ICAO APAC Webinars – Fundamentals of ANS

Air Traffic Flow Management (ATFM)

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Objectives

- To improve understanding:
  - Fundamental knowledge of ATFM
  - ICAO requirements
  - Regional planning
  - Implementation activities
- For all stakeholders including who would not normally be able to attend ICAO's regular meetings and events.

Agenda

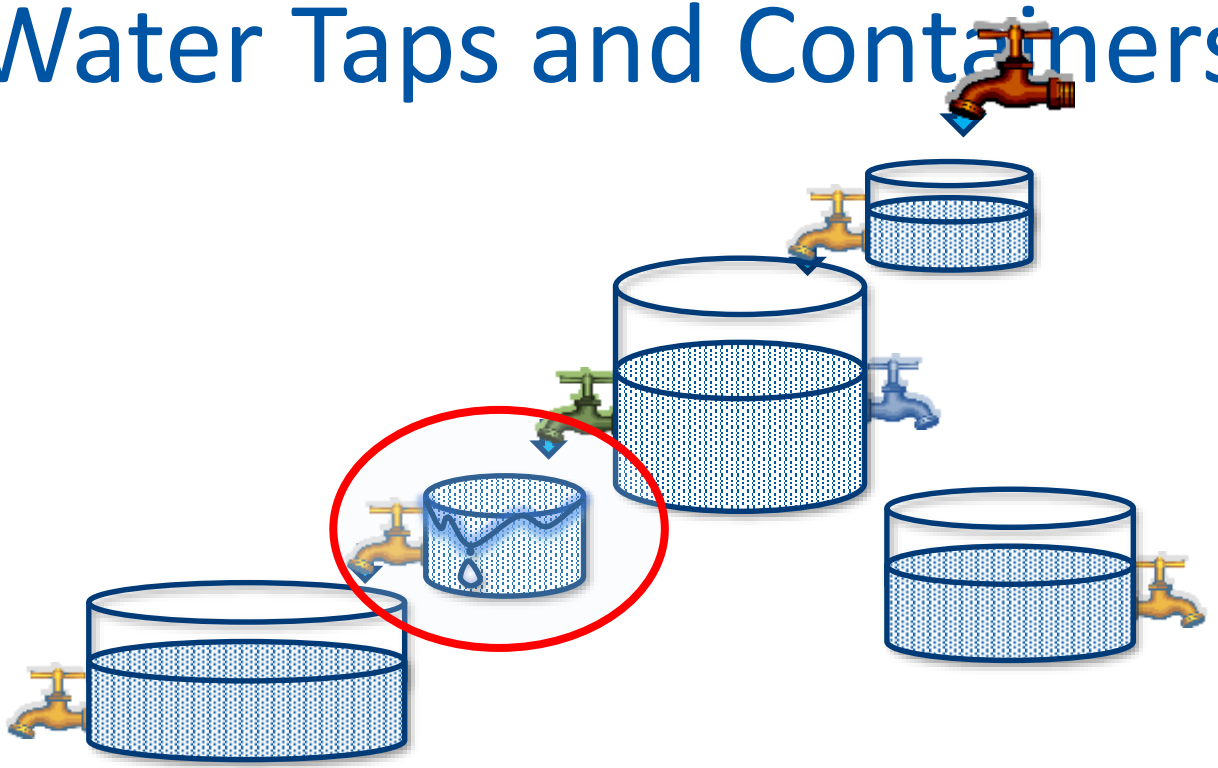
- Basics of ATFM
- Regional requirements
- What ICAO can offer
- Q&A session

BASICS OF ATFM

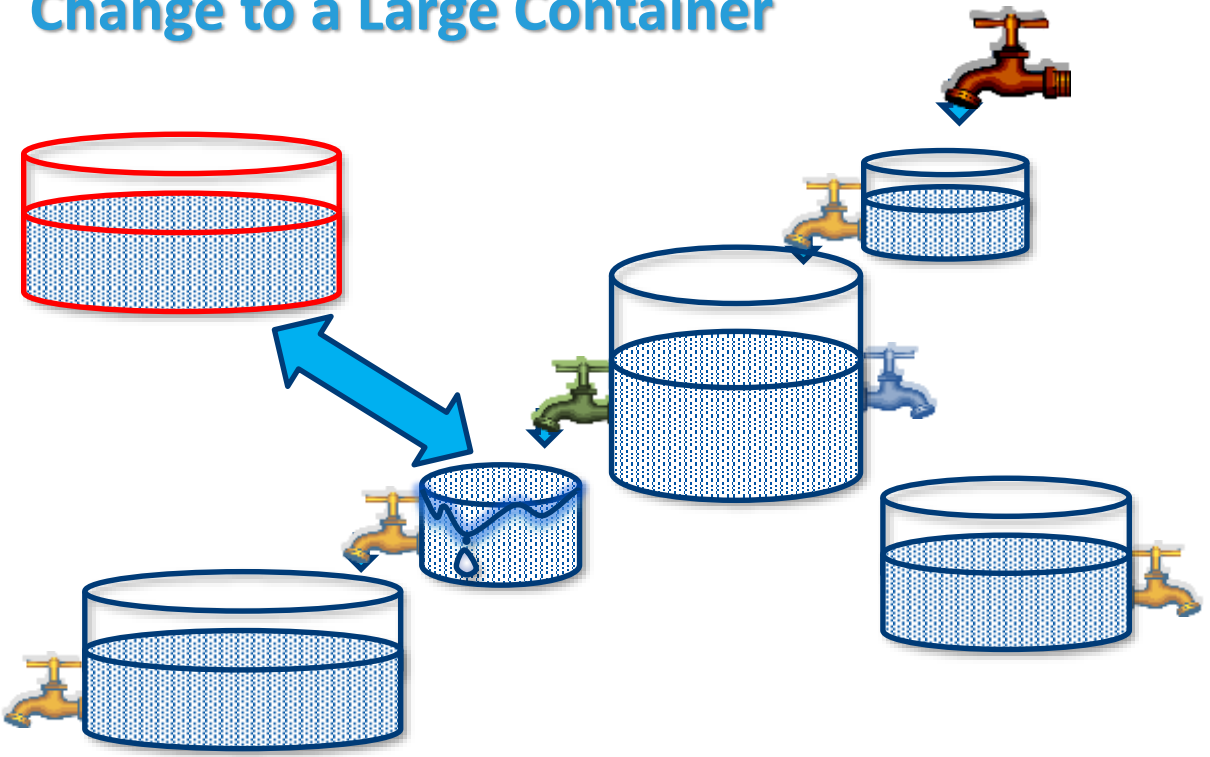
Warm-up Exercise

“ Water Taps and Containers”

