.8. ATFM Measures Processing

Prior to implementation, the FMU/FMP responsible for ATFM oversight must identify the need for a TMI, examine alternative options, and develop a justification for the TMI. The FMU/FMP shall discuss and coordinate the proposed TMI with the receiving facility prior to implementation. FMPs must continuously monitor and assess the TMIs and make the necessary adjustments, including cancellations and notifications, in a timely and effective manner.

Prior to implementation, the designated authority responsible for ATFM must identify the need for an ATFM measure, examine alternative options, and develop a justification for the ATFM measure. The ATFM authority will:

a) discuss and coordinate the proposed ATFM measure with the receiving facility and stakeholders prior to implementation;

b) notify affected facilities and stakeholders of the implementation in a timely and appropriate manner;

c) continuously monitor and assess the ATFM measures to ensure they are producing the desired results;

d) make any necessary adjustments, including the development of an exit strategy; and
e) coordinate with and notify affected facilities and stakeholders of modifications and cancellations in a timely and appropriate manner.

9.9. **Implementation, adjustment, coordination, and cancellation of TMIs**

It is recommended that States and/or service providers develop an internal operations manual for their respective facilities, describing the aforementioned actions.

For example:

a. The implementation of the TMIs will be accomplished through established means, such as telephony, web page/information system, or any other available methodology.

b. Constant monitoring would be required for making the corresponding adjustments.

c. TMIs shall be cancelled when no longer needed and demand/capacity balancing is achieved.

It is important for all system users to be aware of cancelled initiatives so as to make the corresponding adjustments.
10. **C-ATFM OPERATIONS - POST OPERATIONS ANALYSIS**

The final step in the ATFM planning and management process is the post-operations analysis phase.

During the post-operations analysis phase, an analytical process is carried out to measure, investigate and report on operational processes and activities. It shall cover throughout all domains and external units relevant to an ATFM service. This process is the cornerstone of the development of best practices and/or lessons learnt that will further improve the operational processes and activities.

*Note.*—*A best practice is a method, process, or activity that, upon evaluation, demonstrates success, has had an impact, and can be repeated. A lesson learned documents the experience gained during an event, and provides valuable insight with respect to identifying method, process, or activity that should be used or, to the contrary, avoided in specific situations.*

While most of the post-operations analysis process may be carried out internally within the ATFM unit, close coordination and collaboration with external stakeholders will optimize the output of the analysis process. By including ATFM stakeholders in the feedback process, collaboration fosters a more efficient and reliable way to achieve optimum results.

Post-operations analysis should be accomplished by evaluating, along with other items, the ATFM daily plan and its results. Issues reported should be evaluated and analysed in order to learn from the actions reported and to make appropriate adjustments and improvements in the future.

Post-operations analysis shall include analysis of items such as anticipated and unanticipated events, ATFM measures and delays, the use of predefined scenarios, flight planning and airspace data issues. They should compare the anticipated outcome (where assessed) with the actual measured outcome, generally in terms of delay and route extension, while taking into account performance targets.

All stakeholders within the ATFM service should provide feedback, preferably in a standardized electronic format, enabling information to be used in the post-operations analysis in an automated manner.

In complex areas, and in order to support the post-operations analysis process, the use of an automated replay support tool, with graphical display, can be useful.

Post-operations analysis may be used to:

a) identify operational trends or opportunities for improvement;

b) further investigate the cause and effect relationship of ATFM measures to assist in the selection and development of future actions and strategies;

c) gather additional information with the goal of optimizing ATM system efficiency in general or even for on-going events;

d) perform analysis of specific areas of interest, such as irregular operations, special events, or the use of reroute proposals; and

e) make recommendations on how to optimize ATM system performance and to minimize the negative impact of ATFM measures on operations.
It is important to ensure that the relevant ATFM stakeholders are made aware of the results. The following process is recommended:

a) collection and assessment of data including comparison with targets;

b) broad review and further information gathering at a daily briefing;

c) weekly operations management meeting to assess result and recommend procedural, training and system changes where necessary to improve performance; and

d) periodic operations review meetings with stakeholders.

Figure below provides an overview of the post-operations analysis cycle.

