

Asia-Pacific Multi-Nodal



CANSO Air Traffic Data Exchange for the Americas (CADENA)

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CANSO – General Organisational Information

Vision

- To be the recognised leader in transforming global air traffic management (ATM) performance

Membership

- 90 **Full Members** (ANSPs) representing 90% of the world traffic
- 89 **Associate Members** (Organisations that supply goods and services to the air traffic management industry, as well as academic institutions and aircraft operators)

ATFM Implementation Best Practices

- ATFM Operations Around the World
 - Multi-Nodal
 - CADENA



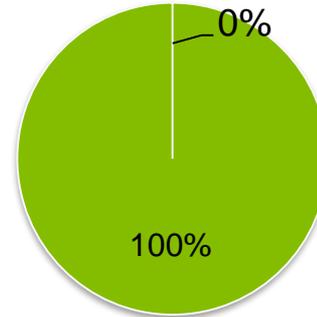
How Multi-Nodal Came About?

- To start, what do we know about ATFM around the world?
- Most operate as **single / centralized entity** providing **ATFM service within FIR** or area of responsibilities
- Most focus on domestic **flights or flights within area of responsibilities**, which captures >70% of overall traffic
- Most **exempt international** and long-haul traffic from outside the area
- ***WHY DID THIS NOT WORK FOR ASIA-PACIFIC?***

How Multi-Nodal Came About?

Why does conventional ATFM concept not work for Asia-Pacific?

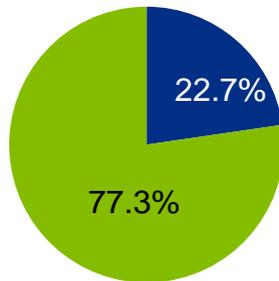
Hong Kong International &
Singapore Changi