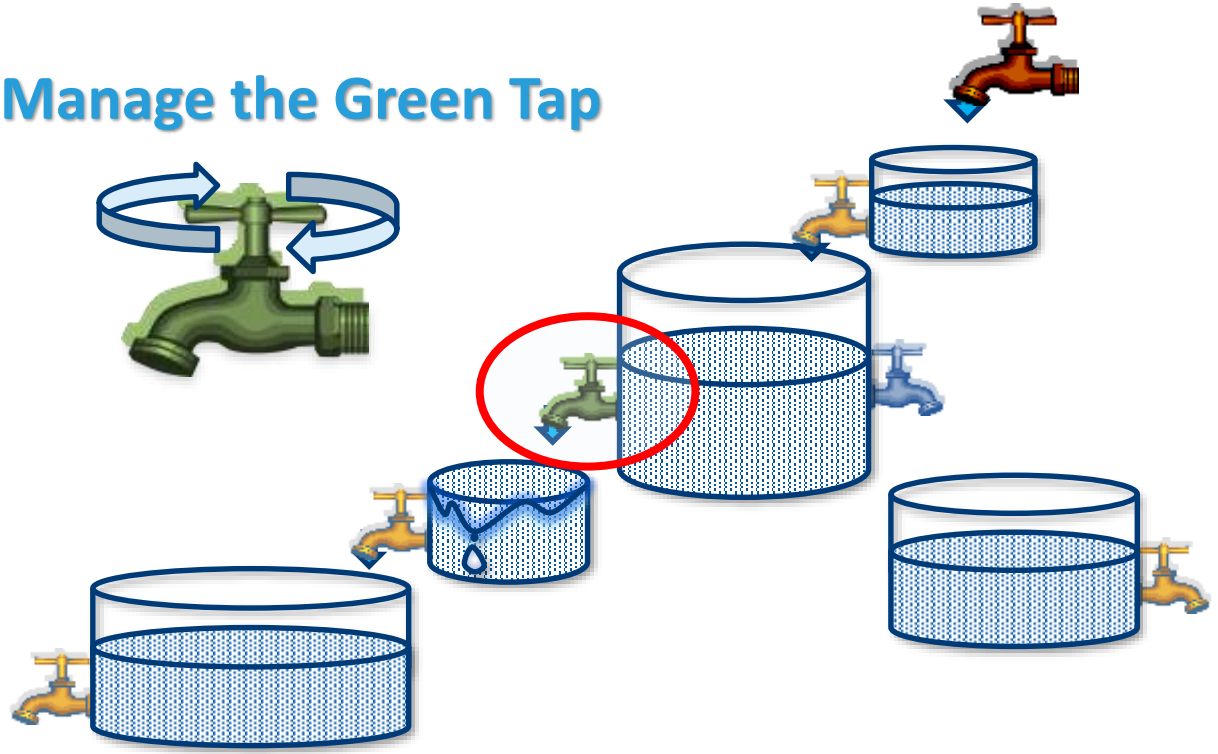
Water Taps and Containers



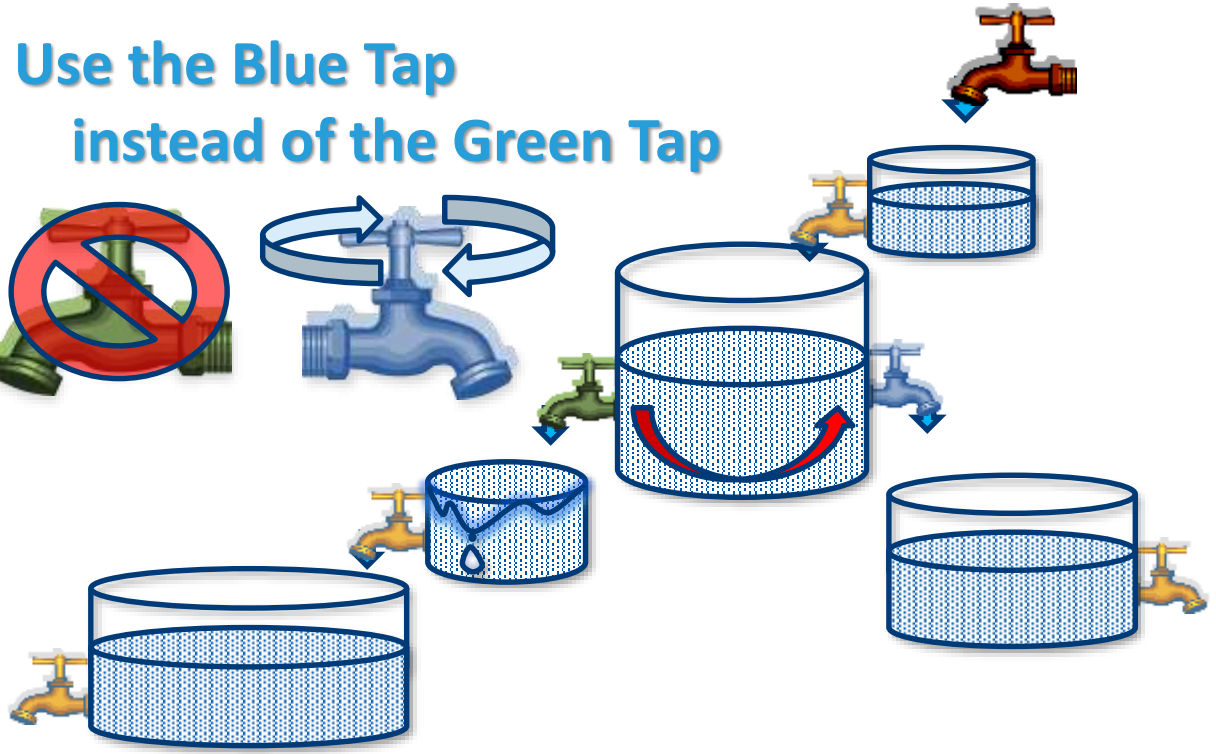
Change to a Large Container



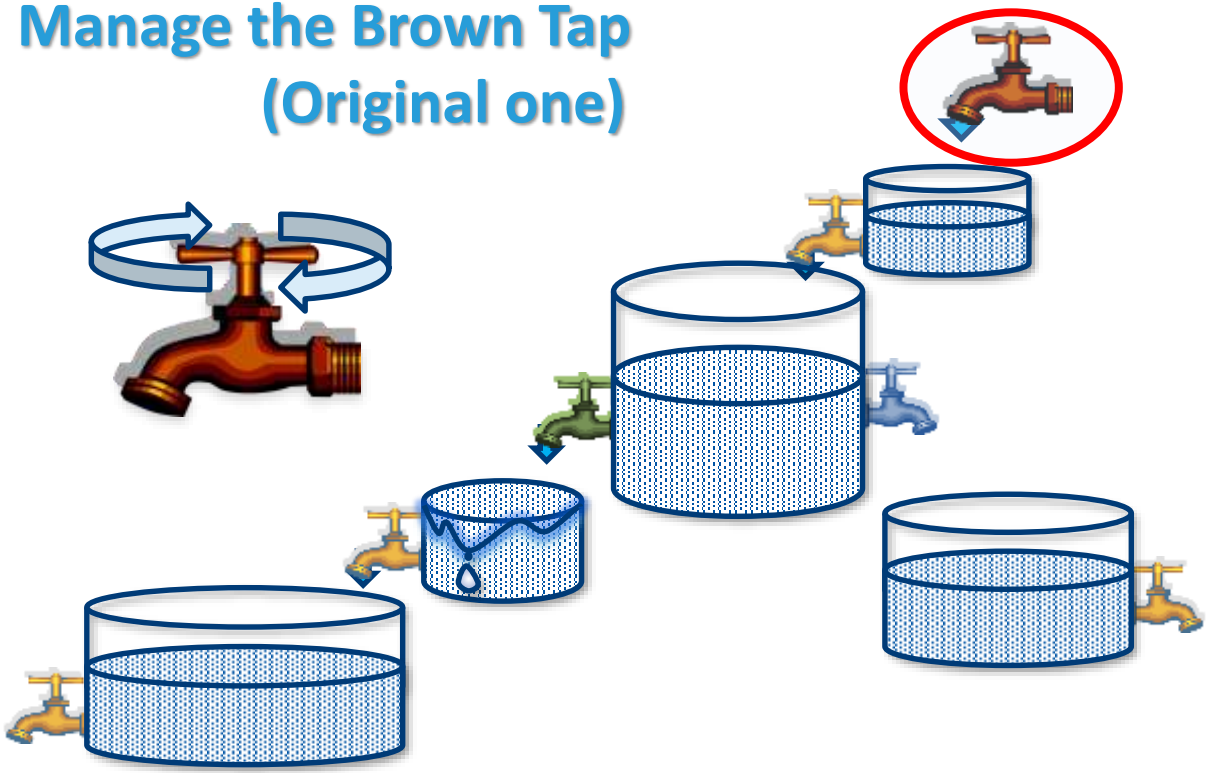
Manage the Green Tap



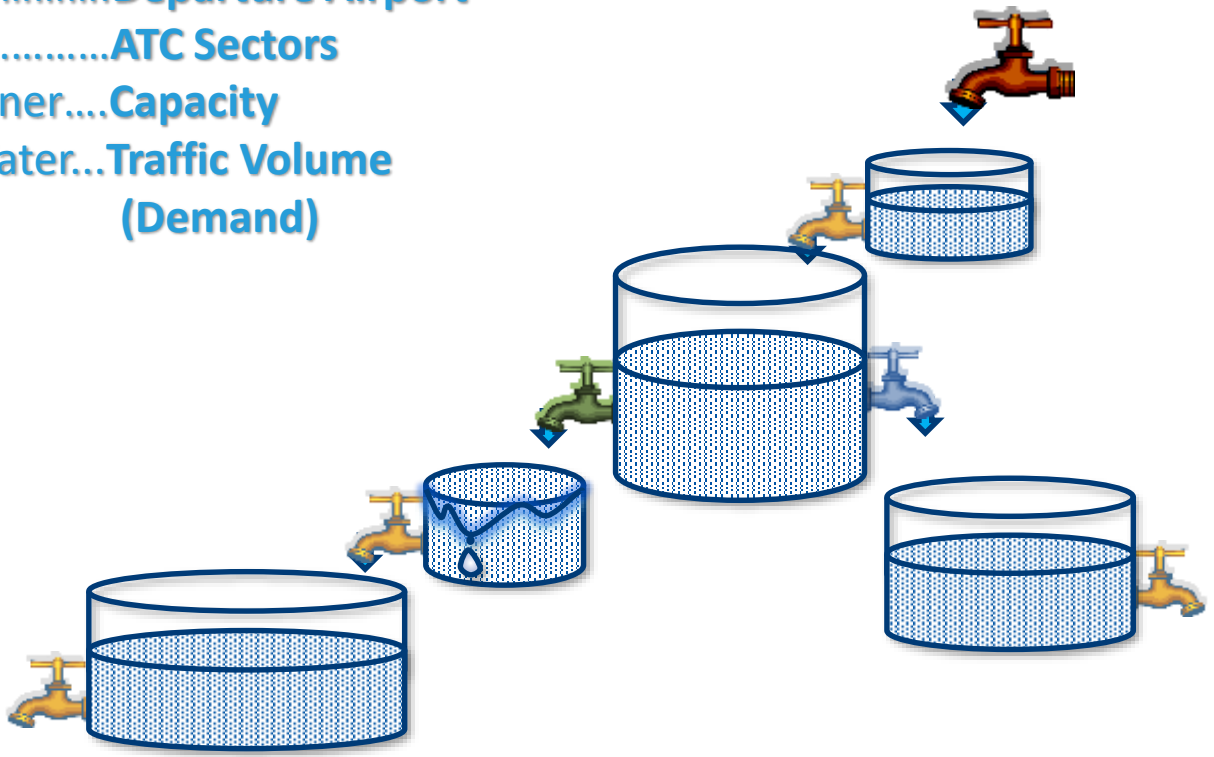
Use the Blue Tap instead of the Green Tap



Manage the Brown Tap (Original one)



Original Tab……**Departure Airport**
Containers……**ATC Sectors**
Size of Container….**Capacity**
Amount of Water…**Traffic Volume (Demand)**



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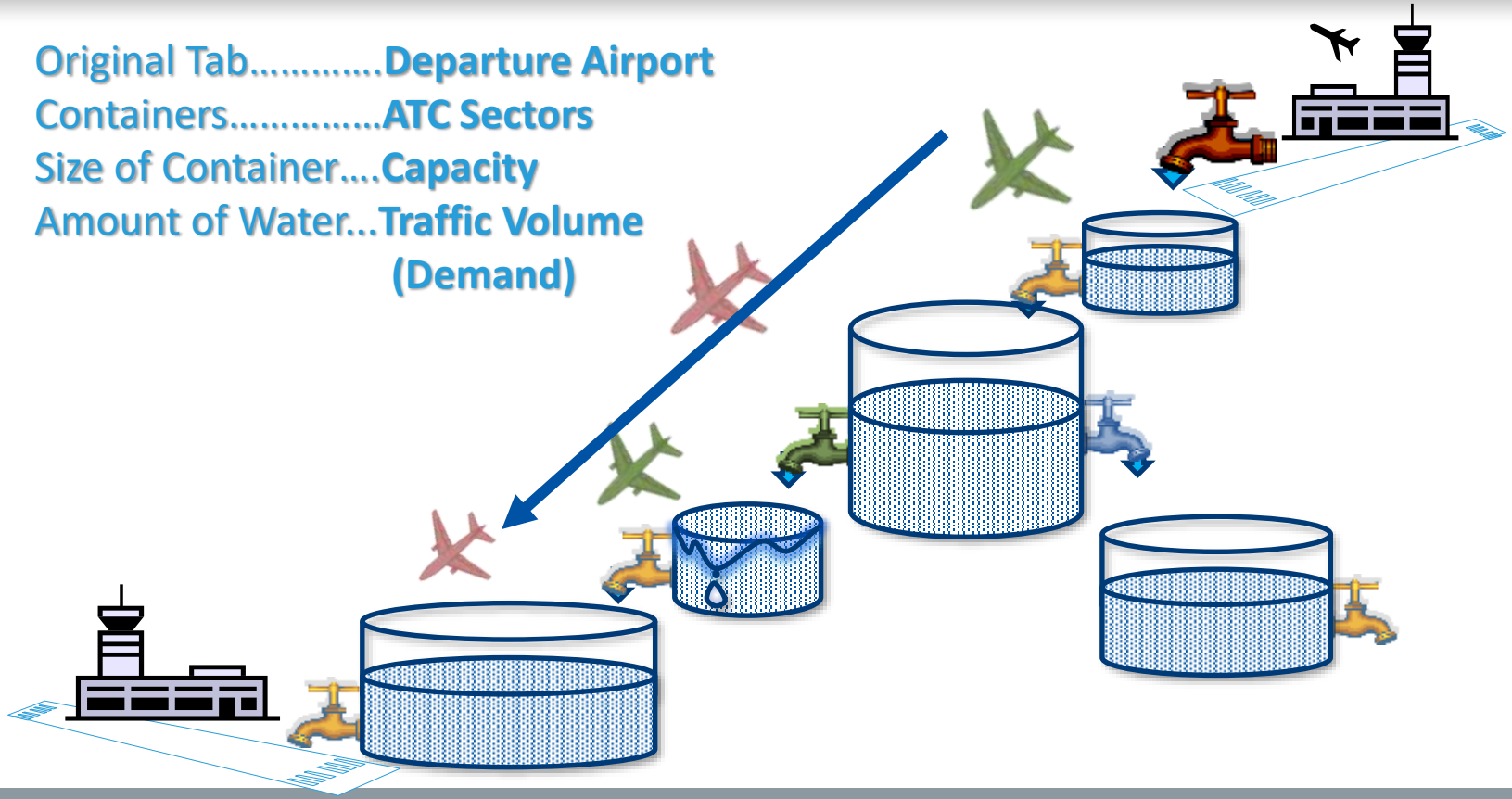
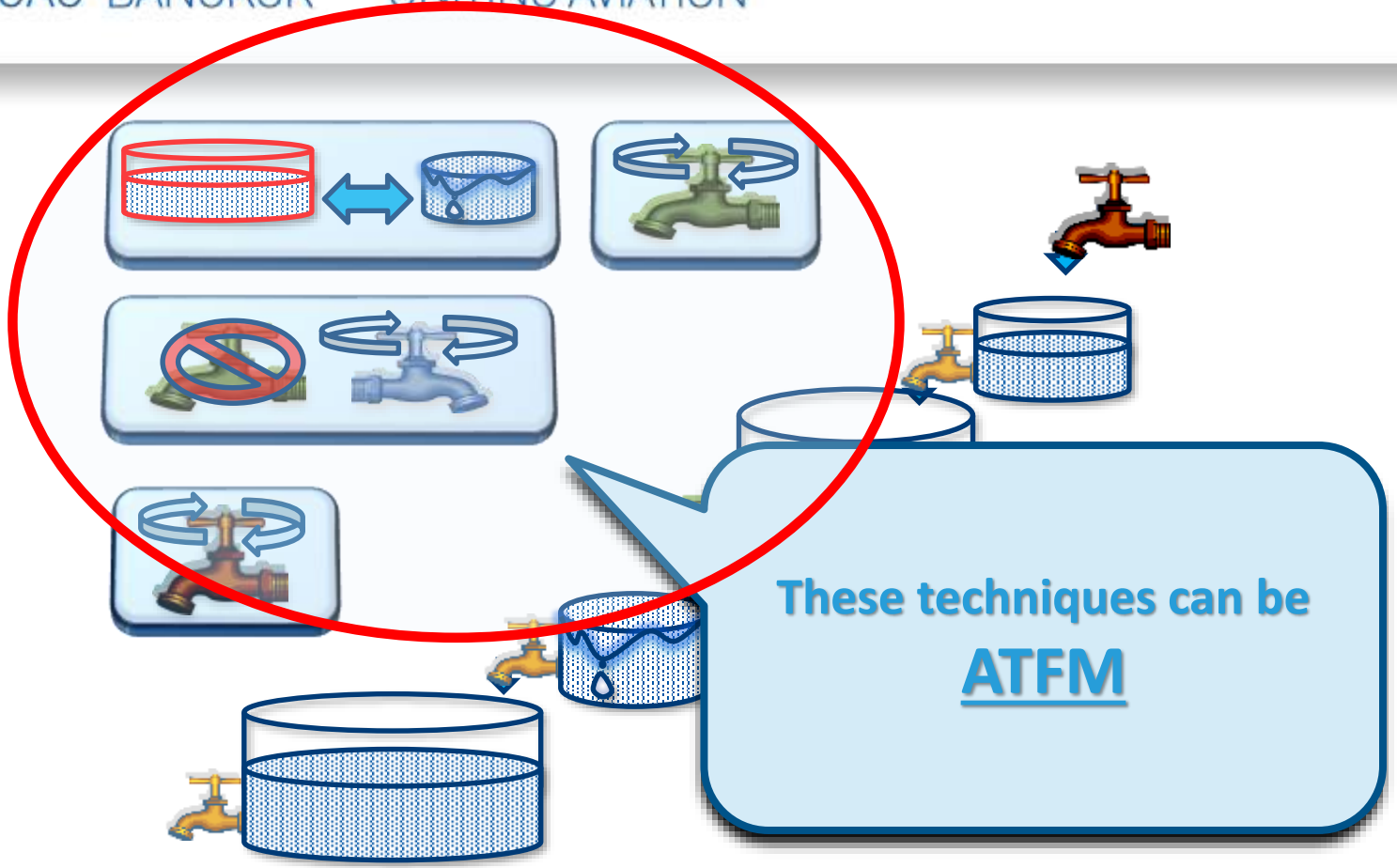
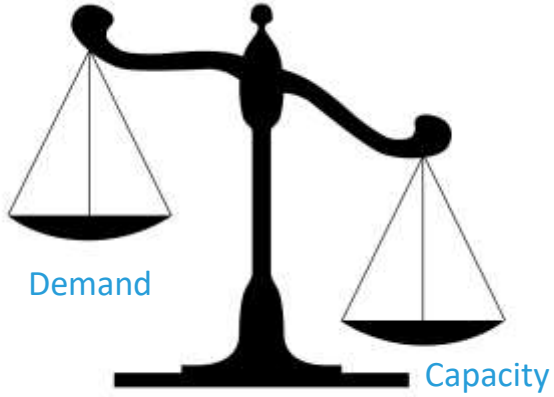



These techniques can be
ATFM

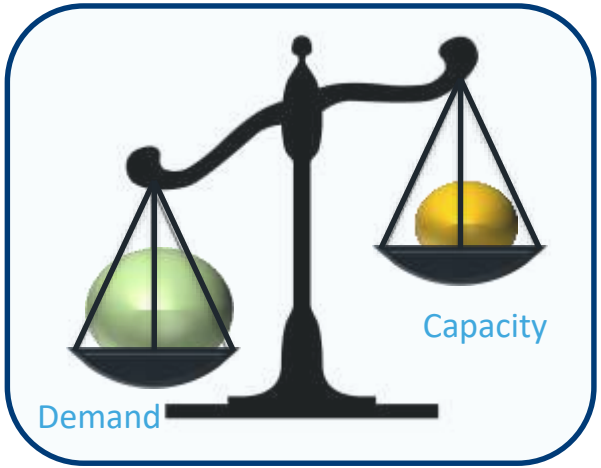
What is ATFM?

What is ATFM?