Logging

There are two kinds of ATFM logs, namely local log and national log. In ATC facilities without a TMU, the ATFM can be recorded in its ATC operational logs. In ATC facilities with a TMU, independent local ATFM logs should be established. The TMUs in ATC facilities should log local ATFM and assist to record ATFM situations around the country affecting their facility. In the CCC, all operation positions log their own work and assist nationwide ATFM logging. A Post Analysis & Information Dissemination Position (PIP) maintains the nationwide ATFM logs.

The ATFM logs must be real-time to ensure that all operational conditions, management decisions, and measures are consistent with the actual operations. There are paper and electronic logs. Paper logs might be converted to electronic/computer logs. In practice, the traffic managers will log during discussion or before the next discussion or action.
The TMSs usually checks logs at the beginning of their shift. The ATFM logs usually consist of operational conditions, ATFM initiatives, and operation safety and operation efficiency related information. These logs record the latest details of conditions and events, such as equipment, traffic, and weather that lead to the present operation status. Some ATFM logs are in unified forms. The record format and content should be standard, since logging requires collaborative efforts of different operation units.

Post Analysing

There are three phases in post analysis of ATFM:
- Operational Data Statistics: To conduct statistics of data in operation process such as actual traffic distribution in time and space, delay and classification of causes of flow problems.
- Analysis and Evaluation: To make a complex analysis of operation process, data and management process; to evaluate management methods, operational efficiency, and so on.
- Suggestions: To provide suggestions on the whole ATFM process, Airspace Management, and ATC based on the result of statistics and analysis.

Post operational analyzing needs a set of flexible statistical tools to effectively analyze and report on the metrics.

Reporting

Reporting is a mechanism of sharing the results of post operation analysis between all the stakeholders and CDM Partners. The methodology, content, visibility, access rules etc., for the reports that are generated by various stakeholders will be decided in a collaborative manner during the course of ATFM implementation. These rules and procedures will be published in due course.

The initial set of guidelines for report generation may consist of the following:
- For reporting purposes, stakeholders should report delays on a monthly basis, at least, and include trend analyses. Delays should be broken down by reason and geographically to support analysis. The CDM partners are encouraged to provide the data electronically in a format that would support further processing by stakeholders.
- Following the publication of delay reports, all the stakeholders should meet to discuss the results and attempt to identify mitigations and corrective actions to improve performance.
- The central unit for ATFM shall monitor occurrences when a correlation cannot be established between a flight plan and the execution of that flight, either:
  - because the flight plan does not exist (case of missing flight plan), or;
  - Because the flight is not executed (case of “ghost” flight plan or multiple flight plans).
- When such occurrences are identified, the central unit for ATFM shall notify the Aircraft Operator concerned.
- AOs, when so notified by the central unit for ATFM, shall report for each non-compliance to ATFCM measures, either through individual reports or after consolidation of the data.
- All the CDM partners shall ensure that appropriate procedures are in place to monitor the adherence to ATFM departure slots at airports in their area of responsibility.
• The CCC shall ensure that ATC units at airports in their area of responsibility, are notified of their lack of adherence to ATFM departure slots,
• ATS units at airports in their area of responsibility so notified above provide the CCC with relevant information of the non-compliance.
• Measures for improvement of adherence shall be prepared by local ATS units in the event of failure to reach adherence targets and these shall be collated by the ATFM directorate and submitted to the ATM directorate to issue recommendations to improve the level of adherence to ATFCM measures.
• AOs shall provide the necessary information allowing the establishment of the correlation between the flight designator contained in the flight plan and that notified for the corresponding airport slot.
• AOs, airport managing bodies and airport slot coordinators shall ensure that appropriate procedures are in place to facilitate the reporting on incidents of repeated operation of air services at times that are significantly different from the allocated airport slots or with the use of slots in a significantly different way from that indicated at the time of allocation, where this causes prejudice to airport or air traffic operations to the airport slot coordinator.
• The central unit for ATFM shall ensure that appropriate procedures are in place to identify repeated operation of air services at significantly different times from the allocated airport slots or with the use of slots in a significantly different way from that indicated at the time of allocation.
• The central unit for ATFM shall ensure that appropriate procedures are in place to facilitate the reporting of such incidents to the relevant airport slot coordinator.

METRICS FROM POST OPERATIONS ANALYSIS

TBD
11. C-ATFM OPERATIONS- FLIGHT PLANNING PROCEDURES

11.1. Introduction
11.1.1. Air Traffic Flow Management is a service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring ATC capacity is utilized to the maximum extent possible and the traffic volume is compatible with the capacities declared by the appropriate ATC authority.