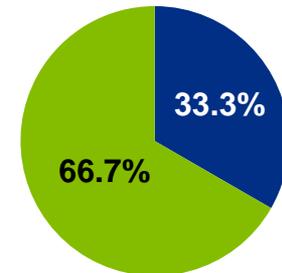
■ Domestic

■ International

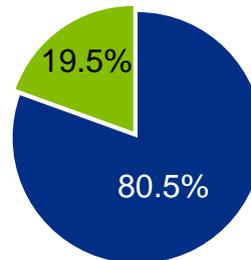
Bangkok Suvarnabhumi



Kuala Lumpur International

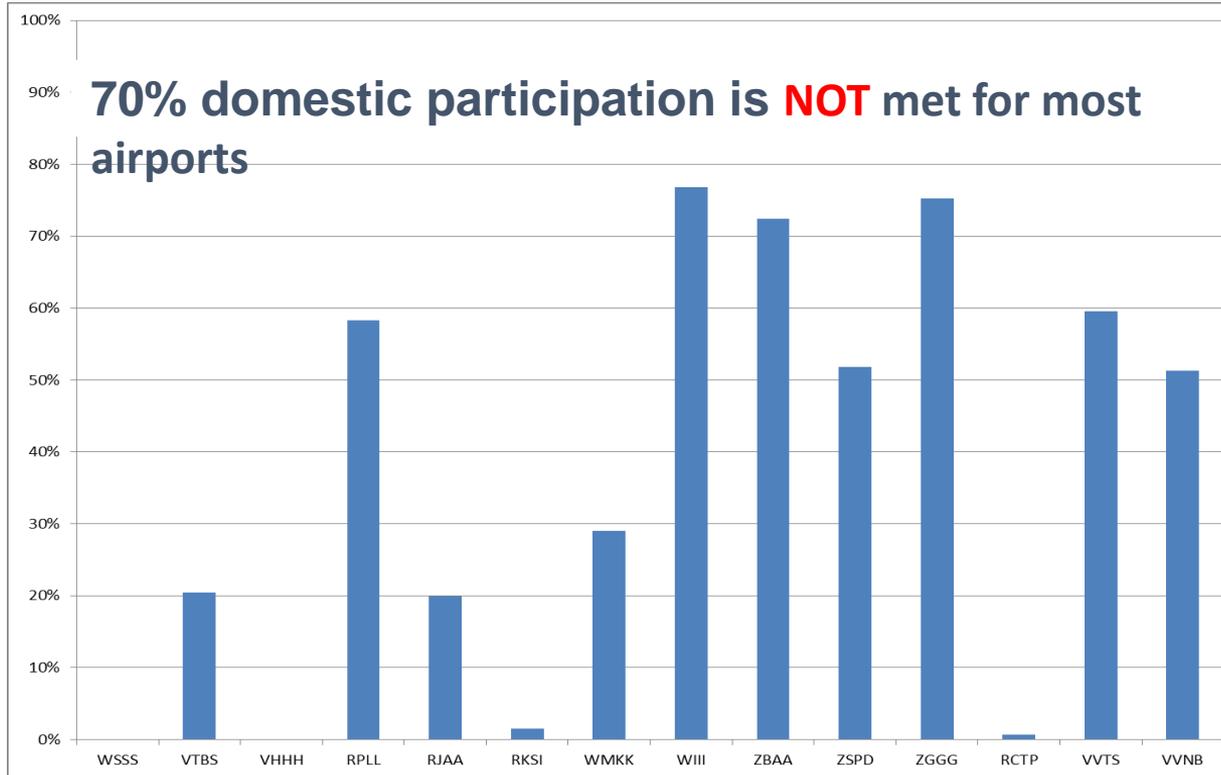


Jakarta Soekarno-Hatta



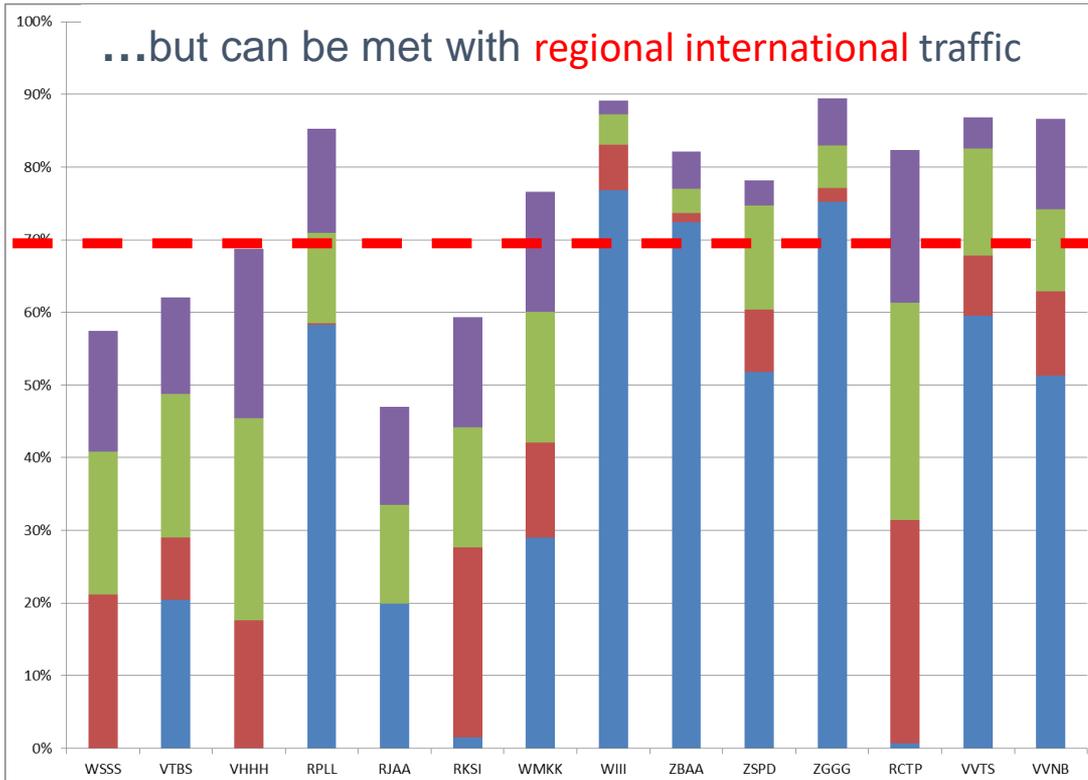
How Multi-Nodal Came About?

Why does conventional ATFM concept not work for Asia-Pacific?



How Multi-Nodal Came About?

Why does conventional ATFM concept not work for Asia-Pacific?



- + Intl Within 1500-2000nmi
- + Intl Within 1000-1500nmi
- + Intl Within 500 - 1000nmi
- + Intl Within 500nmi
- % Domestic

How Multi-Nodal Came About?

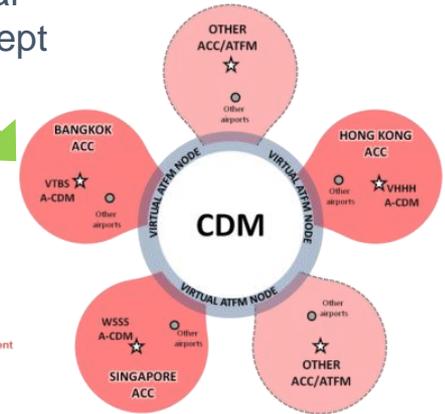
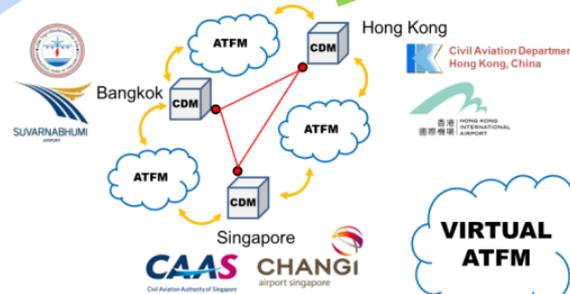
So what did Asia-Pacific do?

Distributed Multi Nodal
Regional ATFM Concept
2014 -



Research Collaboration on
Regional ATFM Concept 2013

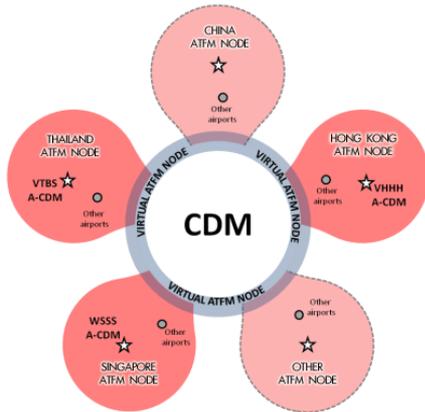
CANSO Whole of flight CDM
Pilot Project between BKK-SIN
2011-2012



Tripartite CDM Project between BKK-
HKG-SIN
2012-2013

What is Multi-Nodal Concept?