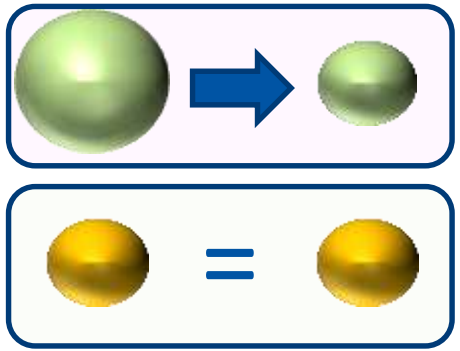
- ATFM is Demand/Capacity Balancing

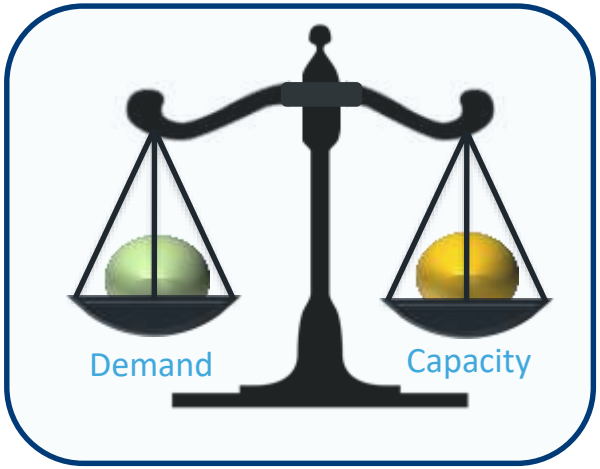


Demand/Capacity Balancing

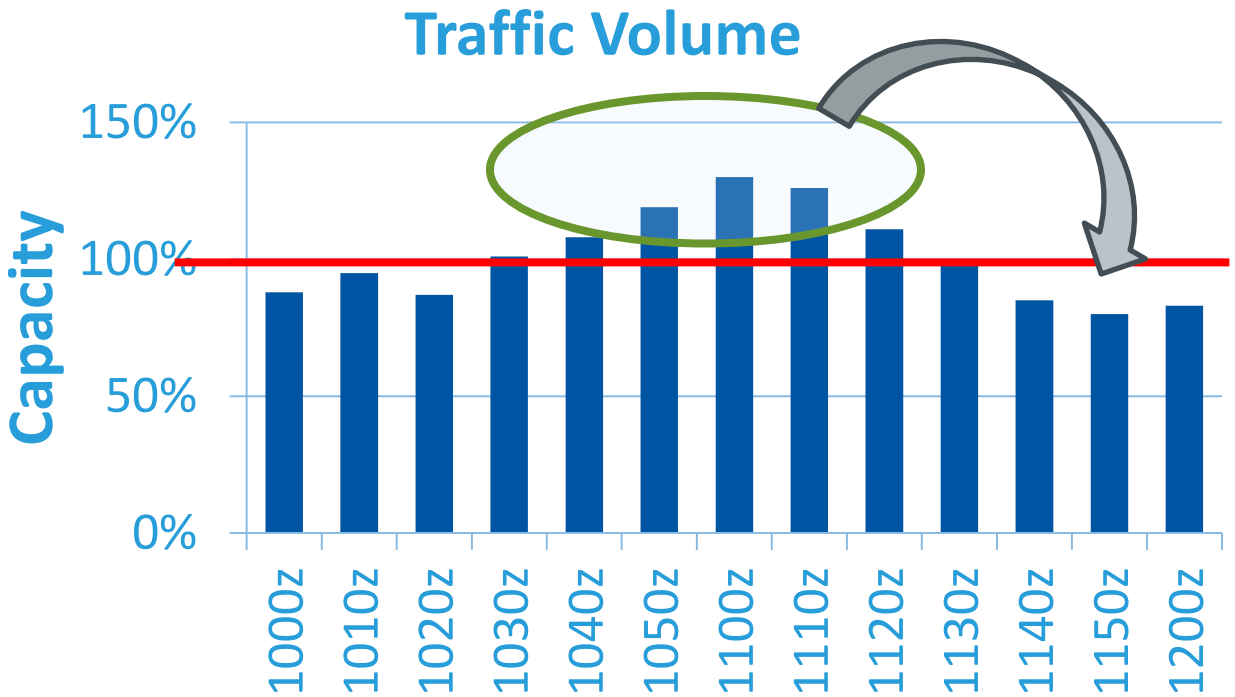


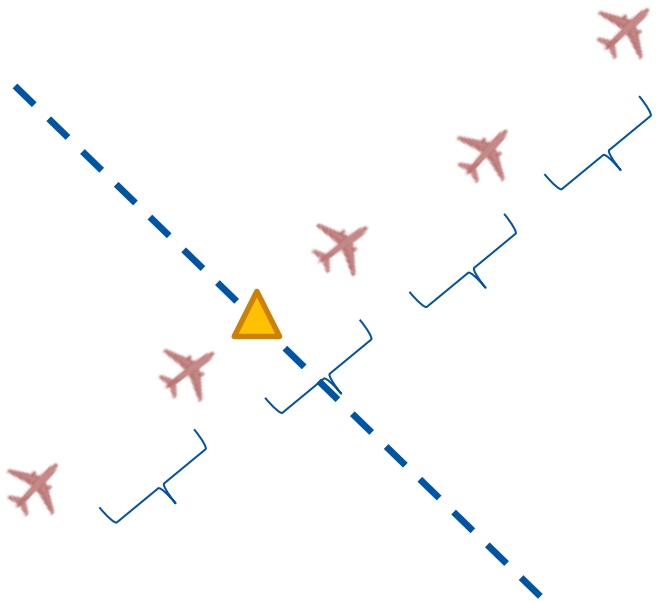
Demand=125, Capacity=100

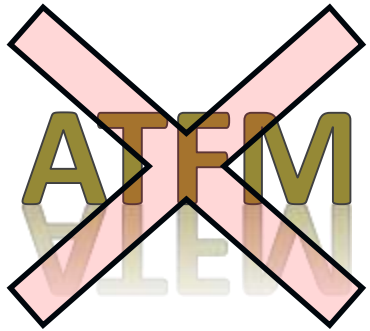




Demand=100, Capacity=100


Traffic Volume
Capacity
150%
100%
50%
0%
1000z
1010z
1020z
1030z
1040z
1050z
1100z
1110z
1120z
1130z
1140z
1150z
1200z

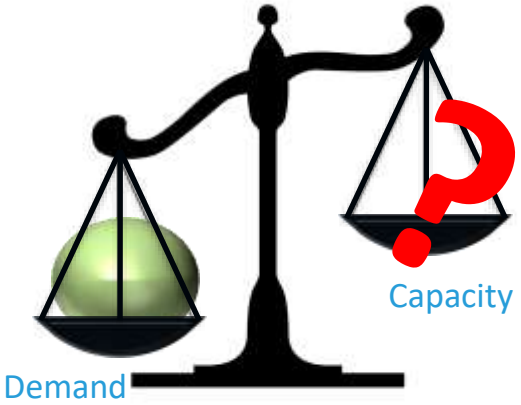




in some cases ATFM was being misused to supplant tactical ATC capacity

Demand vs Capacity

Demand=125, Capacity=**?**



If you don't know the capacity

↓

you can't manage the demand

↓

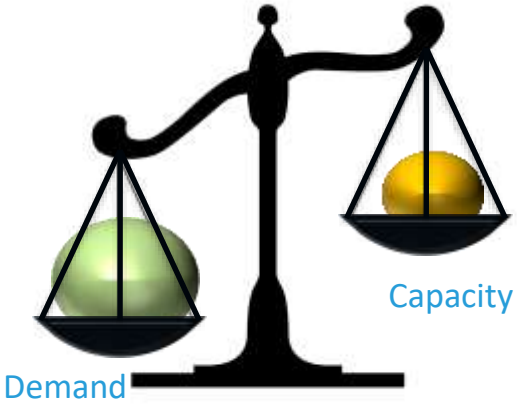
NOT ATFM

Capacity

- The number of aircraft provided with ATC service should not exceed that which can be safely handled by the ATS unit concerned.
- ATS authority should assess and declare the capacity for control sectors (en-route and terminal control area) and for airports.
- Capacity is normally expressed as the maximum number of aircraft that can be accepted over a given period of time at an ATM resource (airspace sector, waypoint, aerodrome, etc.).

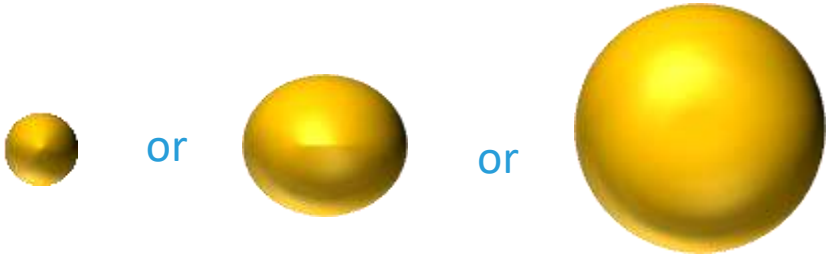
Demand vs Capacity

Demand=125, Capacity=**?**



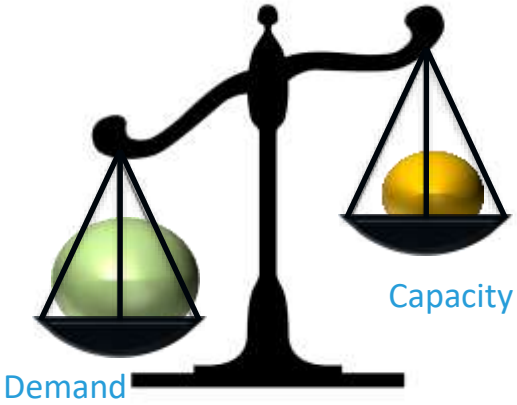
To compare Demand with Capacity

You need to assess your capacity



Demand vs Capacity

Demand=125, Capacity=**100**



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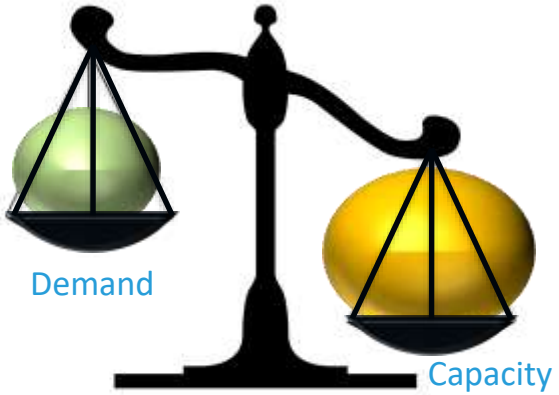
Demand=125, Capacity=**150**



Capacity determination

Capacity Declaration

- Annex 11 defines Declared Capacity as:
  - Measure of ability of the ATC system or any of its sub-systems or operating positions to provide service to aircraft during normal activities

Capacity determining methods

- No universal rule to calculate capacity
- Capacity can be affected by so many variables and external considerations
- It is therefore up to each ANSP to decide how to determine its capacity by choosing from either;
  - Basic methods based on observation
  - Highly sophisticated mathematical models
- In any case, capacity limits may be assessed using feedback from ATC and real-time observations.

Capacity determining methods

- ICAO Doc 9426
  - DORA TASK (England)
  - MMB (Germany)

The essence of both methods was to measure the necessary time for all control working actions and to relate this time to the total time available.

Capacity determining methods

- ICAO Doc 9971
  - Determining the Airport Arrival Rate (FAA)
  - Determining Sector Capacity (FAA)

Those are simplified methods designed for other regions such as South American countries.

Air Traffic Flow Management (ATFM) Workshop on Capacity/Demand Analysis

- Held in Bangkok, Thailand
- 18 - 20 November 2019
- Lessons learned (22 presentations)

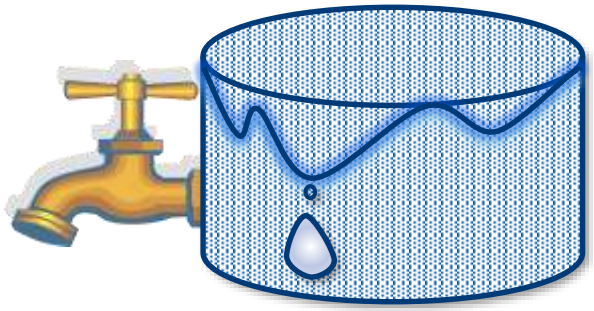
https://www.icao.int/APAC/Meetings/Pages/2019-ATFM-Workshop.aspx

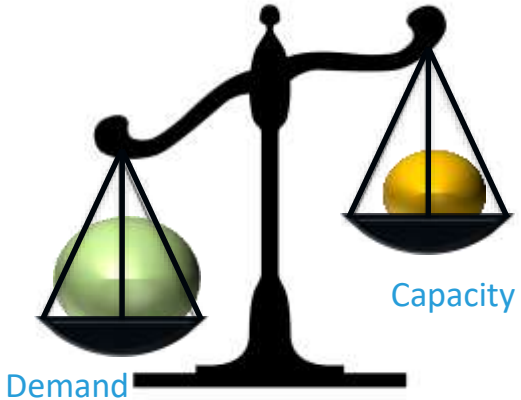
To increase capacity

Demand vs Capacity

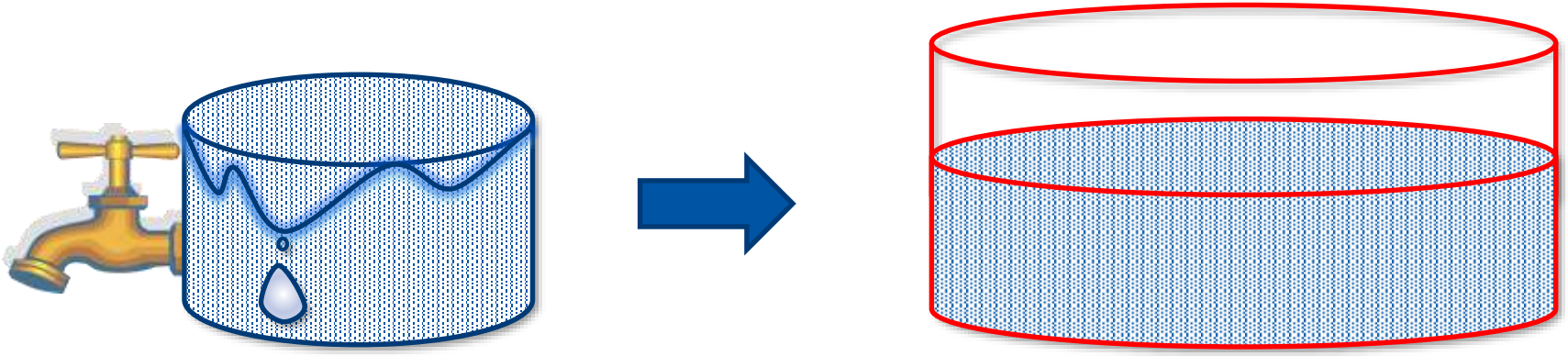
Demand=125, Capacity=100

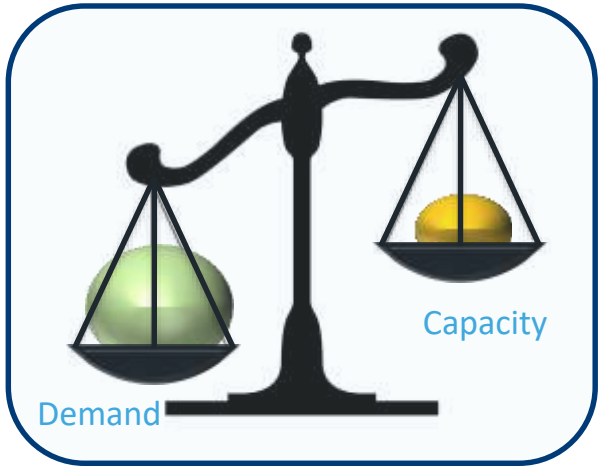
125/100=**125% (exceeding capacity by 25%)**

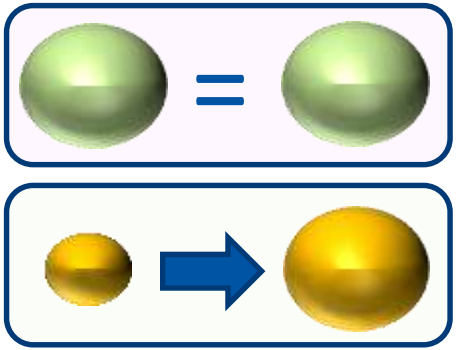


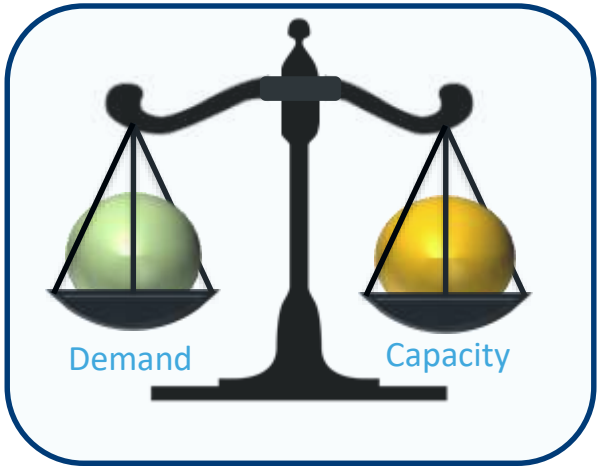


While recognizing that the first response to increased demand should always be an increase in capacity.