11.1.2. A Centralized Air Traffic Flow Management (C-ATFM) service is established in India to optimize the use of air traffic system capacity. The Central Command and Control Center (CCC) in Delhi provides this service in conjunction with Traffic Management Units (TMU) established at each ACC.

11.1.3. The CCC includes a Flight Plan Management Unit responsible for planning, co-ordination and implementation of ATFM measures within the Indian ATFM area. The Flight Data Management Unit (FDMU) of the CCC is responsible for collecting, maintaining and providing data on all flight operations and the air navigation infrastructure. FDMU includes the Integrated Flight Planning System (IFPS).

11.1.4. AAI will publish a IFPS User’s Manual describing operating procedures for flight plan filing in the Indian ATFM area.

11.2. Significance of FPL information to ATFM
11.2.1. Flight plans and associated update messages are submitted for all IFR flights, including the IFR portions of mixed IFR/VFR flights, entering, overflying or departing the area being monitored for application of ATFM. The filed flight plan is the result of the preparation by AOs to ensure, as far as possible, the most efficient and economic profile for the intended flight. The route and levels are determined by many factors such as aircraft type, payload, weather conditions, route charges, etc.

11.2.2. The flight plan data, departure and arrival times, waypoints, route and levels are key elements in the preparation for airports, ACCs and CCC to manage the flight in a safe and optimum manner.

11.2.3. The forecast traffic demand and available ATC capacity is identified by ATC at ATC sector level and thus appropriate scenarios and sector configurations can be put in place for the day of operations. This assessment of traffic counts and sector loads, when and where appropriate, may result in a request for ATFM CCC to put protective ATFCM regulation in place.

11.2.4. ATFCM is implemented for airspace where the traffic demand exceeds the defined ATC capacity.

11.2.5. Flow and/or capacity management measures such as departure slots, level-capping or rerouting scenarios may then be needed to prevent sector overloads.

11.2.6. ATFM regulations are put in place to protect ATC from receiving more traffic than the controller can handle safely. However, it happens that more aircraft than planned enter these protected sectors, exceeding their capacities by more than 10%, which is regarded as an ATFCM “over-delivery”. When investigating those reported occurrences in most cases it has been found (European experience) that additional flights entered the concerned sector as a result of:

- Not flying at the initial requested flight level (RFL); or,
- Departing at times different from the original estimated off-block time (EOBT) or calculated take-off time (CTOT); or,
- Arriving in the sector earlier or later than originally planned; or
- Deviating from their original planned route (often direct routing (DCT)).
11.2.7. Accurate flight plan data is essential. If change is not communicated then this immediately introduces an element of inaccuracy into traffic projections for both en-route and destination airports.
11.2.8. ATFM CCC can allocate a calculated take-off time (CTOT) to protect a congested ATC sector. In such circumstances:
   - Aircraft Operators (AOs) should plan the departure of their flight so that the aircraft will be ready for start in sufficient time to comply with the CTOT.
   - Slot tolerance (-5min +10min) is available to ATC to organize the departure sequencing.
   - Airports and controllers should have effective practices to monitor EOBT & CTOT.
   - ATC has a joint responsibility with AOs in CTOT adherence.
   - ATC may deny start up clearance to a flight unable to meet its CTOT until coordination with the ATFCM unit concerned.

11.3. Flight Planning Procedures –
11.3.1. Flight planning in India is governed by procedures described in AIP India ENR 1.10 FLIGHT PLANNING and AIP supplement 11/2012.
11.3.2. The procedures will need to be amended suitably to enable C-ATFM operations and compliance.
11.3.3. The Flight Planning Procedures for effective and efficient ATFM operations will be reviewed and revised procedures will be published.
11.3.4. The current practice of filing of FPL at concerned airports will continue in the interim period, i.e. till ATFM Phase II.
11.3.5. All the FPLs filed at different airports, regions or through on line FPL portal will be routed internally by AAI to CCC FDMU in addition to their normal routing.
11.3.6. The domestic airlines that are filing RPLs at the regional offices will also be required to submit RPL files to CCC. Any changes, modifications, addition, deletion to the RPL files will also need to be submitted to CCC by the airlines, in addition to the respective regional centers.
11.3.7. In the first phase of C-ATFM, airspace users intending to operate from and to the six major airports are required to submit their FPLs at least three hours in advance from ETD.
11.3.8. AAI will undertake a comprehensive review of FPL procedures and publish the information in AIP in due course.
12. C-ATFM OPERATIONS – IMPLEMENTATION CONSIDERATIONS