Distributed Multi-Nodal ATFM Network: The Concept



Bases:

- Common ATFM principles and guidance with harmonized protocols supported by agreed Common Operating Procedures (COP)
- Effective information sharing and dissemination framework

Concept:

Independent “virtual” ATFM nodes supported by interconnected information sharing framework

Supplemented by : A-CDM Process

ATFM Implementation Best Practices

- ATFM Operations Around the World
 - Multi-Nodal
- CADENA



CADENA

The Game Changer in Latin America





The Region needed CADENA

- CADENA broke new ground and is changing the way the **region** delivers **air traffic flow management**
- CADENA was established in June 2016, has been **implemented**, and is improving
- More States are joining the effort
- The aviation community is **realizing the operational benefits** of collaboration

CADENA Implementation Roadmap



CADENA Members, Stakeholders and Observers

Members

TTCAA (Trinidad & Tobago, Aug 2016)
IDAC (Dominican Republic, Aug 2016)
ECNA (Cuba, Aug 2016)
JCAA (Jamaica, Aug 2016)
DC-ANSP (Curaçao, Aug 2016)
SENEAM (Mexico, Aug 2016)
COCESNA (CENAMER, Aug 2016)
EANA (Argentina, Aug 2016)
FAA (USA, Aug 2016)
CGNA (Brazil, Feb 2017)
ANSA (Aruba, Feb 2018)
DGAC (Costa Rica, Feb 2018)
AEROCIVIL (Colombia, Apr 2018)
MWCR (Grand Cayman, Sep 2018)

Stakeholders

Aerolinas Argentina	Mesa Airlines	
Aeromexico	Sky Airlines	
Air Canada	Spirit Airlines	
American	United	
Atlas Air	UPS	
Azul	Volaris	
Caribbean Airlines	WestJet	
Copa	ICAO	ALTA
Delta	ACI	IATA
JetBlue	NBAA	

Observers

Panama, Venezuela, Peru, Paraguay,
Uruguay, Chile

Weekly Regional Planning Web Conference

- Weekly Web Conference on Fridays
- Target duration is 30 minutes or less
- CADENA ANSPs share the responsibility of hosting the Web Conferences
- Regional aviation stakeholders participate
- Information is shared, discussed, and the ATFM plan is established collaboratively
- **Simple** and **EFFECTIVE!**

CADENA Tactical Web Conferences

- Hurricane
- Route Issues
- Equipment Issues
- Excessive TMM Issues



Example: Hurricane Planning Web Conferences

Benefits

- Common situational awareness
- Rapid and fluid information flow
- Improvement of operational safety

Frequencies

- 17 Web Conferences in 2017
- 9 Web Conferences in 2018

CADENA Operational Information System



Information ▾ Regional TMM 0 Active Reroutes 0 Advisories 5 Español



Regional Operations Plan

SENEAM Mexico :25/Feb/2019 15:12

Anticipated Demand Information HIGH

TMM Planned MMMX; DOMESTIC GDP; MMUN; 20MIT TRAFFIC FROM HOU AREA DEST MMUN, (15 - 23UTC).

Urgent Advisory

Weather NO SIGNIFICANT WEATHER

Volcanic Ash NONE

Constraints NOTAM

(A0533/19 NOTAMR A0446/19

A) MMUN

B) 201901310600

C) PERM

E) FLT TO MMUN BY AWY UB-881 NOT AUTH)

Special Events NONE

Equipment Outages NONE

Other NOTAM A0790/19, ROUTES TO BE FILLED DEST MMUN. (SEE ADVISORIES SECTION)

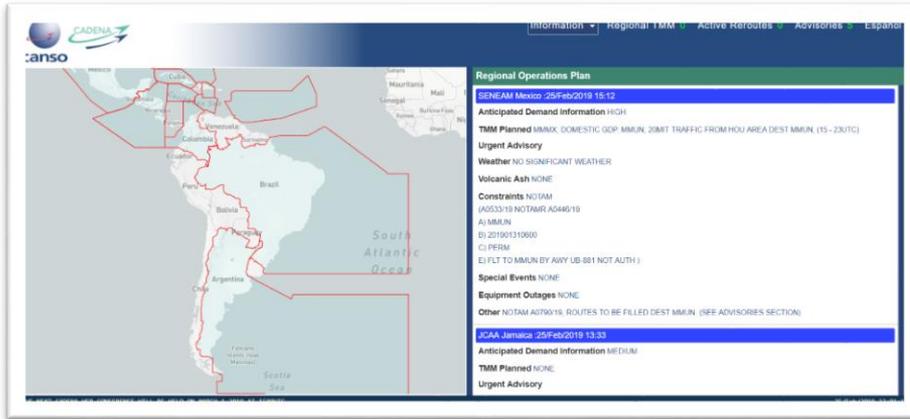
JCAA Jamaica :25/Feb/2019 13:33

Anticipated Demand Information MEDIUM

TMM Planned NONE

Urgent Advisory

CADENA Operational Information System



<https://www.cadenoais.org/>

OIS: effective to **share information** and improve **common situational awareness**

- ATFM Daily Plan (ADP)
- Regional TMM
- Active Reroutes
- Advisories
- Airport Capacity Info
- Reroute Repository

In English and Spanish

CADENA ATFM/CDM Procedures Manual

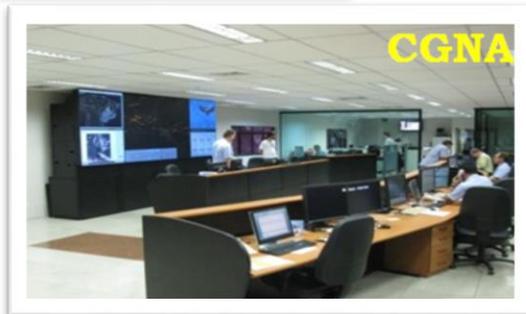
**Civil Air Navigation Service Organisation
Air Traffic Flow Management
Data Exchange Network for the Americas**

