ATFM – A General Overview

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The aim of this ATFM overview is the attainment of basic skills. The ATFM overview provides an introduction to the ATFM system and operational procedures for the management of the flow. The presentation is focused to provide basic knowledge about ATFM.
Content / Agenda

• Why ATFM

• What is ATFM
  • Objectives
  • Principles
  • How ATFM works
  • Best practices
Why ATFM

- If demand exceeds the capacity, “flow” management is required
Air traffic demand for some regions is growing rapidly (estimation 2014 → 2023):
- Domestic aircraft movements 8% / year
- International aircraft movements 7% / year
- Passenger increase 9% / year
Why ATFM

- Major aviation capacity constraints are:
  - Overdemand / Overdelivery
  - Weather
  - Staff shortage
  - Quality of information
  - Technical problems
Why ATFM

- Air Traffic Flow Management contributes to:
  - Making best use of available capacity
  - Protecting Air Traffic Controllers from over-deliveries
  - Ensuring safe, orderly and efficient Air Traffic Management
  - Environmental issues, as Fuel savings and less CO2 emission
  - Predictability of Air Traffic
  - Flexibility in Demand / Capacity Balancing
  - Collaborative Decision Making between all ATM partners, as ATC, Airlines and Airports
Content / Agenda

- Why ATFM
- What is ATFM
  - Objectives
  - Principles
  - How ATFM works
  - Best practices
What is ATFM

- ATFM is an operational process to manage available airspace capacity
- ATFM is the key for efficient demand / capacity balancing
- ATFM is the enabler for Air Traffic Management (ATM) effectiveness
- ATFM ensures safe, orderly and efficient Air Traffic Management
- ATFM enhances safety
- ATFM is for all ATM stakeholders
  - Air Traffic control
  - Airlines
  - Airports
- ATFM is supporting a “No Blame culture” by a common situational awareness
- ATFM is CDM – CDM is ATFM…….
Content / Agenda

• Why ATFM
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**What is ATFM**

**Principles**

ATFM is collaborative decision making - CDM

- The CDM process is a key enabler of an ATFM strategy
- CDM is not an objective in itself
- CDM ensures that decisions are taken transparently and are based on the best information available as provided by the participants in a timely and accurate manner
“first come, first serve” and “equitable access to airspace” have traditionally been very important.

To support global ATM evolution, priorities can be changed such as “most capable, best served” or “best planned, best served”.

“equitable access to airspace” may be viewed on a longer time scale than the short time “first come, first serve” model.
ATFM is demand/capacity balancing

ATFM is a system for balancing demand and capacity in aviation. It is used to manage the flow of aircraft through airspace and ensure that the number of flights that can be accommodated does not exceed the available airspace capacity. This is achieved by adjusting the flight schedules and rerouting flights in real-time as needed.

The diagram shows a scale with one side labeled 'Demand' and the other 'Capacity'. The 'Demand' side is represented by an airplane, symbolizing the number of flights attempting to use the airspace. The 'Capacity' side is represented by a set of traffic lights, symbolizing the available airspace capacity. The balance of the scale indicates that ATFM aims to achieve a level of demand that is in line with the available capacity, thereby ensuring the efficient and safe flow of aircraft.
What is ATFM

**What is needed for ATFM?**

- ATM resources
- Traffic Demand
- Tactical and up to date traffic situation
- Meteorological situation
- Airspace and Airport status
- ATFM tools
- Institutional arrangement and regulation

**Pre-requisites**
What is ATFM

What is needed for ATFM?

- ATM resources

Airspace (national or regional) and Airports are resources that are shared by all ATM stakeholders and require:

- Transparancy
- Collaborative decisions
- Common processes
- Equity
What is needed for ATFM?

- Traffic Demand

Data sharing and understanding is a major pre-requisite of ATFM. At least it needs:

- Airline data (ATC-FPL; schedule)
- ATC capacity (Sectors; Airports)
- Partners constraints
- Intentions
- Information sharing
What is needed for ATFM?

- Tactical and up to date traffic situation

Ensuring accurate and timely data by common data exchange to increase accuracy of short to medium term prediction

- ATFM flight information
- ATFM capacity information
- ATFM demand information
What is needed for ATFM?

- Meteorological situation

Weather is one of the most constraining influences for ATM. Increasing the situational awareness by highly precise:

- Forecast WX
- Dynamic WX
What is ATFM

What is needed for ATFM?

- Airspace and Airport status

Availabilty of Airspace and Airport resources affects the efficient and safely flow of Air Traffic

- Airport Capacity
- Sector Capacity
- Restricted or reserved Airspace
What is ATFM

What is needed for ATFM?

- ATFM tools

Common situational awareness and transparency through data and information sharing by displaying:
  - Weather situation
  - Traffic forecast
  - Communication possibilities
  - Airport and airspace information
What is ATFM

What is needed for ATFM?