12.1. CERTIFICATION:
These new operational systems and interfaces need to be certified by an AAI organization that has the responsibility and enforcement power to ensure that these systems are operating safely and as intended. For example, in the United States, FAA software certification is based on the standard RTCA/DO-178B. The standard provides information about all aspects of the software certification process including the following sections: software planning process, software development process, software verification process, and the certificate liaison process. The software verification process includes more than testing, since testing in general cannot show the absence of errors. Therefore, the software verification process is usually a combination of review, analyses, and testing. Review and analyses are performed on the following different components. [RTCA92]

A> Requirements analyses - To detect and report requirements errors that may have surfaced during the software requirements and design process.
B> Software architecture - To detect and report errors that occurred during the development of the software architecture.
C> Source code - To detect and report errors that developed during source coding.
D> Outputs of the integration process - To ensure that the results of the integration process are complete and correct.
E> Test cases and their procedures and results - To ensure that the testing is performed accurately and completely.

12.2. SAFETY

The ATFMS is not a safety critical system but it will improve overall safety and efficiency of the National Air Space (NAS). All organizations within AAI need to be made aware of what TFM does for the NAS and its impact on safety. However, it is not operated as a safety critical system since it is not responsible for critical aircraft separations. None the less safety analysis is required to ensure that the ATFMS does not adversely affect the safety of the Air Traffic management System. This analysis is conducted as part of the System Engineering Process. During the C-ATFM implementation process AAI and the technical partner will undertake Safety Management Process to ensure the overall safety of ATM system and will also ensure that:

- The Safety Management Process shall ensure that the parties involved in ATFM (or agents acting on their behalf) comply with the DGCA Safety Regulatory Requirements for use of safety management systems by ATM service providers.
- The SMS Process shall ensure that the parties involved in ATFM (or agents acting on their behalf) comply with the AAI Safety Regulatory Requirements for risk assessment and mitigation, including hazard identification, in Air Traffic Management (ATM) when introducing and/or planning changes to the ATM System.
- The SMS process shall ensure that the parties involved in ATFM comply with the AAI Safety Regulatory Requirements for software in ATM systems.
- The SMS Process shall ensure that all relevant staff are adequately qualified and trained before any changes to operations are introduced, in compliance with the DGCA Safety Regulatory Requirements for ATM service’s personnel.
12.3. SYSTEM TRANSITION AND OPERATION

Transition from the old operation to the new operation following system acceptance is an important consideration. In the case of the ATFM program there will not be a transition from an old system to a new system, but rather the addition of a new system and transition to an enhanced way of performing ATFM tasks. Therefore much planning is needed for this phase.

- A Cutover and Transition plan document must be produced during the implementation process.
- The transition plan must consider operator workload, organizational change, and other human resource issues.
- After operations are fully transitioned to the new (or upgraded) system, the system and the relationship with the contractor must be managed throughout the system life cycle. Many of the issues relating to In-Service Management are addressed earlier in this document. For example, the maintenance and warranty strategy will affect the degree to which a relationship must be maintained with the contractor, and will have human resources implications such as staffing and training of technical personnel.
- From the Information Security perspective, it may be wise to require that any updates to the procured antivirus and other security solutions, be available at no cost, at least for the entire duration of the warranty period.

12.4. C-ATFM SYSTEM- CONTINGENCY PROCEDURES

- The central unit for ATFM shall develop, maintain and publish contingency plans defining the actions to be taken in the event of a major failure of a component of the ATFM service which would result in significant reductions in capacity and/or major disruption to traffic flows.
- The central unit for ATFM shall publish local contingency plans defining the actions to be taken in the event of a failure of a local component of the ATM service which would result in significant reductions in capacity and/or major disruption to traffic flows.
- Local ATFM units shall have in place pre-defined contingency plans detailing the configurations, capacities and strategies in each critical event for their area of responsibility, in order to enable the central unit for ATFM to assist local ATFM units in contingency operation.
- Local ATFM units shall coordinate their contingency plans with the central unit for ATFM and include them in a LoA.
- Local ATFM units shall be responsible for ensuring such plans are kept updated and notified to the central unit for ATFM.
13. FUTURE DEVELOPMENTS

Air Traffic Control System Modifications
The air traffic control function consist of complex tasks demanding a high degree of skills and abilities for quick and fast information processing, reasoning and decision-making. Operational efficiency of the controller and ATFM specialists could be improved by providing appropriate decision support software tools for support of air traffic flow management. These tools will assist the controller in conflict prediction, detection, advisory and resolution and the ATFM specialist in the identification and resolution of congestion problems.