CADENA
Air Traffic Flow Management
and
Collaborative Decision Making
Procedures Manual



- Supports standardized procedures and practices
- Outlines roles and responsibilities
- Describes ATFM structure and operation
- 1st version July 2017. Updated version planned summer 2019
- Based on ICAO Doc 9971 – “Manual on Collaborative Air Traffic Flow Management (ATFM)”

FMUs Around the Region





CADENA–Advanced ATFM Operational Simulation Training

- CADENA developed and implemented (at no cost to ANSPs) Advanced ATFM Operational Simulation Training. The training brought together neighboring ANSPs to:
 - Understand capacity, constraints, and predicted demand
 - Develop ATFM solutions with the least operational impact for the ANSP and the region
 - Analyse the results of traffic management measures on the efficient flow of traffic and the balancing of demand to available capacity
 - Collaboratively identify operational issues and work towards a common goal
- Training will continue to include ANSPs throughout the region to foster a common understanding of regional constraints and beneficial and collaborative solutions

CADENA – TFM Data Exchange

- Critical to exchange flight data (e.g., Flight Plan, Position Data) for the accurate demand information
- FAA has Traffic Flow Management System (TFMS) and System Wide Information Management (SWIM)
- Colombia has full ATFM capabilities
- TTCAA started TFM DE in October 2017
- COCESNA ready to test TFM DE (as of Feb 2019)

CADENA – Next Steps

- Continue collaboration with ICAO
- Continue improvement of Procedures and Processes
- Additional ANSPs for traffic data exchange to improve demand information
- Additional aviation stakeholders participation
- Provide additional CADENA Advanced ATFM Operational Training Opportunities

Asia-Pacific Multi-Nodal



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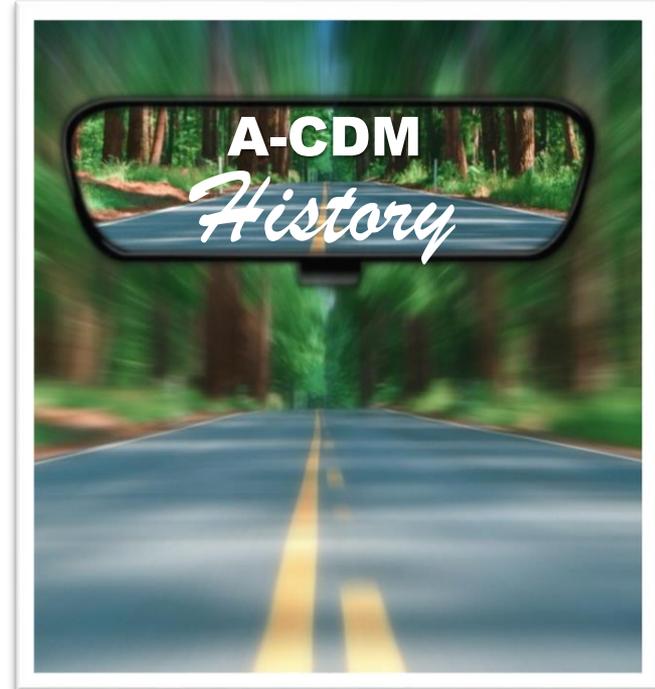


Back-up Slides

- A-CDM

A-CDM – Some History

- **A-CDM** arose from the need to minimize the disruptive effects from bad weather conditions.
- **Back in Year 2000** trials were conducted at several major European airports to study and develop an Airport CDM concept for Europe.
- This led to the creation of the Airport CDM Task Force in Eurocontrol and the result was **Airport CDM Implementation Manual**.
- Munich Airport was the **first A-CDM airport back in 2007**.



A-CDM – Quick Facts



- ✓ Airport CDM (A-CDM) aims at improving the overall efficiency of airport operations by optimizing the use of resources and improving the predictability of events.
- ✓ It focuses especially on aircraft turn-round and pre-departure sequencing processes.

- **28 European airports are fully A-CDM compliant and more are to come**
- **Airports in the APAC, ME and South America are starting to adopt A-CDM**

Globally Endorsed

- ✓ ACI
- ✓ CANSO
- ✓ IATA
- ✓ ICAO

A-CDM – Example in APAC



A-CDM in APAC

- **ICAO recommends** states in APAC to implement A-CDM in accordance with the **Seamless ATM Plan**.
- The Plan prioritizes the implementation of the Global Air Navigation Plan Aviation System Block Upgrades (ASBUs)
- Recommended ASBU upgrades are:
 - **B0-ACDM** Airport CDM
 - **B1-ACDM** Enhanced Airport CDM
- <https://www.icao.int/sustainability/Pages/ASBU-Framework.aspx>