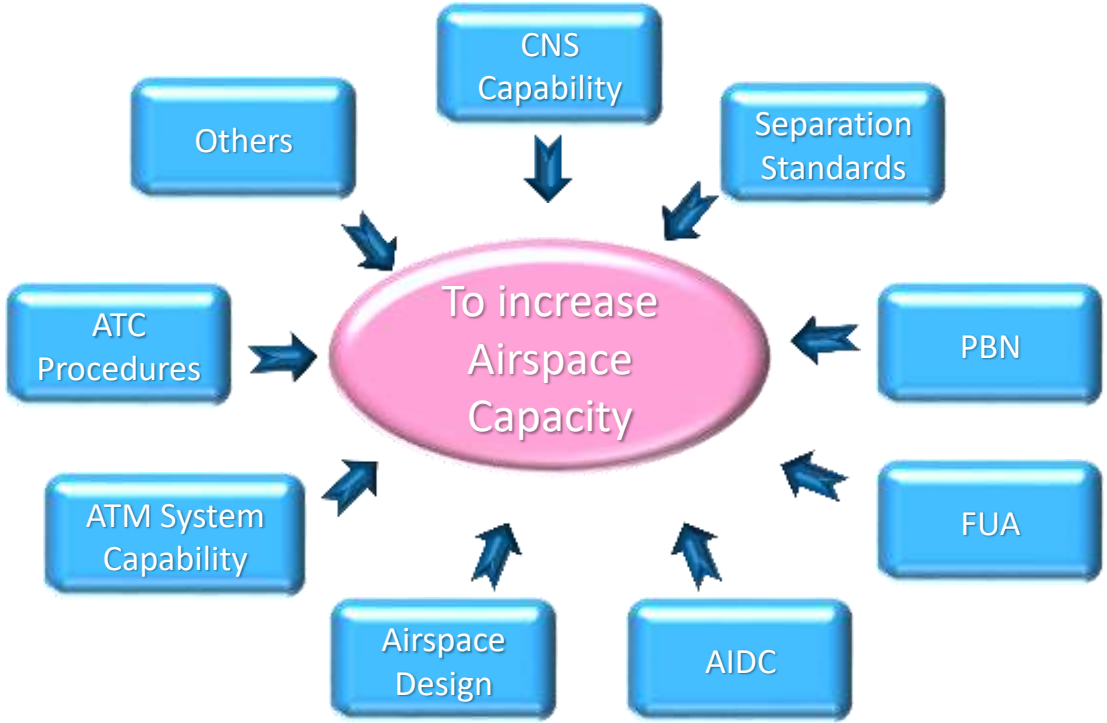




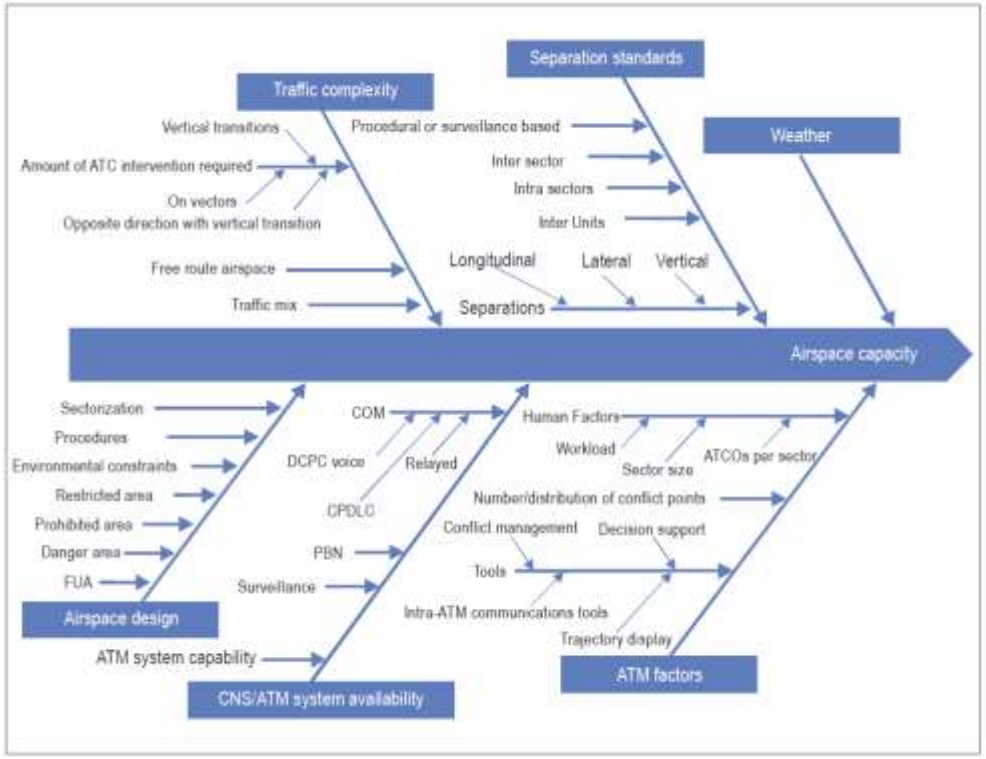




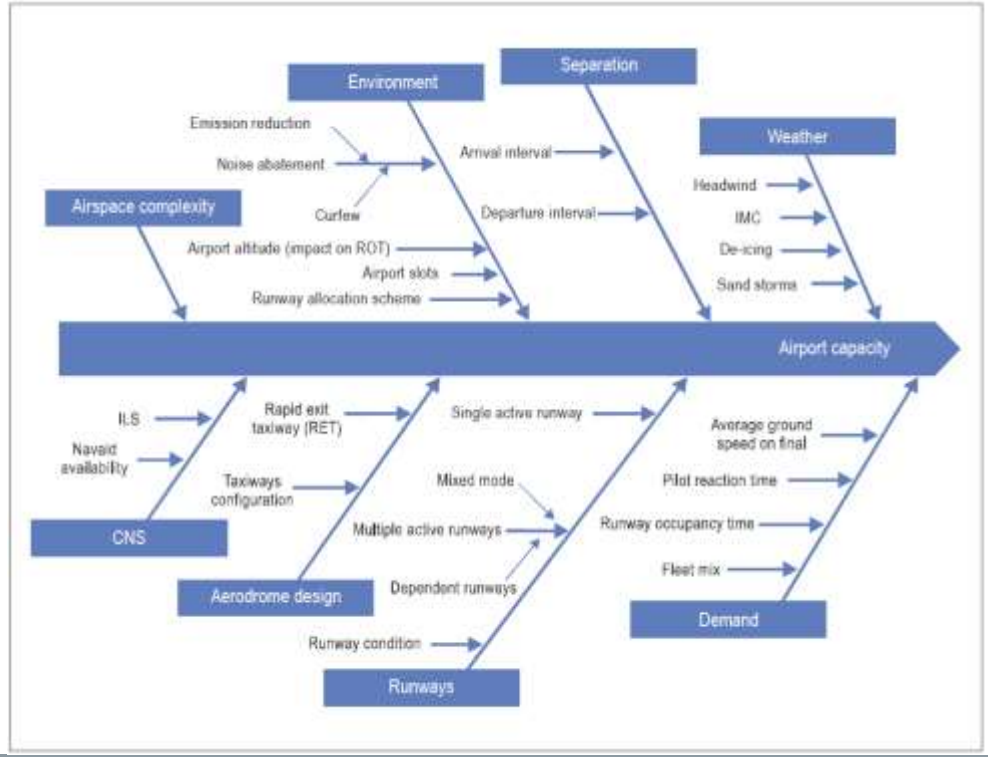
Increased capacity is the primary and central method for managing increasing demand. Capacity increases may be achieved by improvements in infrastructure, airspace and ATS route design, procedures and stakeholder behaviours.


CNS Capability
Separation Standards
PBN
FUA
AIDC
Airspace Design
ATM System Capability
ATC Procedures
Others
To increase Airspace Capacity

Factors affecting airspace capacity



Factors affecting airport capacity



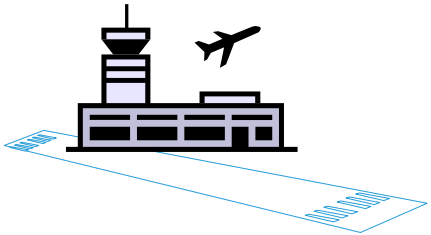
Case Study (ATFM)

Case 1

EOBT 1000z

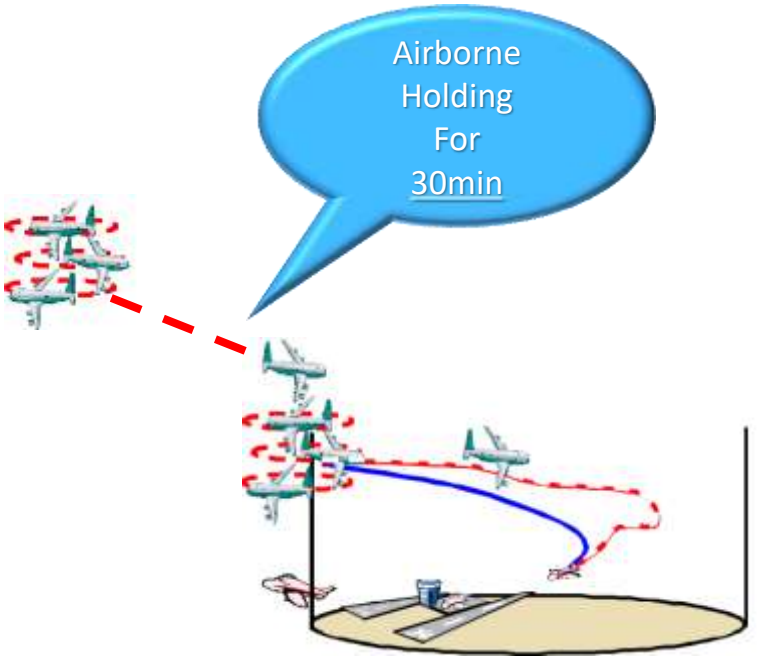
Take off 1015z

ETA 1300z



Push back 1000z

Take off 1015z



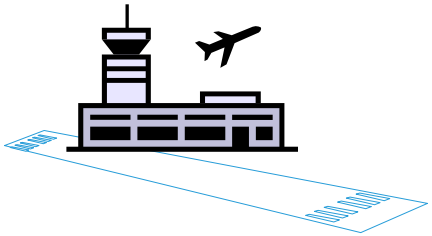
Landing 1330z

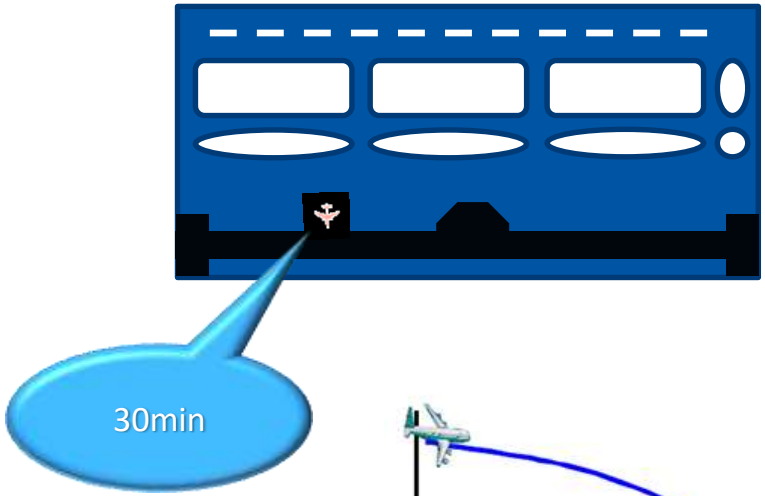
Case 2

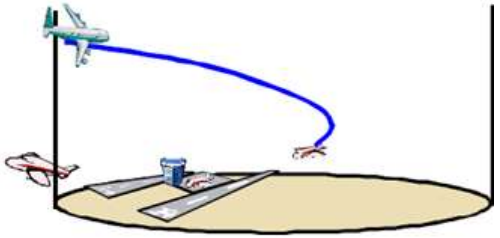
EOBT 1000z

Take off 1015z

ETA 1300z





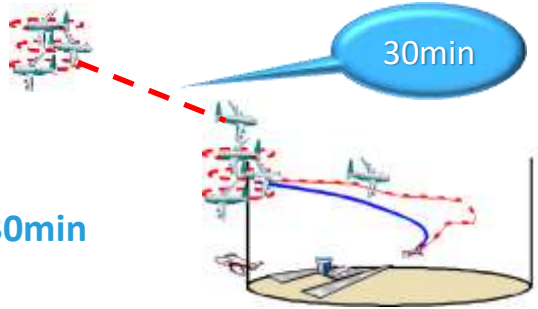


Push back 1000z **-> 1030z**

Take off 1015z **-> 1045z**

Landing 1330z

Case 1
EOBT 1000z
Push back **1000z**
Take off **1015z**
Airborne holding **30min**
Landing 1330z



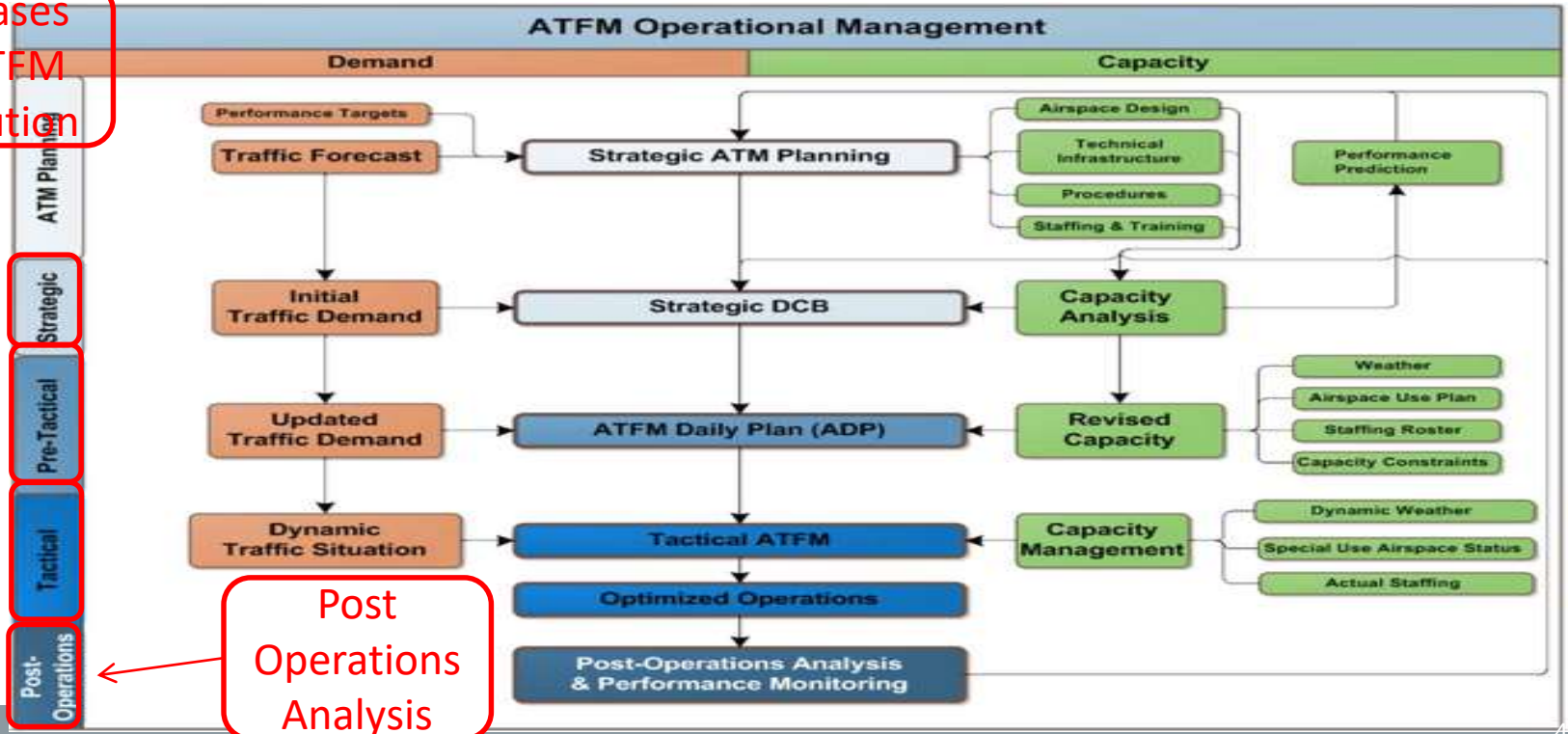
Case 2
EOBT 1000z
Push back **1030z**
Take off **1045z**
Airborne holding **0min**
Landing 1330z

Airlines : Save FUEL, Cut CO2 emission
ATC : Reduce workload
Overall : Enhance safety and efficiency

ATFM Phases

ATFM Phases

3 Phases of ATFM Execution



Post Operations Analysis

ATFM Phases

- Timely application of measures requires:
  - Fundamental understanding of airport and airspace capacity
  - Continuous assessment of capacity and factors that impact it

Strategic ATFM

- Measures taken more than 1 day prior to day of operation
- Could be up to 2 months or more
- Planning and execution of long-term demand and capacity balancing
  - Arrival slot allocation at coordinated airports