The expectation is that greater degrees of accuracy could be achieved through the sophisticated data processing associated with automation and should allow more direct routings. Furthermore, traffic congestion in en route and terminal airspace as well as at airports should be more accurately forecasted and efficient traffic management initiatives formulated. These systems should be implemented at all ATC centers, busy terminals and airports.

The role of automation should enhance controller and ATFM specialist performance with consequential benefits in increased safety, capacity and efficiency. The level of automation must be compatible with the humans’ ability to execute and manage the task. There should be a back-up system to cope up with system failure.

As defined above, ATC automation will require modifications primarily because the ATFMS and the ATC systems need to exchange information bidirectionally. An example of this data exchange happens during the implementation of GDPs or GSs. The ATFMS will produce a list of flights affected with their Estimated Departure Clearance Times (EDCT) and then the controllers will either hold these flights or release them later in order to meet the ATFMS assigned EDCT.
14. **APPENICES**

a. APPENDIX A - CCC AND TMU LOCATIONS

b. APPENDIX B - CCC LAY OUT

c. APPENDIX B - WEB BASED CDM PROCEDURE

d. APPENDIX C - ATFM COMMUNICATION

e. GLOSSORY
a. **CCC AND TMU LOCATIONS**

- **CCC (DELHI)**
  - TMU (DELHI)
    - TMU (JAIPUR)
    - TMU SRINAGAR
    - TMU JAMMU
    - TMU CHANDIGARH
    - TMU AMRITSAR
  - TMU (MUMBAI)
    - TMU AHMEDABAD
    - TMU NAGPUR
    - TMU INDORE
    - TMU BHOPAL
  - TMU (CHENNAI)
    - TMU COCHIN
    - TMU TRIVANDRUM
    - TMU CALICUT
    - TMU INDORE
    - TMU BHOPAL
  - TMU (KOLKATA)
    - TMU GUWAHATI
    - TMU TRIVANDRUM
    - TMU BHOPAL
    - TMU MANGALORE
  - TMU (BANGALORE)
    - TMU GOA
    - TMU BHOPAL
    - TMU MANGALORE
    - TMU PORTBLAIR
  - TMU (HYDERABAD)
    - TMU VIZAG
    - TMU TRIVANDRUM
    - TMU BHOPAL
    - TMU MANGALORE
    - TMU PORTBLAIR
    - TMU TRICHY
    - TMU MADURAI
    - TMU MANGALORE
    - TMU PORTBLAIR
    - TMU MADURAI
    - TMU RANCHI
b. **CCC LAY OUT**

- **CCC OPERATIONAL SUPERVISOR**
  - ATFM MANAGER (W)
  - ATFM MANAGER (E)
  - ATFM MANAGER (N)
  - ATFM MANAGER (S)
- FLIGHT DATA MANAGEMENT UNITS (2 Positions)
- ATFM MANAGER (S)
  - ASM (FUA, ROUTES COORDINATION)
  - CDM (AIRPORTS, GA, MILITARY)
  - CDM (AIRCRAFT, MILITARY)
- ARMS & CNS FACILITIES MONITORING
  - AIRLINES REP
  - SPL EVENTS MONITORING POSITION
  - REPLAY POSITION
- DIRECTORATE OF AIR TRAFFIC FLOW MANAGEMENT
c. **CDM PROCEDURES**