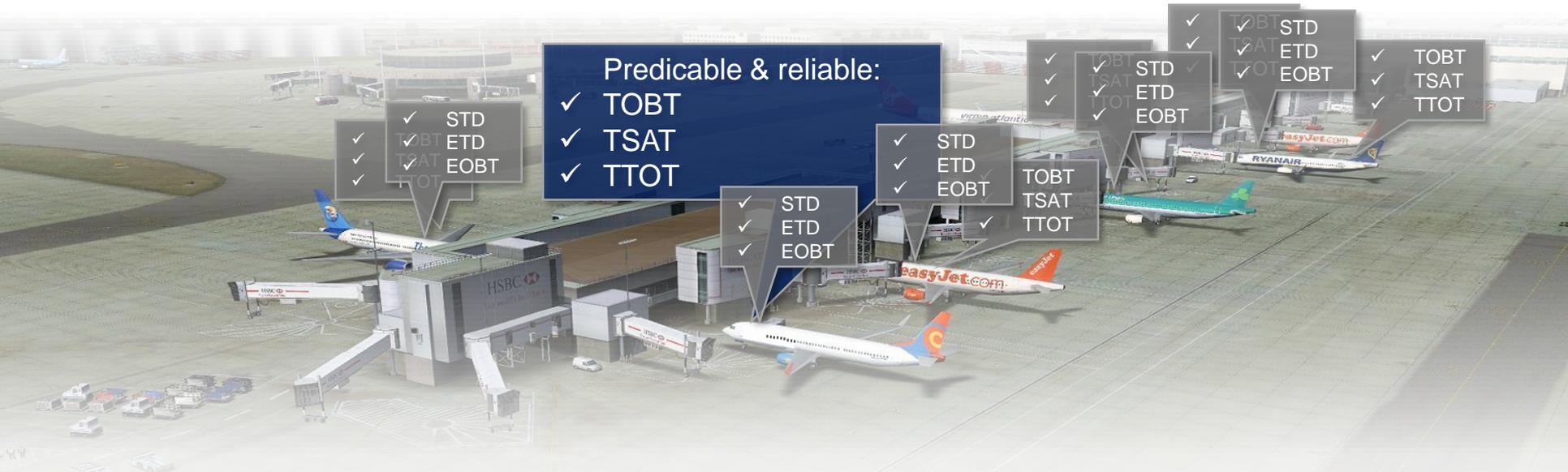
A-CDM – What is it REALLY about?

**WHAT
TIME IS
IT?**



- ✓ **Single source of the “TRUTH”** – all stakeholders look at the SAME information.

A-CDM – What is it REALLY about?



- ✓ Move away from the "FIRST COME FIRST SERVED" to "BEST PLANNED BEST SERVED"
= **Adherence to TOBT and TSAT**
- ✓ Integration with ATFM = **Information exchange for better demand & capacity balancing**

A-CDM – What is it REALLY about?

Information Sharing

1

The diagram shows a central 'CDM' box with 'AP' and 'DE' boxes on either side. A 'CDM' box is also shown below. The background features a stylized globe and a network of nodes and lines.

Milestone Approach

2

The diagram shows a central 'CDM' box with 'AP' and 'DE' boxes on either side. A 'CDM' box is also shown below. The background features a stylized globe and a network of nodes and lines.

Variable Taxi Time (VTT)

3

The diagram shows a central 'CDM' box with 'AP' and 'DE' boxes on either side. A 'CDM' box is also shown below. The background features a stylized globe and a network of nodes and lines.

Pre-Departure Sequence

4

The diagram shows a central 'CDM' box with 'AP' and 'DE' boxes on either side. A 'CDM' box is also shown below. The background features a stylized globe and a network of nodes and lines.

CDM in Adverse Conditions

A-CDM creates predictability and common awareness during e.g. typhoons, thunderstorms

5

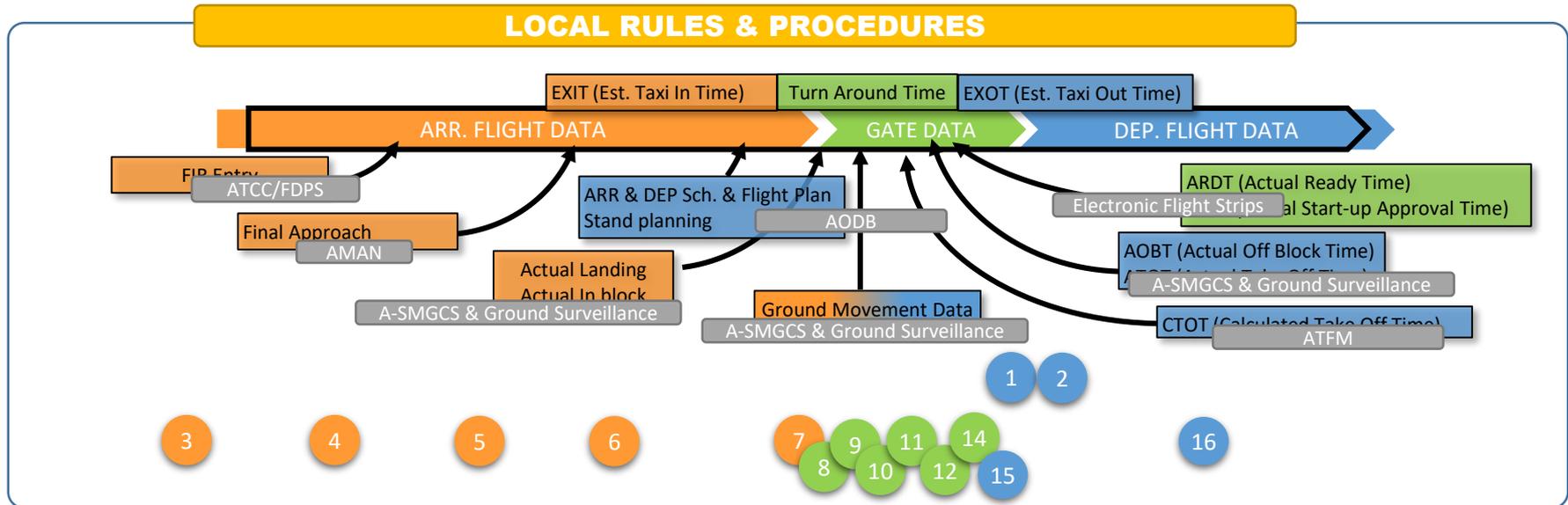
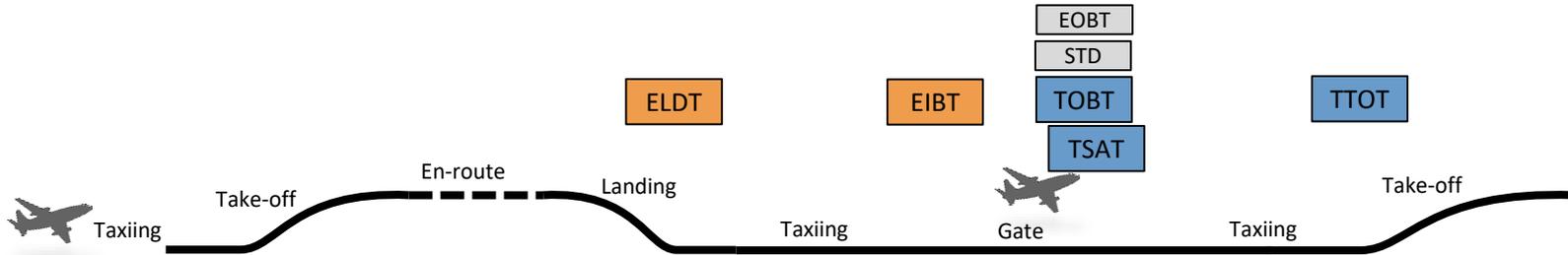
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Integration with Flow Management