- Institutional arrangement and regulation

- “World”
  - ICAO
  - CANSO/ANSP
  - IATA
  - States
  - DOC 9971

- “Regional”
  - ICAO Region
  - CANSO/ANSP
  - IATA
  - States
  - DOC 9971
  - Supplements
  - Positions
  - Action Plans

- “National”
  - States
  - ANSP
  - Airspace Users
  - Airports
  - CONOPS
  - AIP
  - ATFM Handbook
  - LoA
  - Stakeholders
  - working arrangements

- “Local”
  - All Stakeholder
  - Processes
  - Procedures
  - Working instructions
Content / Agenda

• Why ATFM

• What is ATFM
  • Objectives
  • Principles
  • How ATFM works
  • Best practices
How ATFM works?

- ATFM Phases
- Methods and measures
- Structure
What is ATFM

ATFM Phases

- **Strategic**
  - More than 6 days before Day of Operation

- **Pre-Tactical**
  - 1 to 6 days before Day of Operation

- **Tactical**
  - Day of Operation

- **Post Operational**
  - Following the Day of Operation

How ATFM works
What is ATFM

ATFM Phases

- Strategic phase
  - Iterative process over the entire strategic cycle
  - Integration of airport capacity information and flight intentions into airspace planning
  - Planning of special events
  - Consideration of military needs
  - Special seasons (e.g. holidays)

How ATFM works
ATFM Phases

- Pre tactical phase
  - Prediction and refinement of traffic load and available capacity
  - Update on staffing (sector capacity) from ANSPs to Network Operations
  - Update on available airport infrastructure and ATC capacity
  - Refinement on expected airspace load
  - Planning of required ATFM measures

What is ATFM

How ATFM works
What is ATFM

ATFM Phases

- Tactical phase
  - ATFM traffic monitoring
  - Delay monitoring
  - CTOT allocation
  - Update of demand
  - Update of capacity
  - Adjustment of implemented ATFM measures
  - New ATFM measures
  - Collaborative decision making

Day of Ops
ATFM Phases

- Post operational phase
  - Review of operational day compared to plan
  - Identification of short comings in the process
  - Identification of regular bottlenecks
  - Addressing all stakeholders
  - Lessons learned
  - Analyse / Investigate
  - Best practices
  - Improve for the future
Methods and measures

- Pre-Flight
  - Ground Delay Program
  - Ground Stop
  - Rerouting
  - Minutes in Trail

- In-Flight
  - Rerouting
  - Miles in Trail
  - Fix Balancing
  - Airborne Holding
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, so called “Calculated Take Off Times – CTOT” are assigned. CTOT correspond to available entry slots into the constrained airspace or arrival slots into the constrained airport.

- GDP minimize airborne holding
- GDP shall be carried out in a planned manner (at least a few hours prior to the over capacity) and only if other measures can not help
- Delays have great impact on Airspace Users
- CTOT have to be informed Airspace Users as early as possible
- CTOT may be modified with Airspace Users coordination
What is ATFM

Methods and measures

- Ground Delay Program - GDP

Flight
EOBT
12:00

Estimated Take-Off Time
ETOT
12:10

Taxitime

Estimated Take-Off Time
ETOT
12:10

ATFM Delay

12:30
CTOT

Slot Tolerance Window (STW)
-5 CTOT +10
12:25-12:40

Sector/Airport
regulated
1300/1600

ETO
Regulated
Area
14:00

20 min shift / delay

CTO
14:20

12:10
ETOT

EOBT
12:00

What is ATFM
How ATFM works
Methods and measures

- Ground Stop Program - 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. Ground Stop is typically used:

- In cases destination airports are unavailable due to significant WX or due to accident/incident
- To preclude extended periods of in-flight holding
- To preclude sector reaching near saturation levels or airport gridlock
- In the event of a facility is unable to provide ATC services due to unforeseen circumstances
- In cases routings are unavailable due to severe WX or catastrophic events
- Airspace users need further information as soon as possible
What is ATFM

Methods and measures

- Ground Stop - GS

![Diagram showing ATFM processes]

- Flight
- EOBT 12:00
- Taxitime
- Estimated Take-Off Time ETOT 12:10
- ETO Regulated Area 14:00
- Sector/Airport collapsed 1300/1600
- No prediction possible
- No entry possible
- Flight suspended
- UFN
Methods and measures

- **Rerouting**

  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. They may be issued to:

  - Make sure that aircraft operate along the traffic “flow”
  - Remain clear of special use airspace
  - Avoid congested airspace
  - Avoid areas known for their difficult weather conditions, and which aircraft are circumventing or refusing to fly.

- Level capping scenarios could be carried out by means of flight level restrictions
What is ATFM

Methods and measures

- Minutes in Trail - MINIT

  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

  - MINIT should not be used as ATFM measure, where GDP could be implemented
  - MINIT is also used when the spacing interval is such that it would be difficult for a sector controller to measure it in terms of miles
What is ATFM

Methods and measures

- Miles in Trail - MIT

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.