**TBD**
d. **ATFM COMMUNICATION – TERMINOLOGY**

**TBD**
## GLOSSARY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AAI</td>
<td>Airports Authority India</td>
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<tr>
<td>AAR</td>
<td>Aerodrome Arrival Rate or Airport Acceptance Rate</td>
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<td>Air Traffic Management</td>
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<td>ABI</td>
<td>Advanced Boundary Information (AIDC)</td>
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<td>ACAS</td>
<td>Airborne Collision Avoidance System</td>
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<td>ACC</td>
<td>Area Control Centre</td>
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<tr>
<td>ACP</td>
<td>Acceptance (AIDC)</td>
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<td>ADOC</td>
<td>Aircraft Direct Operating Cost</td>
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<td>ADS-B</td>
<td>Automatic Dependent Surveillance-Broadcast</td>
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<tr>
<td>ADS-C</td>
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<td>AIDC</td>
<td>ATS Inter-facility Data Communications</td>
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<td>AIGD</td>
<td>ICAO ADS-B Implementation and Guidance Document</td>
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<td>AIM</td>
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<tr>
<td>AIRAC</td>
<td>Aeronautical Information Regulation and Control</td>
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<td>AIRD</td>
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<td>AIXM</td>
<td>Aeronautical Information Exchange Model</td>
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<td>AMAN</td>
<td>Arrival Manager</td>
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<td>AN-Conf</td>
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<tr>
<td>AOC</td>
<td>Assumption of Control (AIDC)</td>
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<td>AOM</td>
<td>Airspace Organization and Management</td>
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<tr>
<td>APAC</td>
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<tr>
<td>APANPIRG</td>
<td>Asia-Pacific Air Navigation Planning and Implementation Regional Group</td>
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<tr>
<td>APCH</td>
<td>Approach</td>
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<tr>
<td>APEC</td>
<td>Asia Pacific Economic Cooperation</td>
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<td>APSAPG</td>
<td>Asia/Pacific Seamless ATM Planning Group</td>
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<tr>
<td>APV</td>
<td>Approach with Vertical Guidance</td>
</tr>
<tr>
<td>APW</td>
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<tr>
<td>ASBU</td>
<td>Aviation System Block Upgrade</td>
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<tr>
<td>ASD</td>
<td>Aircraft Situation Display</td>
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<tr>
<td>ASEAN</td>
<td>Association of Southeast Asian Nations</td>
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<td>ASMGCS</td>
<td>Advanced Surface Movements Guidance Control Systems</td>
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<td>ATCONF</td>
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<td>ATIS</td>
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<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>ACC</td>
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<tr>
<td>AFTN</td>
<td>Aeronautical Fixed Telecommunications Network</td>
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<td>ATC</td>
<td>Air Traffic Control</td>
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<tr>
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<td>Air Traffic Control Center</td>
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<td>Air Traffic Flow and Capacity Management</td>
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<td>ATFM</td>
<td>Air Traffic Flow Management</td>
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<tr>
<td>ATM</td>
<td>Air Traffic Management</td>
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<tr>
<td>ATNS</td>
<td>Air Traffic and Navigation Services (South Africa)</td>
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<td>ATS</td>
<td>Air Traffic Services</td>
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<td>BOBCAT</td>
<td>Bay of Bengal Cooperative ATFM System</td>
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<td>CAMU</td>
<td>Central Airspace Management Unit (Australia)</td>
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<tr>
<td>CDM</td>
<td>Collaborative Decision Making</td>
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<tr>
<td>CFMU</td>
<td>Central Flow Management Unit</td>
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<tr>
<td>CGNA</td>
<td>Air Navigation Management Center (Brazil)</td>
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<tr>
<td>CLDT</td>
<td>Calculated Landing Time</td>
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<tr>
<td>CNS</td>
<td>Communications, Navigation, Surveillance</td>
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<tr>
<td>COTS</td>
<td>Commercial-Off-The-Shelf</td>
</tr>
<tr>
<td>CTMO</td>
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</tr>
<tr>
<td>CTOT</td>
<td>Calculated Take Off Time</td>
</tr>
<tr>
<td>CVSM</td>
<td>Conventional Vertical Separation Minima</td>
</tr>
<tr>
<td>CANSO</td>
<td>Civil Air Navigation Services Organization</td>
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<tr>
<td>CARATS</td>
<td>Collaborative Actions for Renovation of Air Traffic Systems</td>
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<tr>
<td>CDM</td>
<td>Collaborative Decision-Making</td>
</tr>
<tr>
<td>CCO</td>
<td>Continuous Climb Operations</td>
</tr>
<tr>
<td>CDO</td>
<td>Continuous Descent Operations</td>
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<tr>
<td>CFIT</td>
<td>Controlled Flight into Terrain</td>
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<td>CLAM</td>
<td>Cleared Level Adherence Monitoring</td>
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<td>COM</td>