6

The diagram shows a central 'CDM' box with 'AP' and 'DE' boxes on either side. A 'CDM' box is also shown below. The background features a stylized globe and a network of nodes and lines.

A-CDM – What is it REALLY about?



A-CDM – What is it REALLY about?

- To achieve A-CDM success it will require collaboration between key stakeholders
- The collaboration will be based on commonly agreed procedures and information exchange to achieve TOBT, TSAT and ATFM integration.



A-CDM – REAL Benefits!

Local benefits

- Average taxi-out time savings between 0.25 and 3 minutes per departure.
- Average schedule differences/improvements between 0.5 and 2 minutes per flight.
- Reduction in push-back delay after air traffic approval.
- Increased ATFM slot adherence.
- Improved ground handling resource utilisation.
- Reduction in the number of late starts and late arrivals.
- Improved management of and recovery from adverse conditions.
- Reduction in Flight Activation Monitoring suspensions.
- Increased peak departure rates at the runway.
- Improved take-off time predictability by 85% during adverse conditions.

If you want this...well...very simply put!

A-CDM and ATFM Integration is a requirement!

Network benefits

- Reduction in the standard deviation of take-off accuracy from 14 to between 5 and 7 minutes.
- Clear reduction in en route sector over-delivery risk when fed by 60% of flights from a CDM airport.
- Increase by 3.5 - 5.5% of en route capacity when Europe's 50 busiest airports become integrated.
- 80% of en route capacity benefits realised when the top 30 European airports are integrated.
- Average ATFM delay reduction of three minutes per regulation.
- 40 CDM airports could yield reductions of average ATFM delay of 20-25%.
- Departures from ACDM airports receive less ATFM delays than departures from non-ACDM airports through the same restriction – by an average of one minute per flight.

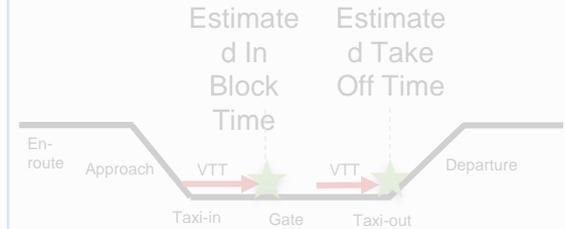
A-CDM and ATFM – Why?

Information Sharing

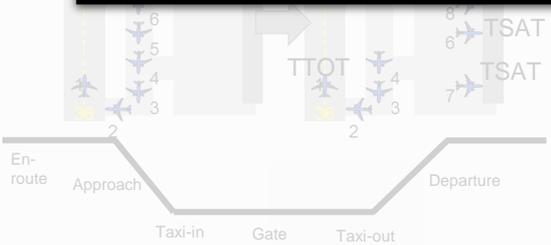
Milestone Approach

Variable Taxi Time (VTT)

- VERY WELL defined, tested and implemented in EUROPE!
- Outside of Europe the ATFM Concepts look different → how integration is supposed to work is still to be worked out.



Pre



Integration with Flow Management

”INTEGRATED A-CDM & ATFM”



ATFM and A-CDM

- ✓ ATFM and A-CDM can both exist as “stand-alone” BUT this will not realize the full benefits

→ **INTEGRATE**

- ✓ Integration will require harmonization of ConOps, data sharing and quality assurance