Pre-Tactical ATFM

- Measures taken up to one day prior to operations
- Main objective – Optimizing capacity through effective, dynamic organization of resources
- Dependent on CDM processes established between stakeholders

Tactical ATFM

- Measures taken on day of operations
- Managing traffic flows and capacities in real time
- Supported by AMAN and DMAN
- Inclusion of 70% of flights is necessary to deliver benefits

Post-operations Analysis phase

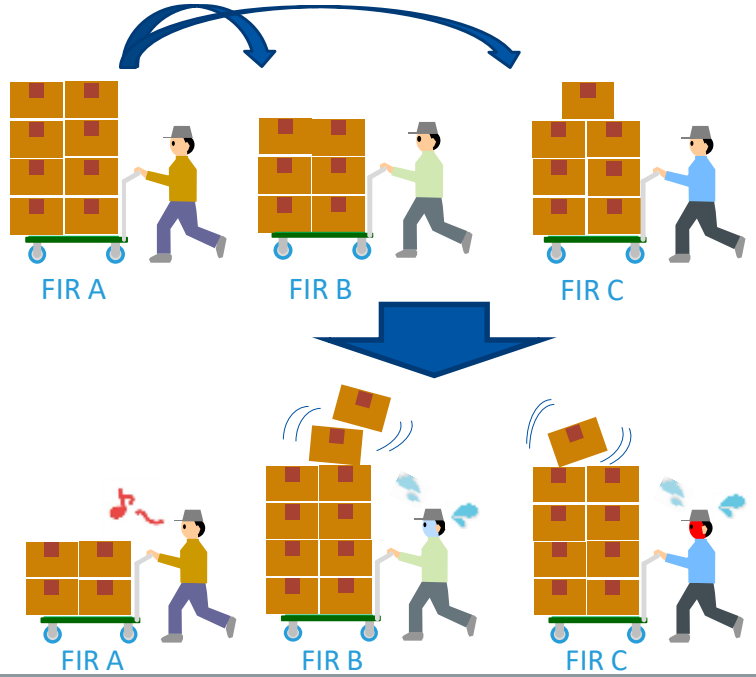
- An analytical process is carried out to measure, investigate and report on operational processes and activities
- The development of best practices and/or lessons learnt that will further improve the operational processes and activities
- All stakeholders within the ATFM service should provide feedback

Post-operations Analysis phase

- Post-operations analysis may be used to;
  - Identify operational trends or opportunities for improvement
  - Further investigate the cause and effect relationship of ATFM measures
  - Gather additional information with the goal of optimizing ATM system efficiency
  - Perform analysis of specific areas of interest, such as irregular operations
  - Make recommendations on;
    a. how to optimize ATM system performance
    b. how to minimize the negative impact of ATFM measures on operations

Post-operations Analysis phase

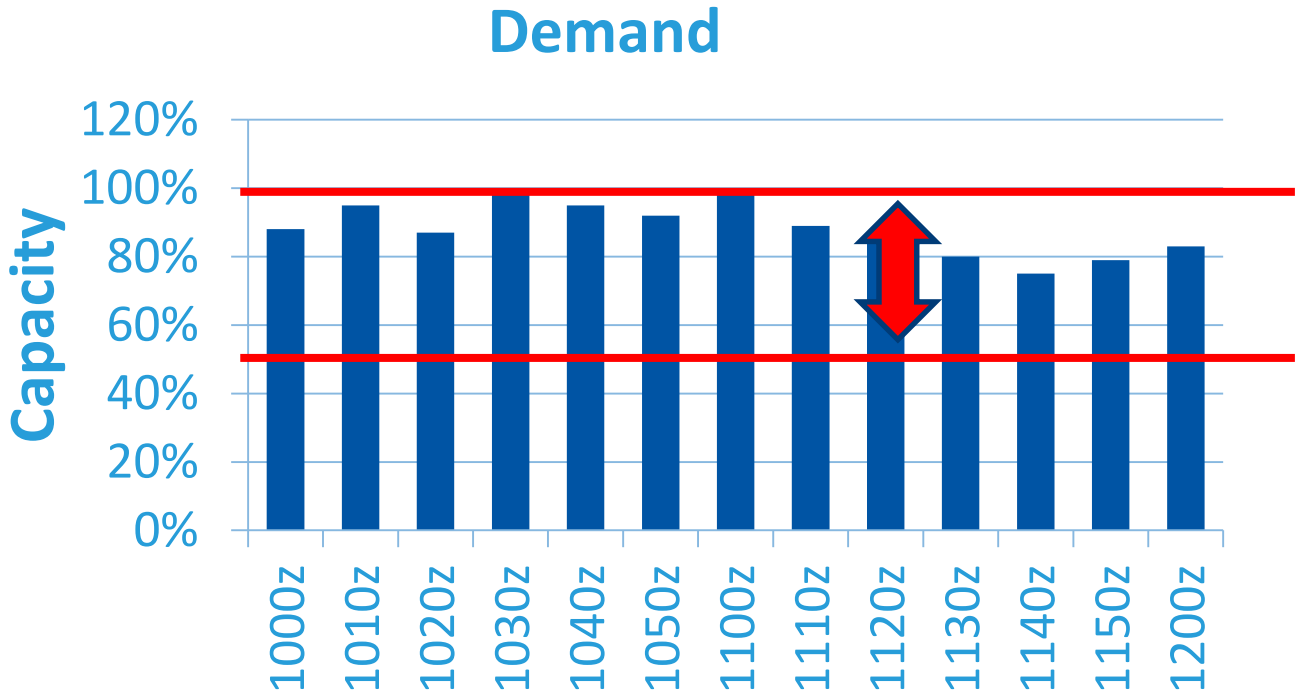
- It is important to have a common understanding that putting excessive ATFM measures makes adjacent FIR's ATC workload increase drastically.



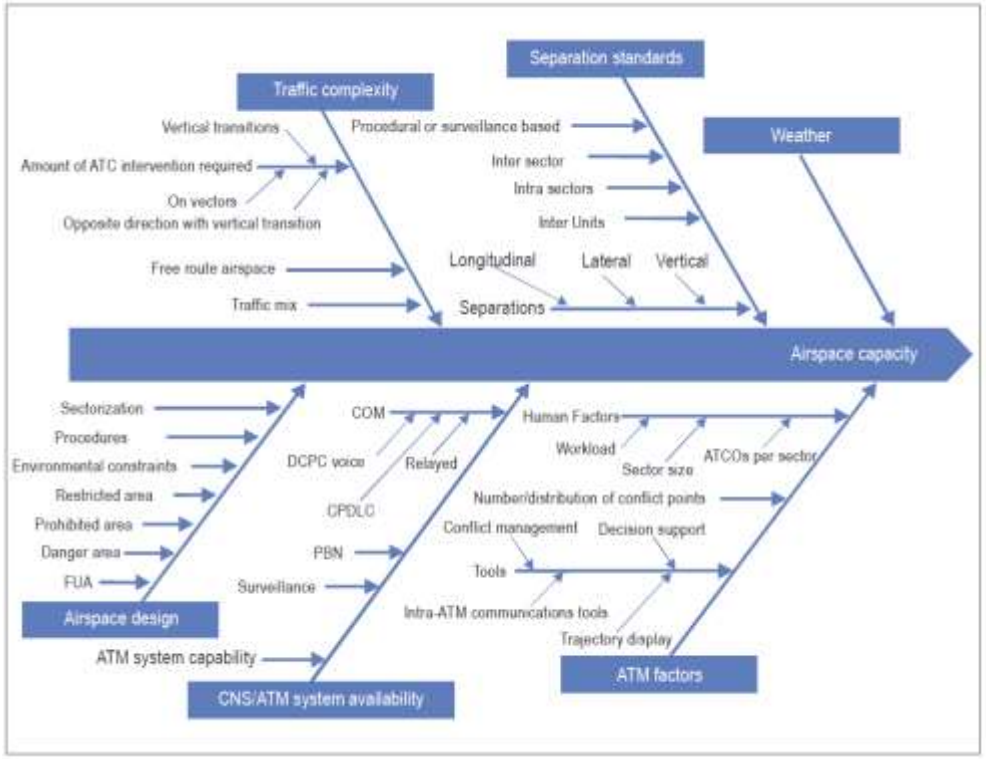
Post-operations Analysis phase

Case Study
(Operational Capacity)

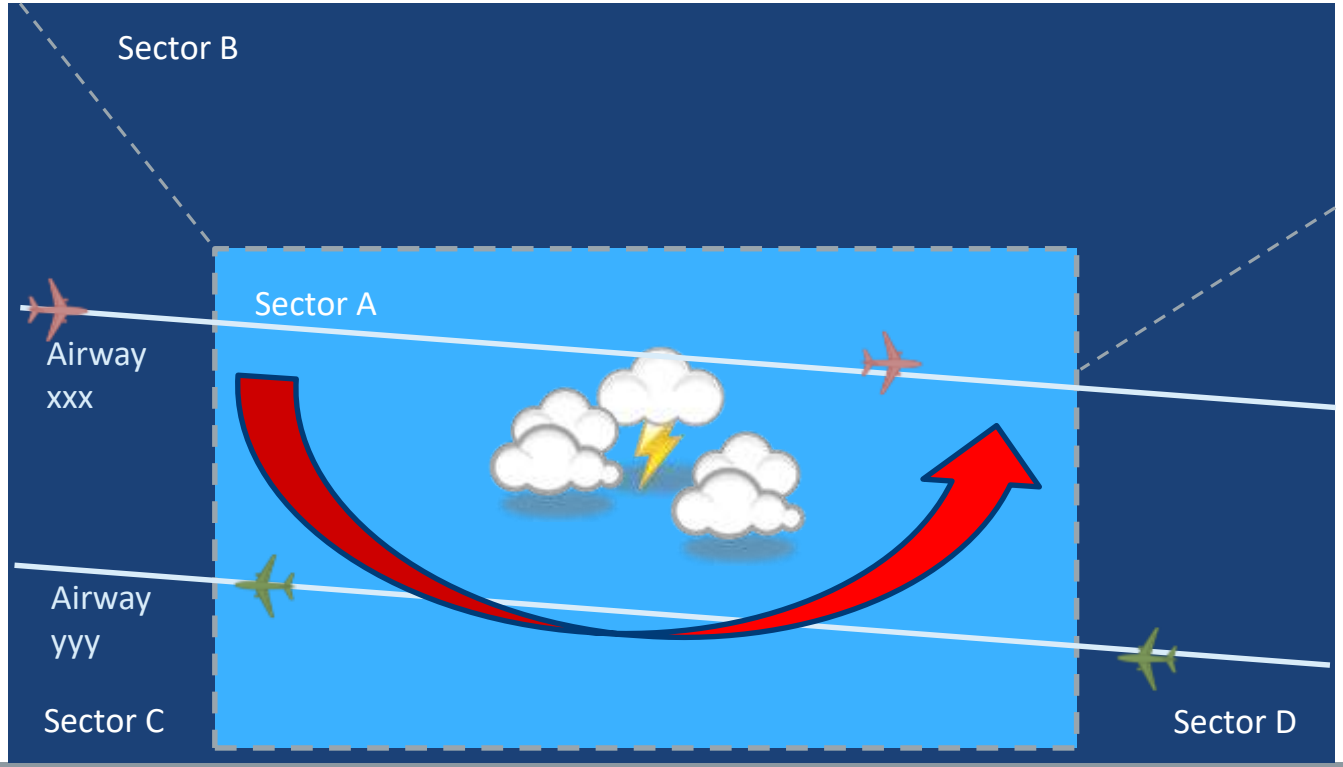
Variability of capacity



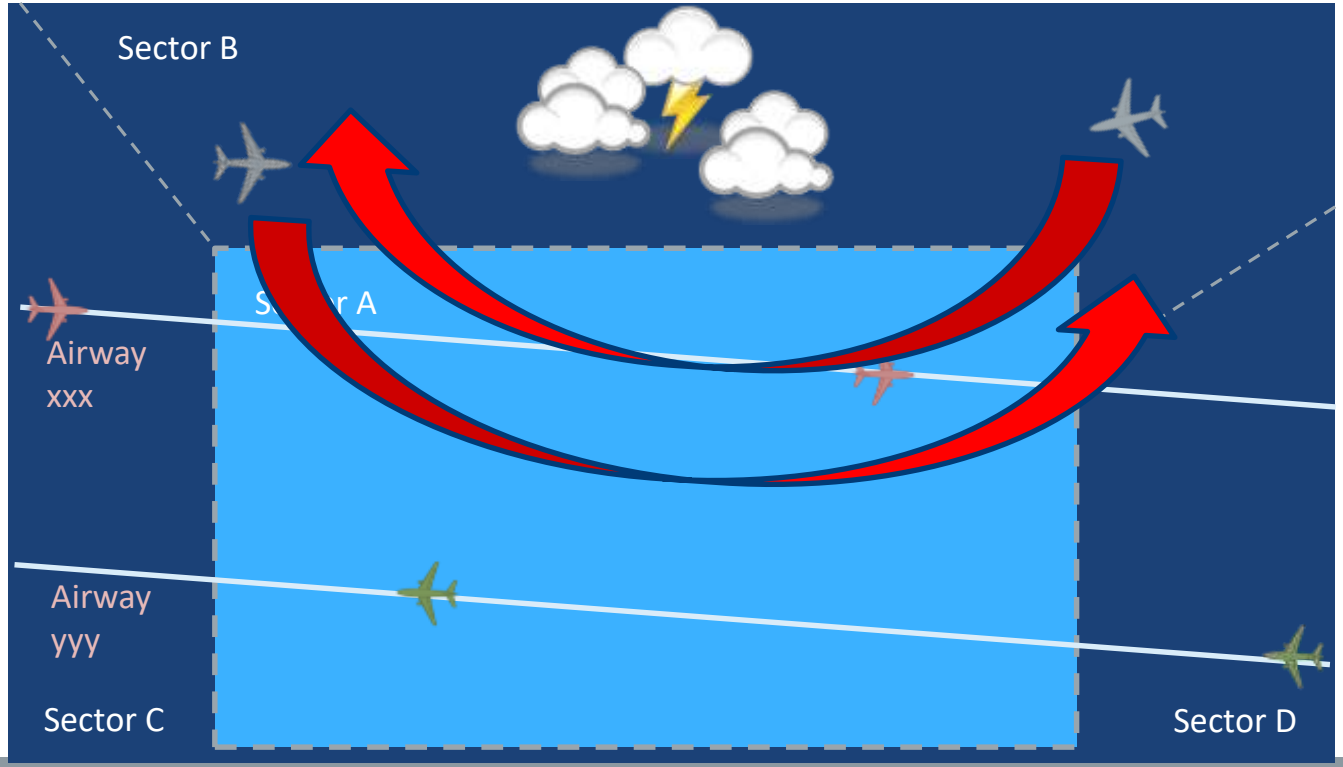
Factors affecting airspace capacity



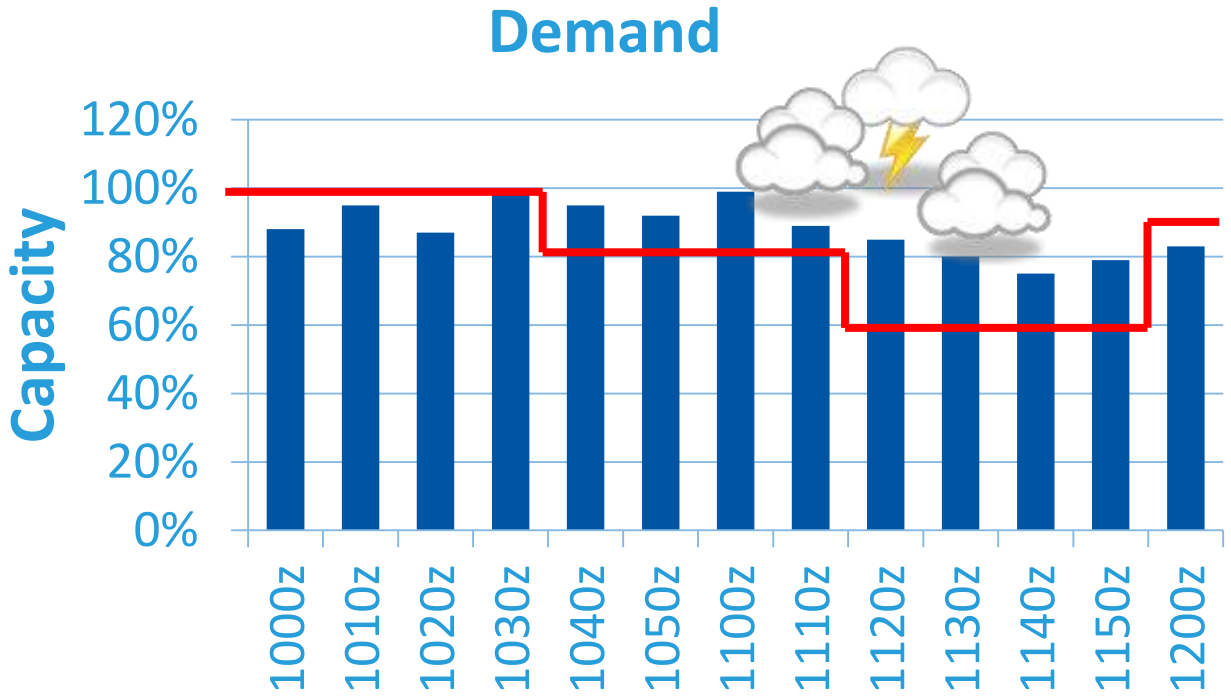
Weather impact (Sector A)