<td>Communication</td>
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<td>CONOPS</td>
<td>Concept of Operations</td>
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<tr>
<td>CNS</td>
<td>Communications, Navigation, Surveillance</td>
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<td>CPDLC</td>
<td>Controller Pilot Data-link Communications</td>
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<td>Cross-Polar Working Group</td>
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<tr>
<td>CTA</td>
<td>Control Area</td>
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<td>Control Zone</td>
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<td>DARP</td>
<td>Dynamic Airborne Re-route Planning</td>
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<td>DGCA</td>
<td>Conference of Directors General of Civil Aviation</td>
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<td>DMAN</td>
<td>Departure Manager</td>
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<td>DME</td>
<td>Distance Measuring Equipment</td>
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<td>EST</td>
<td>Coordinate Estimate</td>
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<td>FAA</td>
<td>Federal Aviation Administration</td>
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<td>FDPS</td>
<td>Flight Data Processing System</td>
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<td>FIR</td>
<td>Flight Information Region</td>
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<td>Flight Information Region Boundary</td>
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<tr>
<td>FL</td>
<td>Flight Level</td>
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<td>FLAS</td>
<td>Flight Level Allocation Scheme</td>
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<td>Flight Level Orientation Scheme</td>
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<td>FRMS</td>
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<td>Flexible Use Airspace</td>
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<td>GANIS</td>
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<td>GANP</td>
<td>Global Air Navigation Plan</td>
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<td>GASP</td>
<td>Global Aviation Safety Plan</td>
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<td>GBAS</td>
<td>Ground-based Augmentation System</td>
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<td>Gross Domestic Product</td>
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<td>GLS</td>
<td>GNSS Landing System</td>
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<td>GNSS</td>
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<td>GPI</td>
<td>Global Plan Initiative</td>
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<td>Lateral Navigation</td>
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<td>LVO</td>
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<td>MET</td>
<td>Meteorological</td>
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<td>METAR</td>
<td>Meteorological Aerodrome Report</td>
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<td>MLAT</td>
<td>Multilateration</td>
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<td>MSAW</td>
<td>Minimum Safe Altitude Warning</td>
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<td>MTF</td>
<td>Major Traffic Flow</td>
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<td>NextGen</td>
<td>Next Generation Air Transportation System</td>
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<td>OPMET</td>
<td>Operational Meteorological</td>
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<tr>
<td>OLDI</td>
<td>On-Line Data Interchange</td>
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<td>OTS</td>
<td>Organised Track System</td>
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<td>Acronym</td>
<td>Description</td>
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<tr>
<td>PACOTS</td>
<td>Pacific Organized Track System</td>
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<tr>
<td>PARS</td>
<td>Preferred Aerodrome/Airspace and Route Specifications</td>
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<td>PASL</td>
<td>Preferred ATM Service Levels</td>
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<td>PBN</td>
<td>Performance-based Navigation</td>
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<tr>
<td>PIA</td>
<td>Performance Improvement Areas</td>
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<tr>
<td>PKP</td>
<td>Passenger Kilometres Performed</td>
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<tr>
<td>PVT</td>
<td>Passenger Value of Time</td>
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<td>RAIM</td>
<td>Receiver Autonomous Integrity Monitoring</td>
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<td>SATVOICE</td>
<td>Satellite Voice Communications</td>
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<td>Search and Rescue</td>
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<td>Space Based Augmentation System</td>
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<td>South China Sea</td>
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<td>SESAR</td>
<td>Single European Sky ATM Research</td>
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<td>SHEL</td>
<td>Software, Hardware, Environment and Liveware</td>
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<td>SID</td>
<td>Standard Instrument Departure</td>
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<td>SIGMET</td>
<td>Significant Meteorological Information</td>
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<tr>
<td>SPECI</td>
<td>Special Weather Report</td>
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<tr>
<td>STAR</td>
<td>Standard Terminal Arrival Route or Standard Instrument Arrival (Doc 4444)</td>
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<tr>
<td>STCA</td>
<td>Short Term Conflict Alert</td>
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<td>STS</td>
<td>Special Handling Status</td>
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<td>Universal Access Transceiver</td>
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