→ **COLLABORATION**



Back-up Slides



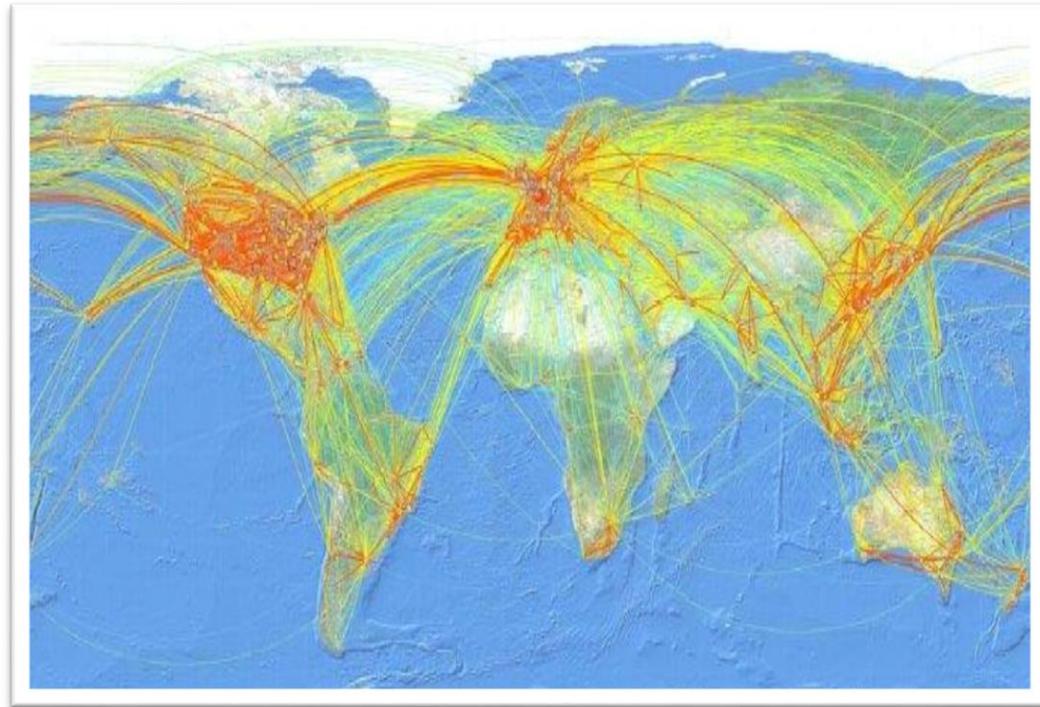
Agenda

1. What is ATFM?
2. Implementation Best Practices
3. ATFM Tools
4. Global Application and Next Steps

ATFM Benefits - Societal



- Improved quality of air travel
- Increased economic development through efficient and cost-effective services
- Reduced fuel burn, greenhouse gas emissions, and operating costs



ATFM Benefits - Predictability



- Allows us to build achievable schedules
- Allows us to load the appropriate fuel weight
- Every kilo of extra fuel offsets cargo and passenger capacity
- We may have to offload passengers and cargo to carry extra fuel
- It costs fuel to carry fuel
- Predictable direct sectors are 4-6% more efficient than tactical direct sectors
- Collaborative approach allows us to help the system

Global Application – Airline Benefits



European

- The European system has been designed to manage the capacity constraints, and to allow airports to manage airport activities. Out of necessity, A-CDM was developed in order to allow airports to begin proactively coordinating the arrivals and departures with the CFMU NM

Eurocontrol CFMU

- The CFMU, has developed a number of tools and procedures to manage traffic within the EU area. It has focused on utilizing the tools to manage the data associated with flights, and to coordinate with the airports and airlines. The basic structure develops a network plan in advance of the operational day, and then works with ANSPs to mitigate unexpected disruptions. The CFMU does not have the authority to unilaterally modify the network plan.

Performance?

- The level of performance, is based on the number of delays and preference approvals.
- Weather and other issues have reduced the overall performance. In particular, the lack of flexibility in the airspace, staffing and workforce actions, and lack of harmonized equipment, have contributed to delays.

Main Challenges?

- Airspace needs to be more accessible. The amount of OAT airspace over Europe limits ANSP flexibilities.
- Airlines may need to adjust flight times in order to take advantage of preferred routes
- Airports need to improve management of gates and support activities.

Global Application – Airline Benefits



United States/FAA

- The FAA has a very robust ATFM system . The CDM structure utilized by the FAA provides a venue for stakeholders to commonly agree on issues related to real-time operations. Via a suite of tools, ATC, airlines and airports are able to reduce delays by optimizing resources and improving predictability of events.

FAA Air Traffic Command Center

- The FAA ATCSCC is active in managing and coordinating aspects related to the flow of all traffic within US delegated airspace and works directly with airport operators to lessen capacity constraints and restrictions, by determining how best to mitigate enroute and airport delays. The FAA's ATFM module is interconnected with ACCs and adjacent FIRs.

Performance?

- The FAA reports on both airport and FAA ATC performance.
- Delays and other performance measures are tracked.
- Airlines are provided opportunities and encouraged to comment and daily performance.

Main Challenges?

- Weather is a huge factor impacting the US.
- New entrants such as commercial space activities, and RPAS operations will have an impact on specific areas.
- Further development of technologies will assist the FAA in improving their operation, but may make it difficult to harmonize systems with Global partners

Global Application – Airline Benefits



Asia-Pacific

- There is no centralized provider of ATFM services within the region, however, there are a number of States with Domestic ATFM programs. What Asia has realized is that they will not have a centralized Unit for the region, therefore alternative options must be explored to provide **Cross Border ATFM, that would** link the various domestic ATFM initiatives - hence Multi Nodal and NARAHG (Korea, Japan, Eastern China). In addition, to the above a number of ANSPs and airport operators manage activities utilizing A-CDM principles.

Demonstrations

- The region will undergo a demonstration of SWIM capabilities later in 2019. As the region moves forward, SWIM will be a key enabler in building a multi-modal LR-ATFM system. In this regard, Australia is currently embarking on a LR-ATFM project which will look at planning of their arrival sequence much further out than today and integrate it with their AMAN and GDP.