Weather impact (Sector B)



Operational Capacity

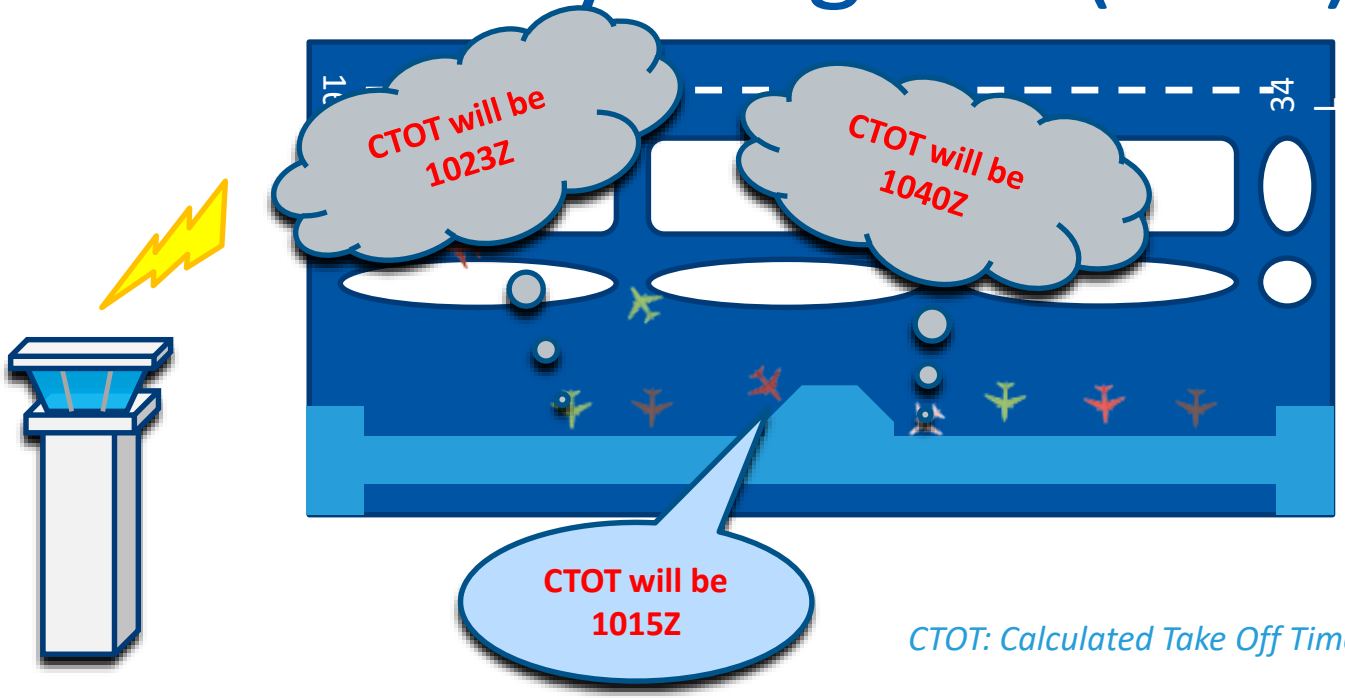


ATFM Measures

ATFM Measures

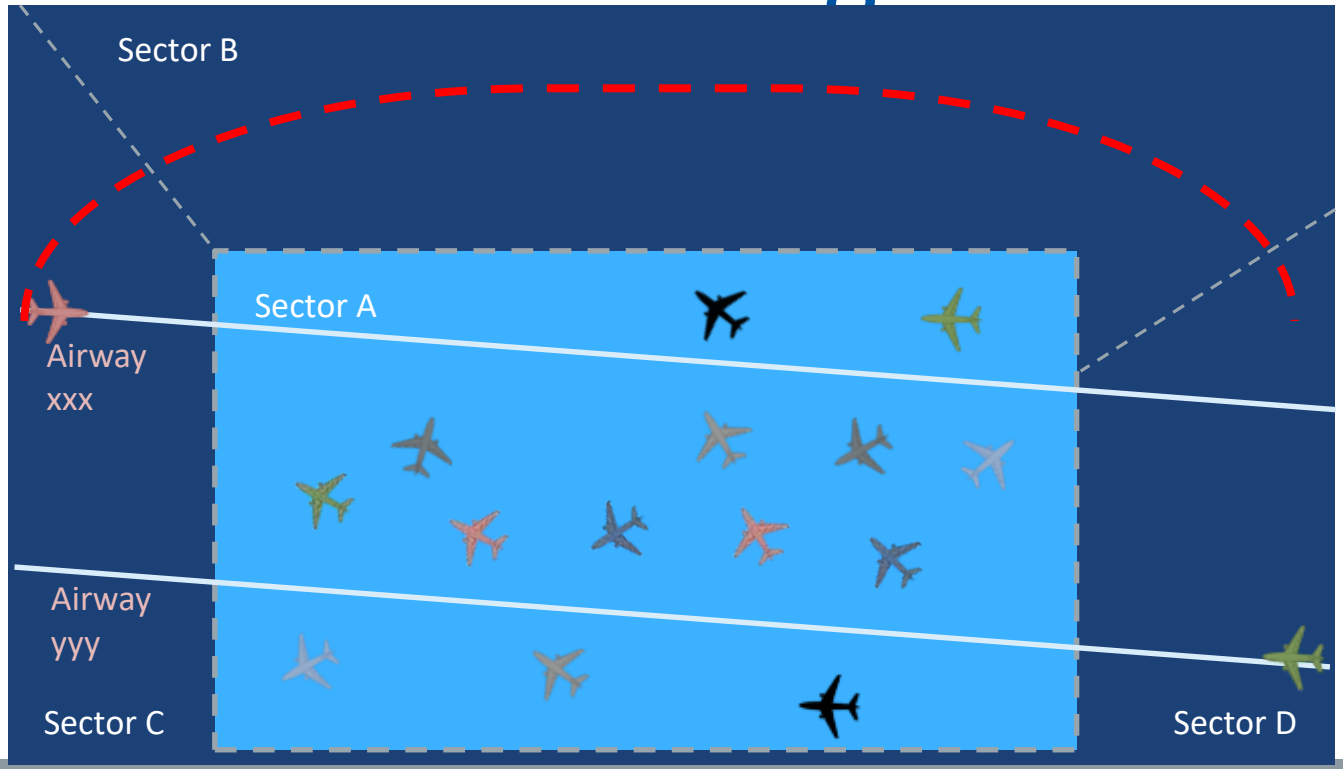
ATFM measure	Constraint			Control mechanism	Time frame	Requirements to be effective
	Airport arrivals	Airport departures	Airspace			
GDP	X	X	X	CTOT	Pre-tactical and tactical	Participation in percentage and distance
Re-route			X	Flight path change to avoid constraint	Pre-tactical and tactical	Access to airspace and published routes
Ground stop	X			Prevent departures from specific aerodromes to address existing tactical load on an arrival aerodrome	Tactical	
MIT/MINT	X		X	Time- or distance-based separation on a single stream of traffic	Tactical	
MDI	X		X	Time-based separation from departures from the same aerodrome	Tactical	
Fix balancing	X		X	Flight path change to avoid	Tactical	
Level capping			X	Flight path change to avoid	Tactical	

Ground Delay Program (GDP)