- MIT can be carried out without a planned manner (compared to GDP)
- MIT may increase the workload of the other sectors
Methods and measures

- 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.

To be used, e.g. during periods of convective weather where:

- Standard instrument arrival (STAR) unusable
- Standard instrument departure (SID) unusable
Methods and measures

- Airborne Holding
  Aircraft to be hold at a waypoint in a pre-defined standard holding pattern. 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
  - Airborne Holding is complementary to ground delay programmes and ground stops
  - Airborne Holding generates high workload for ATC and pilots
  - Consideration must be given to reducing sector capacity during airborne holding periods
  - Should not used as ATFM measure, where GDP is more appropriate
What is ATFM

Balancing demand and capacity

How ATFM works
ATFM

Backup
Gudrun Held
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Best Practices

ATFCM Europe

History of ATFM in Europe

- Traffic Overloads since the 1970s
- National Flow Management Units in the 80s and early 90s
- Central Flow Management Unit (EUROCONTROL) in Brussels since 1995
- Eurocontrol becomes declared Network Manager (NM) for Europe
  - NMOC (Network Manager Operations Center)
NMOC Responsibilities

- Flights subject to ATFCM Measures
  - All Flights departing within NM area
  - Flights departing from NM adjacent area and entering NM area

- Flights exempted from ATFCM Measures
  - Flights departing outside the “adjacent area”
  - VFR Flights
  - Military Operational Traffic (OAT)
  - Flights with the following entries in item 18 of FPL
    • STS/HEAD STS/SAR STS/FFR STS/MEDEVAC STS/ATFMX
ATFM and adjacent area

- 42 States
- 1750 Sectors
- 65 ACCs & 61 Flow Management Positions
- 520 Airports
- 1940 Aircraft Operators
- +6700 Connected end-users
- Peaks + 33.400 Flights a day
- 10,000,000 Flights a year
Best Practices

Phases Flow-Management

Strategic

Pre-Tactical

Tactical

Post Operational

More than 6 days before Day of Operation

1 to 6 days before Day of Operation

Day of Operation

Following the Day of Operation

Preplanning of fairs, events, military exercises, holidays.

Publication of RAD and NOP

Prediction of Traffic Load and available Capacity

ADP Publication on D-1 (Network News + ANM)

Traffic Monitoring, Delay Monitoring ANM Amendment Ground Delay Pro. Ground Stop Pro. ReRouting

Analysis of the Day of Operation

Feed back into Previous Phases

ATFCM Europe
NMOC Ops Room

- Several sub units / positions:
  - System operations
  - Flight planning services
  - Current ops manager
  - Traffic Flow Management Ops
  - Military Liaison Officer
  - Pre Tactical Flow Management Ops
  - Airspace Data Management
NMOC Systems

- Initial Integrated Flightplan Processing System (IFPS)
  - Check process and distribute Flightplan Messages and ATS-messages

- Enhanced Tactical Flow Management System (ETFMS)
  - Core System to calculate Traffic Load and implement Regulations

- Archive System (ARCH)
  - Store all Data from ETFMS for evaluation, and for Pre-Tactical Use

- PREDICT
  - Predict Traffic Load from today to D+6, evaluate effect of planned regulations

- Environment System (ENV)
  - Supply all other Systems with basic Data, e.g. ATS Routes, ACC Sectorization, Taxi Times,
  - ...
Best Practices

NMOC Systems

ETFMS

Aircraft Operator

PREDICT

ARCH

ENV

ATC

IFPU 1 Brussels
IFPU 2 Bretigny

CTOT

Flight Plan

Flight Plan/RPL

Configuration

Capacity
Best Practices

NMOC Message Flow

Aircraft Operator (AO) or AIS

ATFCM Measures

e.g., SAM, FCM

FPL
ATS messages

ACK, REJ

IFPS
Flight Data

ETFMS

Flight Plans
ATFCM Messages
Traffic Data
ATC Capacity
Coordination of ATFCM Measures

ATC

FMP

ATFCM Europe
Best Practices

GDP General rules

- Automatic Slot Calculation by ETFMS:
  - CTOT = EOBT + Taxi Time + ATFM Delay (Non A-CDM Airports)
  - CTOT = TTOT + ATFM Delay (A-CDM Airports)
- CTOT is allocated (generally and earliest) two hours before EOBT through a SAM message. The Slot Tolerance window is -5/+10 minutes from CTOT.
- SAM will be sent to all relevant addresses (ATC and AO).
- Pilot and Controller are both responsible for keeping the CTOT (STW CTOT-5/+10)
- SRM to update CTOT
- FLS in case of ground stop
- ....
Conclusion on ATFCM Europe

- Based on ICAO
- Centralized ATFM
- Operational since 1995
- Network Manager by EUROCONTROL
- European ATFCM is comparable and very much similar to the Indian C-ATFM developments