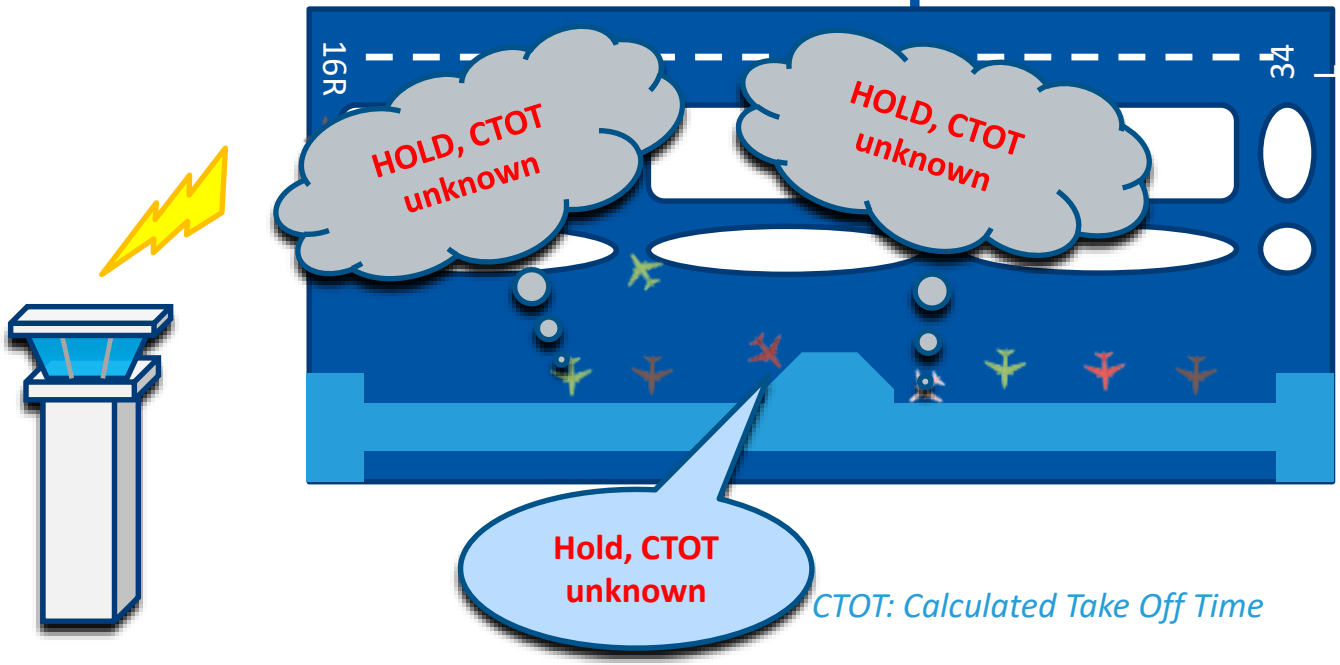


CTOT: Calculated Take Off Time

Rerouting

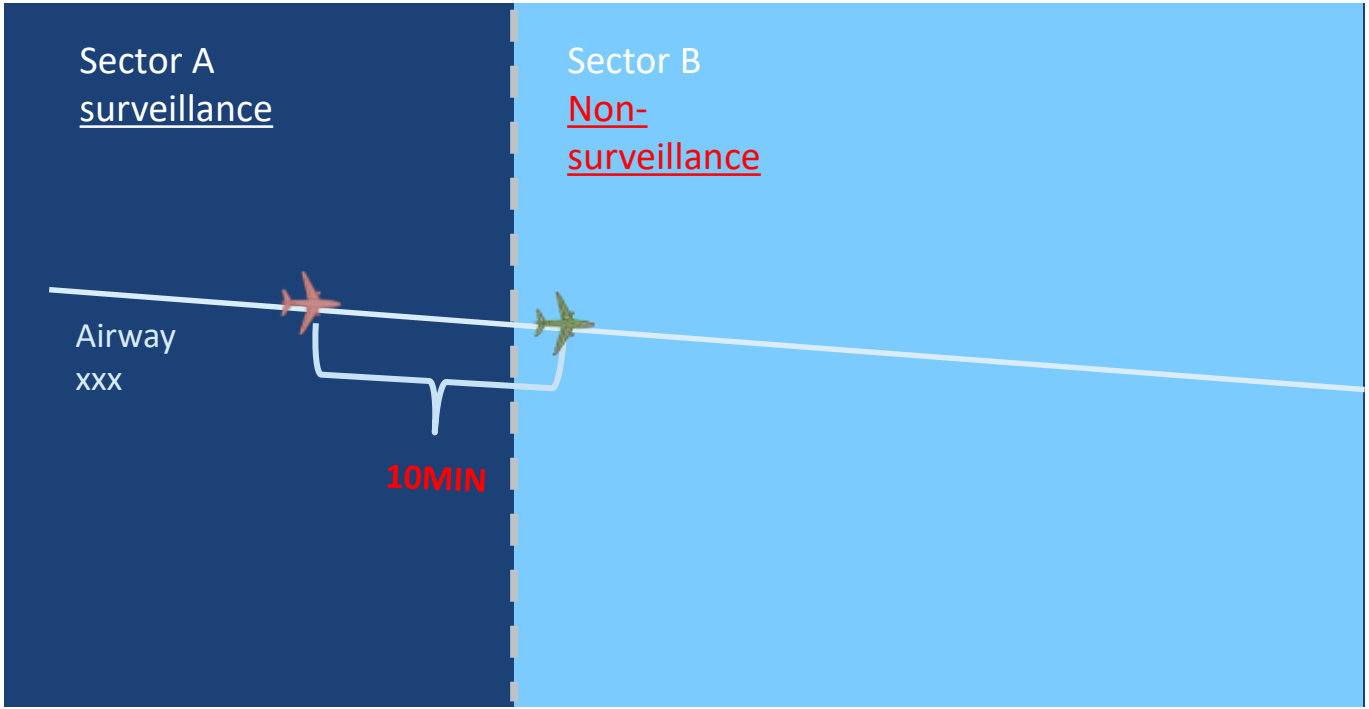


Ground Stop

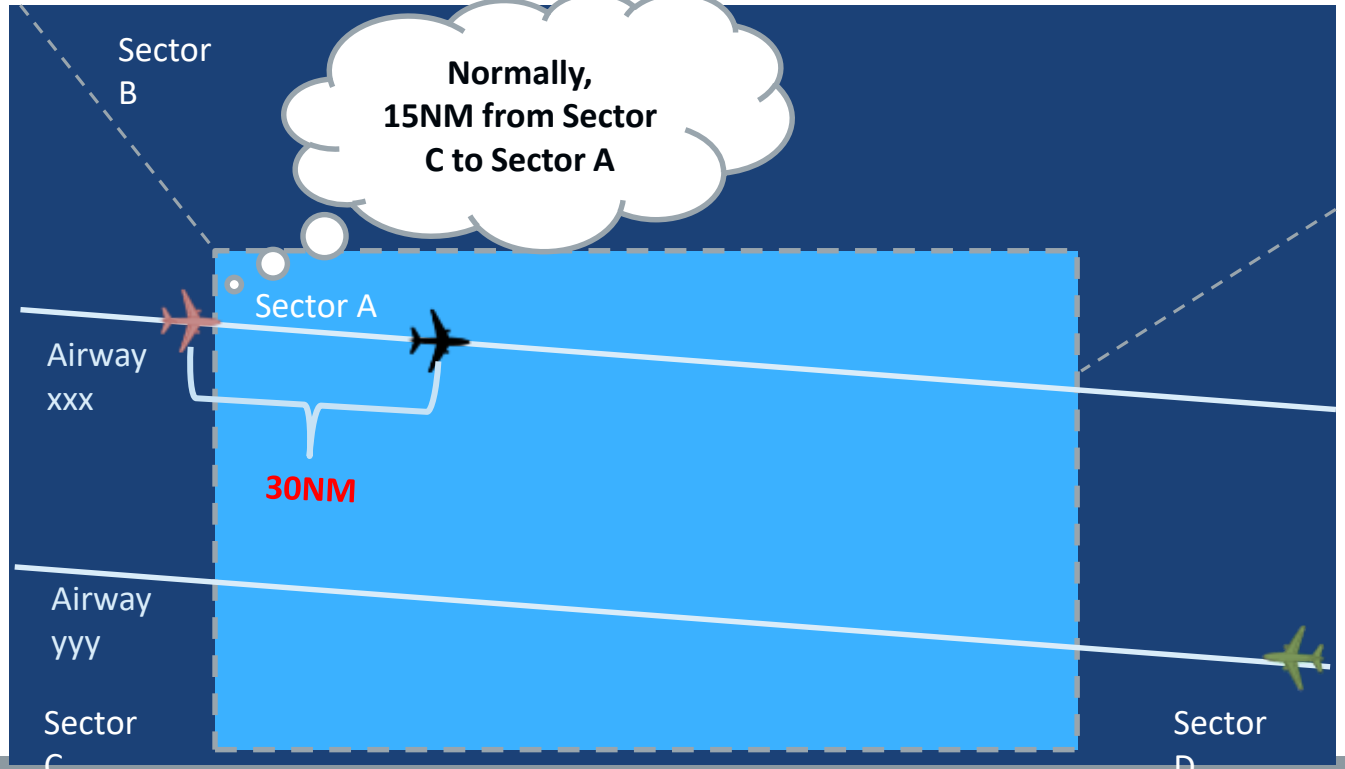


CTOT: Calculated Take Off Time

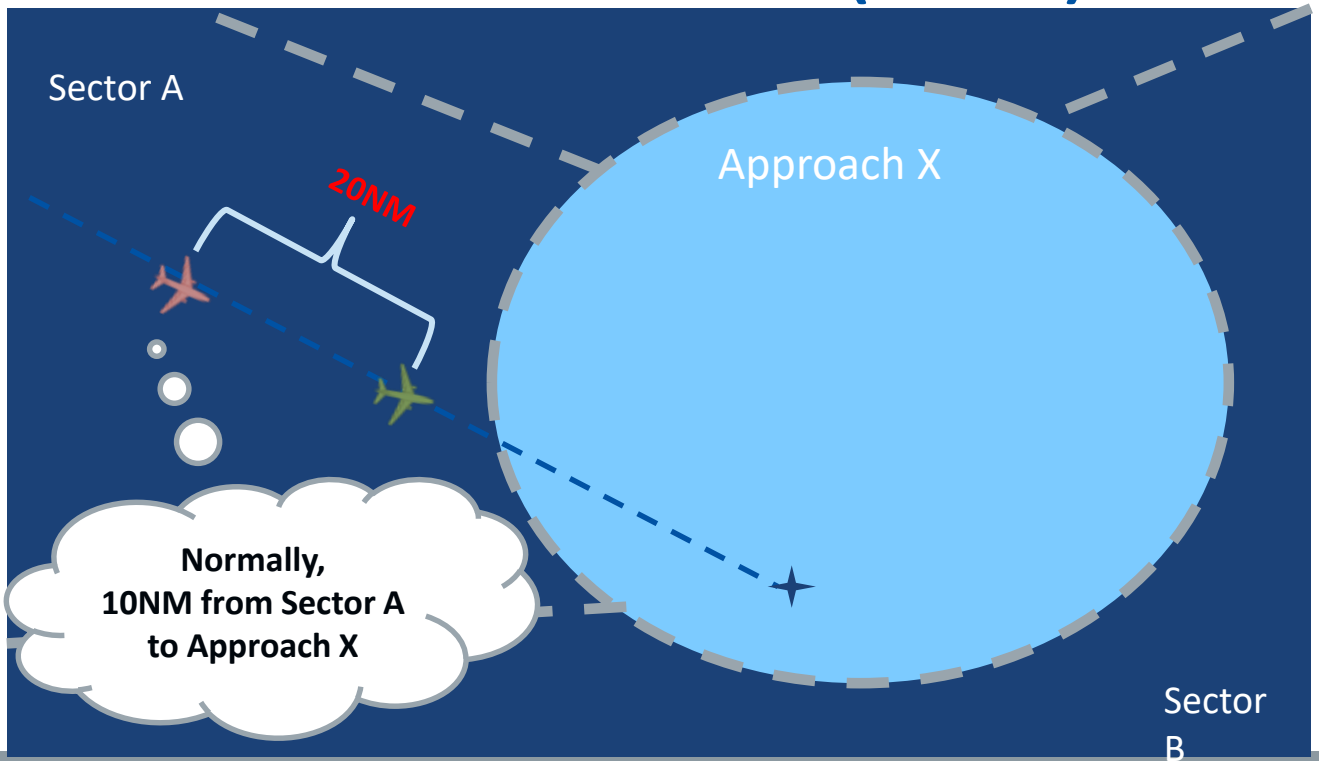
Minutes in Trail (MINIT)



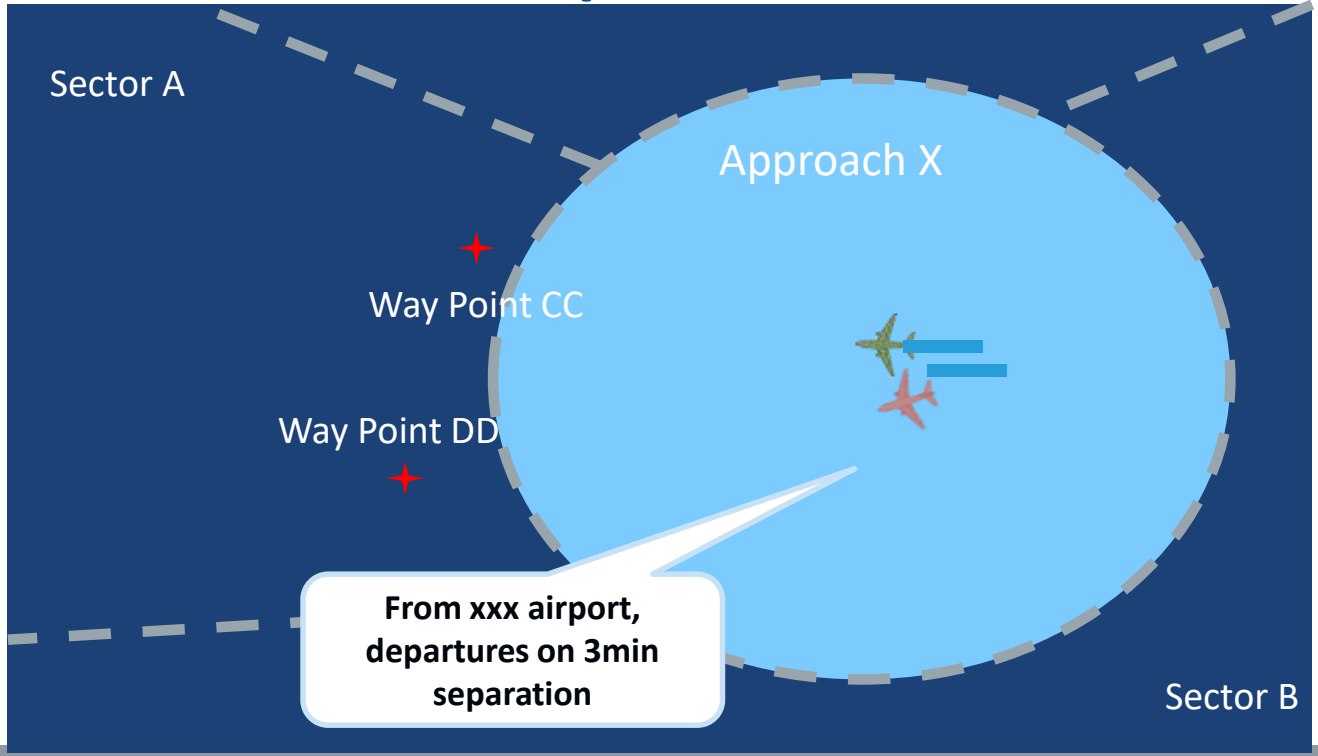
Miles in Trail



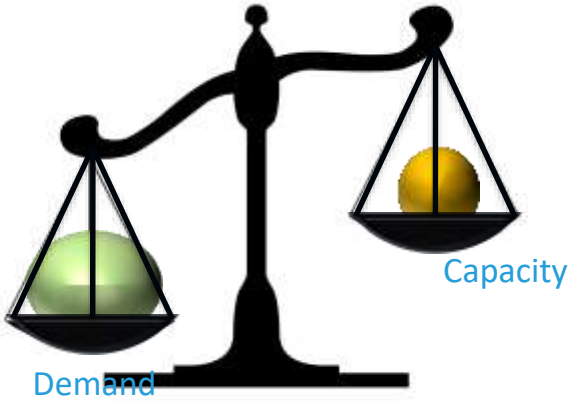
Miles in Trail (MIT)

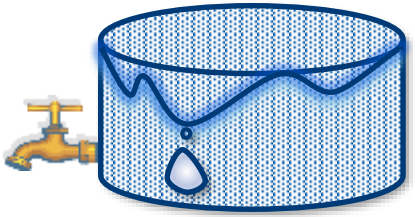


Minimum Departure Intervals

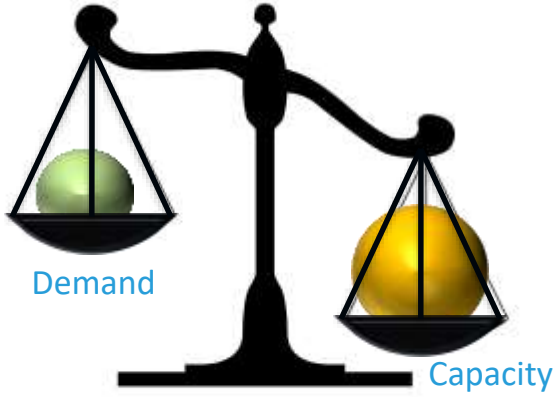


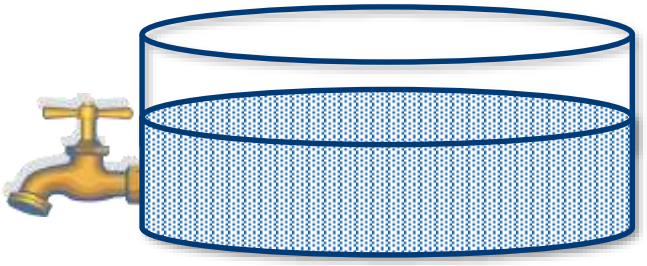
Case Study (ATFM 2)



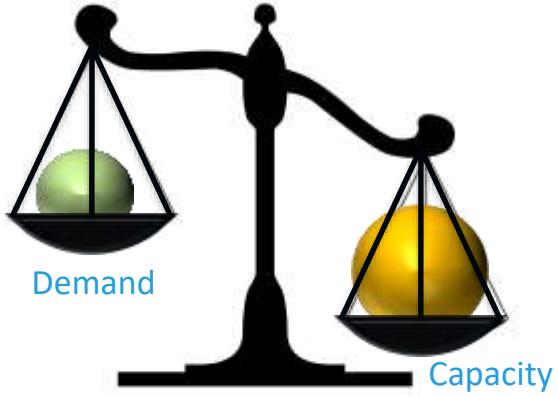


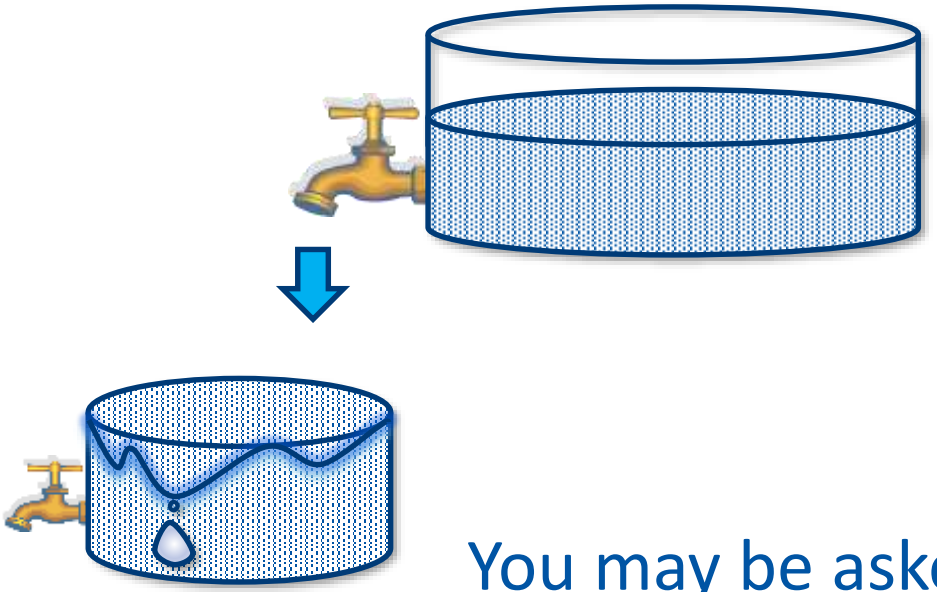
Do you need ATFM?



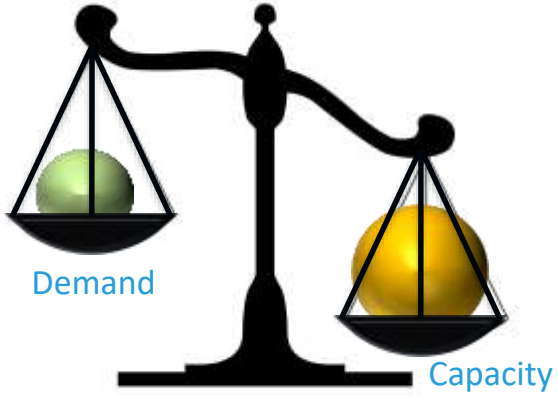


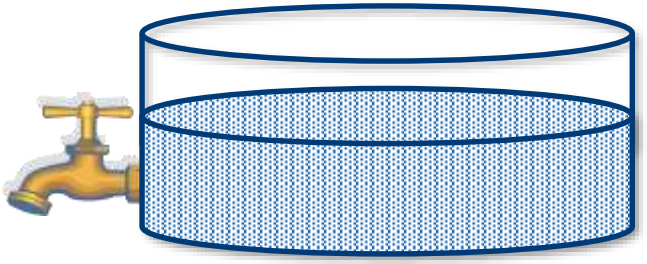
You don’t really need ATFM?





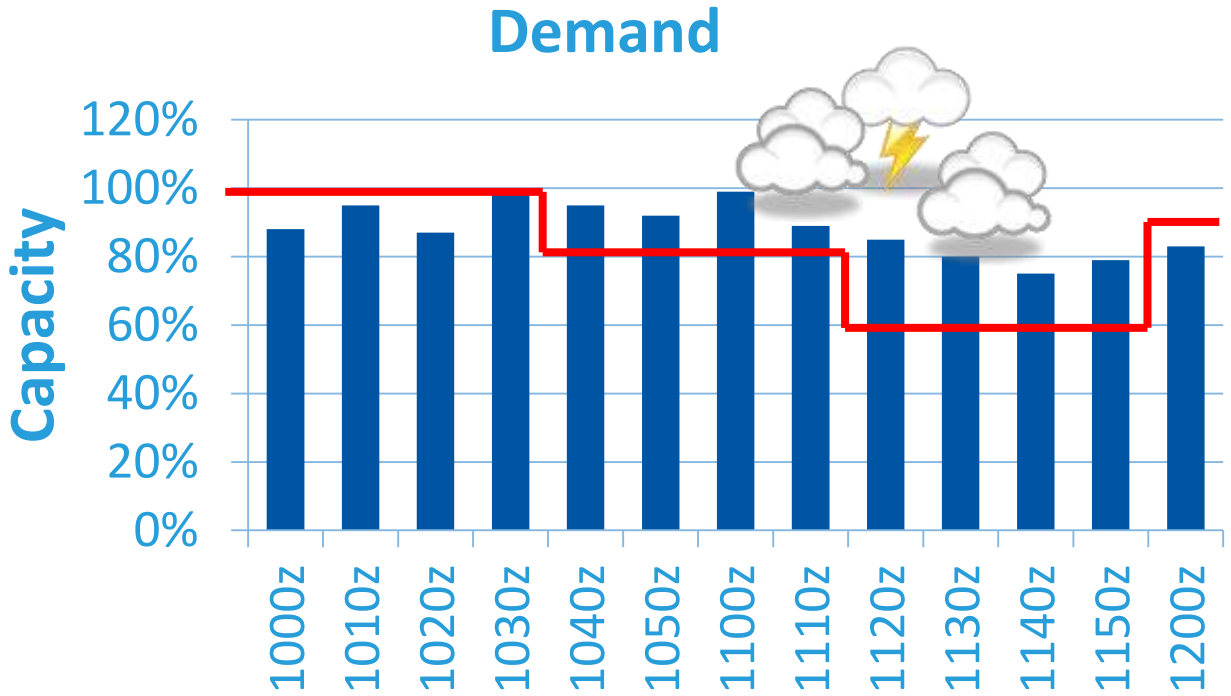
You may be asked by neighboring ANSP.

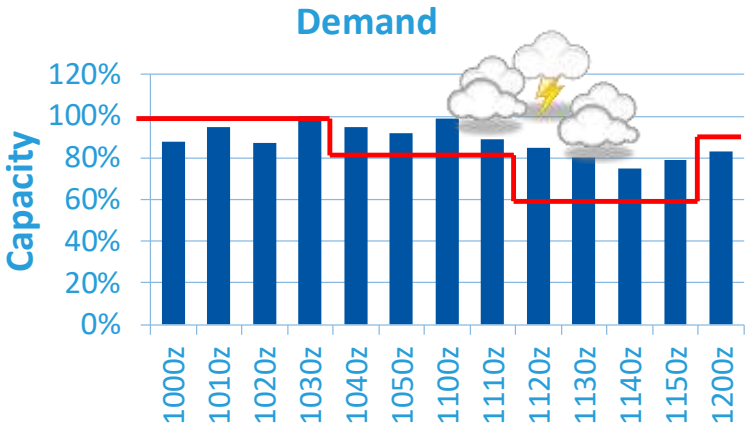


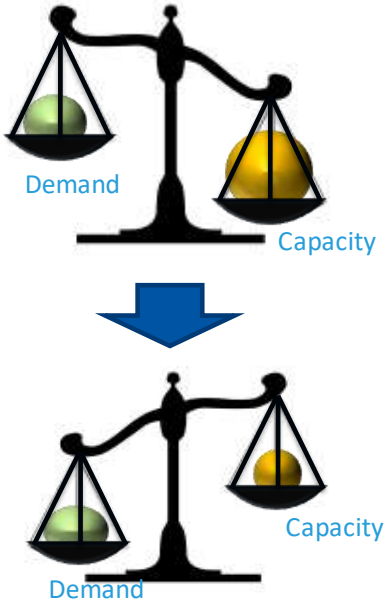


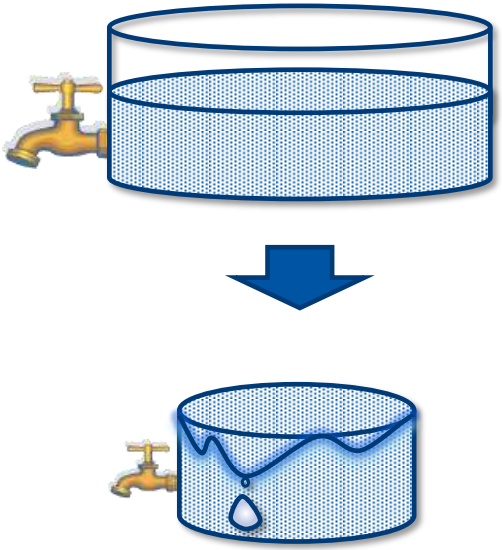
You don’t really need ATFM?

Operational Capacity




Demand
120%
100%
80%
60%
40%
20%
0%
Capacity
1000z
1010z
1020z
1030z
1040z
1050z
1100z
1110z
1120z
1130z
1140z
1150z
1200z


Demand
Capacity
Capacity
Demand



ATFM and Contingency

ATFM and Contingency

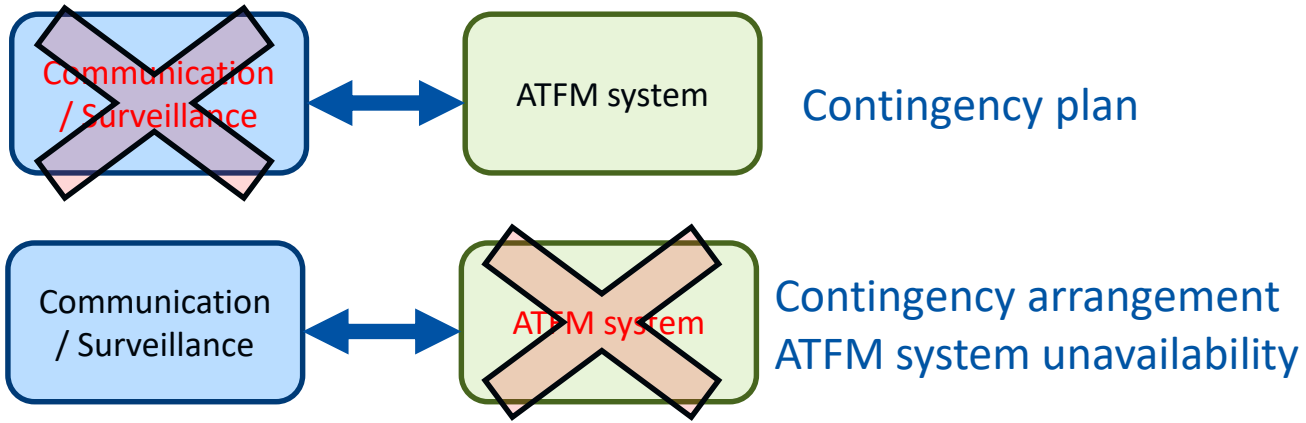
- ATFM and contingency arrangements are closely interlinked
  - ATFM provides a process for mitigating the effects of disruption in an ATM resource
  - Contingency arrangements are required in the event of a failure of the ATFM

ATFM and Contingency

- ATFM contingency plans
  - Description of the potential ATM resource failure (e.g. communication failure, surveillance failure, unanticipated aerodrome closure, etc.)
  - ATFM measures to be taken in response to disruptions
  - Process for the application of ATFM measures during each contingency situation
  - Recovery procedures
  - Information on contingency points of contact, roles and responsibilities
  - Post-contingency reporting procedures

ATFM and Contingency

- Contingency arrangements in the event of an ATFM system unavailability



REGIONAL REQUIREMENTS

Asia/Pacific Ministerial Conference on Civil Aviation

- Held in Beijing, China
  from 31 January to 1 February 2018.
- Attended by 32 Members States of the APAC Region, 4 Member States (France, Russian Federation, United Kingdom and United States) of other Regions and representatives of 6 international organizations.

Beijing Declaration

Air Navigation Services

Commit to implementation by 2022, of the Asia/Pacific Seamless Air Traffic Management (ATM) Plan to enhance ATM capacity and harmonization in the region, including a focus on:

(f) Air Traffic Flow Management / Collaborative Decision Making(CDM) implementation for high density airports

APAC Seamless ANS Plan v3.0

- 7.37 All ATC Sectors should have a nominal aircraft capacity figure based on a scientific capacity study and safety assessment, to ensure safe and efficient aircraft operations.
- 7.38 All ACCs operating within FIRs where demand may exceed capacity should implement ATFM incorporating CDM to enhance capacity, using bi-lateral and multi-lateral agreements, initial integration of ASM with ATFM, Collaborative Network Flight Updates, Basic Network Operation Planning and Initial Airport/ATFM slots, A-CDM Network Interface and Dynamic Slot Allocation consistent with NOPS-B0/1 –5(Priority 1).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APAC Seamless ANS Plan v3.0

- 7.52 All ACCs operating within FIRs where demand may exceed capacity should operate systems that enable, where applicable, Short Term ATFM measures, Enhanced NOPS Planning, Enhanced integration of airport operations and NOPS planning, Enhanced Traffic Complexity Management, Full integration of ASM with ATFM, Initial Dynamic Airspace configurations, Enhanced ATFM slot swapping, Extended Arrival Management, ATFM Target Times and Collaborative Trajectory Options Programme consistent with NOPS-B1/1 –10supportingtheintegrationof time-based management within a flow centric approach, consistent with TBO-B0/1and TBO-B1/1.


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APAC Seamless ANS Plan v3.0

Research and Development

b. Sub-Regional ATFM-Inter-linked (data-sharing) ATFM units (which may be virtual offices) should be developed to serve various sub-regions. This concept is consistent with Seamless ANS Principle 8 *(Sub-regional ATFM based on system-wide CDM serving the busiest terminal airspace and MTF)*. The Global ATM Operational Concept paragraph 2.4.3 states: *Demand and capacity balancing will be integrated within the ATM system*;


INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA-PACIFIC SEAMLESS ANS PLAN

- Doc 9971
  - Manual on Collaborative Air Traffic Flow
  - Ver. 3.0 (January 2018)

- Asia Pacific Air Traffic Flow Management Concept of Operations
  - Ver. 1.0 (September 2015)


INTERNATIONAL CIVIL AVIATION ORGANIZATION

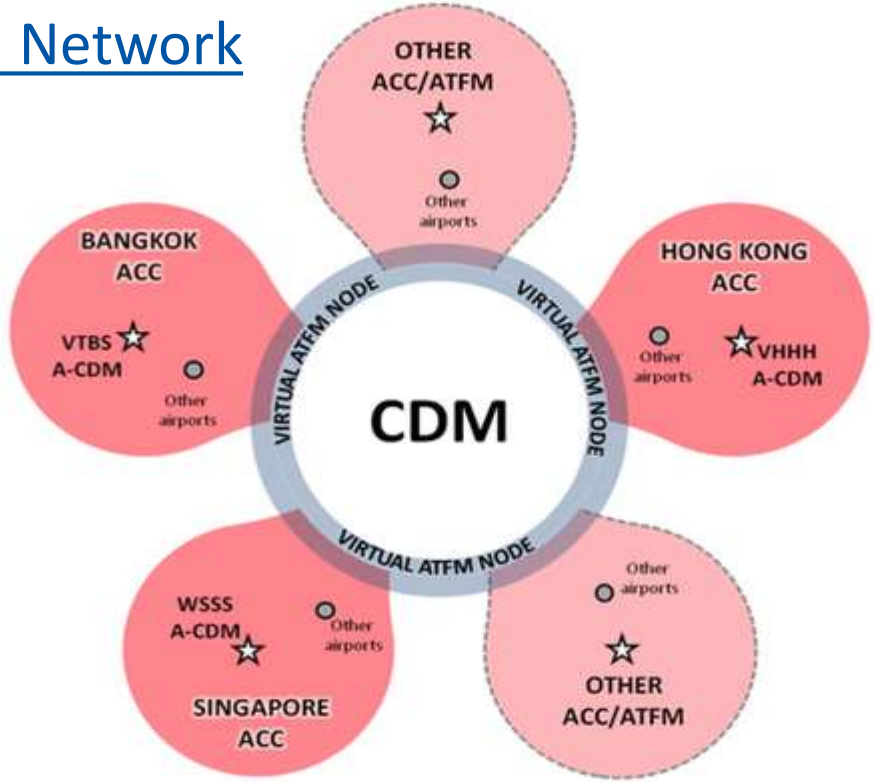
ASIA/PACIFIC REGIONAL
AIR TRAFFIC FLOW MANAGEMENT
CONCEPT OF OPERATIONS

- Asia Pacific Framework for Collaborative Air Traffic Flow Management
  - Ver. 3.0 (August 2017)

Regional ATFM

- Core Concept is Distributed Multi-Nodal ATFM Network
  - Referenced to Draft Regional ATFM Concept of Operations
- Virtual ATFM Platform of interconnected States and/or sub-Regional groups operating ATFM network
- No need for any central, physical facility providing network management*

Distributed Multi-Nodal ATFM Network



ATFM related information/documents

- The Asia Pacific Ministerial Conference on Civil Aviation (APACMC)
  https://www.icao.int/APAC/Meetings/Pages/2018-APACMC.aspx
- APAC Seamless ANS Plan
  https://www.icao.int/APAC/Documents/edocs/Asia%20Pacific%20Seamless%20ATM%20Plan%20V%203.0.pdf
- Asia Pacific Air Traffic Flow Management Concept of Operations
  https://www.icao.int/APAC/Documents/edocs/Regional%20ATFM%20Concept%20of%20Operations.pdf
- Asia Pacific Framework for Collaborative Air Traffic Flow Management
  https://www.icao.int/APAC/Documents/edocs/Asia%20Pacific%20Regional%20Framework%20for%20Collaborative%20ATFM%20version%203.0.pdf
- Other documents https://www.icao.int/APAC/Pages/eDocs.aspx

WHAT ICAO CAN OFFER

Regional workshop/seminar/webinar

Planned in cooperation with

- ✓ A-CDM
- ✓ MET

Tailored events for your State/Organization

Based on your needs, ICAO can assemble

- ✓ Workshop
- ✓ Seminar
- ✓ Webinar
- ✓ Technical assistance

For further information, please contact the ICAO APAC RSO, apac-rso@icao.int or htakata@icao.int

ADDITIONAL INFORMATION

COVID-19 related information

- ICAO has developed this COVID-19 Recovery Platform to collate the forecasts, guidance, tools, and resources which are needed by national regulators pursuing pandemic responses.
  https://www.icao.int/covid/Pages/default.aspx

- COVID-19 BCP Measures & Guidelines Information Sharing
  https://www.icao.int/APAC/Pages/COVID-19-BCP.aspx

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- First meeting of the ICAO APAC COVID-19 Contingency and Recovery Planning Group (ACCRPG/1)
  https://www.icao.int/APAC/Meetings/Pages/2020-ACCRPG1.aspx

Q&A SESSION

Q&A session

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