Performance?

- The region currently experiences a varying degree of delays. Quite often, they are attributable to weather and capacity constraints.
- In addition, the amount of available airspace is limited due to reserved military areas.

Main Challenges?

- Available airspace, Civil & Military sharing, i.e., FUA
- Development of automated interoperable systems
- Established links with adjacent FIRs will enable the sharing information
- Improved use of weather forecasting and opening of alternative routes.

Global Application – Airline Benefits



Middle East

- There is no centralized provider of ATFM services in the region. The lack of available airspace, and areas where military operations restrict the use of established route structures, only adds to congestion and reductions in capacity.

ATFM Development

- ICAO has formed a Task Force to consider the subject.
- There are a number of events upcoming that will increase the demand on available airspace.
- ANSPs in the region, although largely equipped with new systems, have not implemented interoperable systems that enable automated sharing and collaboration.

Performance?

- Capacity demand has resulted in delays at a number of airports
- Although not a significant factor, weather has the potential to disrupt operations.
- AIS and Flight Plan data is provided via AFTN.
- The use of AIDC is increasing, but inconsistent.

Main Challenges?

- The lack of interoperability between systems, inhibits advancement.
- Implementation of SWIM will improve the ability of systems to communicate, but progress is slow.
- Lack of available airspace and routes will continue to restrict capacity.
- Political situation results in difficulties for ANSPs

Global Application – Airline Benefits



Americas

- Although the region benefits from having a number of advanced ANPS who are implementing advanced systems, there are challenges related to system interoperability with surrounding regions. This disconnect is not sustainable.

ATFM Development

- Here to, the America's region is open to advancing robust methods for managing operations, however they have challenges with airspace restrictions, and weather avoidance
- There is a need to implement interoperable systems, thus allowing harmonized procedures.

Performance?

- Weather accounts for the majority of delays.
- Airport capacity constraints, due to size and configuration are also key factors affecting the performance.

Main Challenges?

- Lack of automation improvements.
- SWIM technology would assist the ANSPs in being able to share information.
- Airport infrastructure and management of gates and support activities, could also improve predictability, and increase efficiencies.
- Inter-regional coordination and the use of alternative routings during weather events would improve overall operations.

Global Application – Airline Benefits



Overall Benefits

- ✓ Enhanced ATM system safety
- ✓ Increased **predictability**
- ✓ Increased situational awareness
- ✓ Reduced fuel burn and operating costs
- ✓ Effective management of irregular operations and unforeseen events

NOTE: An ATM system which has no plans regarding capacity, i.e., no systems in place to manage flows, ultimately may become a **hindrance** to maintaining a steady flow of traffic and result in increased costs



Next Step - Tools Development

- Long Range ATFM
- Trajectory Based Operations
- Gate-to-Gate System Integration
- Advanced Weather Prediction and Interpretation Tools
- Cloud Based Applications



Wrap-up

1. What is ATFM?
2. Implementation Best Practices
3. ATFM Tools
4. Global Application and Next Steps

CANSO and IATA

ATFM: Collaborating for Air Traffic Flow Efficiency



Moderator: Rafael D. L. Quezada, CANSO Operations

Speakers: Stuart Ratcliffe, Metron Aviation
Fredrik Lindblom, Saab
Daniel Vaca, IATA
Javier Vanegas, CANSO Latin America

Thank you to our speakers.

For more information visit their booths:



Booth 403



Booth 147



Booth 1259



Booth 305



Agenda

1. What is ATFM?
2. Implementation Best Practices
3. ATFM Tools
4. Global Application and Next Steps

What is ATFM and How it Works?

1. ATFM Objectives
2. ATFM Concepts
3. CDM Objectives
4. ATFM Functional Flow



What is ATFM? and How it Works

- Air traffic flow management (ATFM) is used to manage the flow of traffic in a way that minimizes delays and maximizes the use of the entire airspace. ATFM can regulate traffic flows involving departure slots, smooth flows and manage rates of entry into airspace along traffic axes, manage arrival time at waypoints, flight information region or sector boundaries, and reroute traffic to avoid saturated areas. ATFM may also be used to address system disruptions including crisis caused by human or natural phenomena. – ICAO Global Air Navigation Plan
- Air traffic flow management (ATFM) is an enabler of air traffic management (ATM) efficiency and effectiveness. It contributes to the safety, efficiency, cost effectiveness, and environmental sustainability of an ATM system. It is also a major enabler of global interoperability of the air transport industry. – ICAO ATFM/CDM

ATFM Objectives

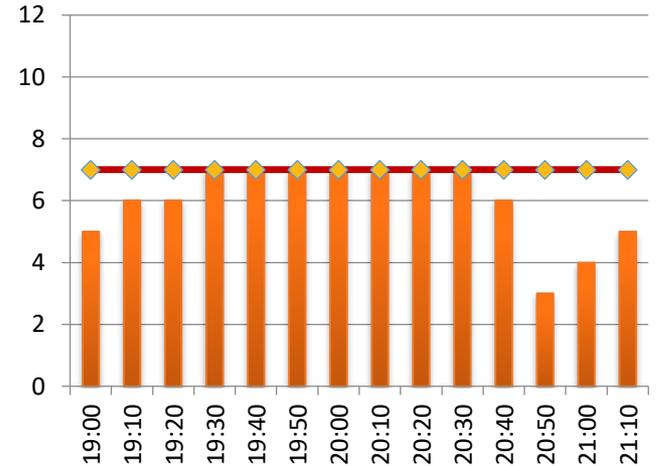
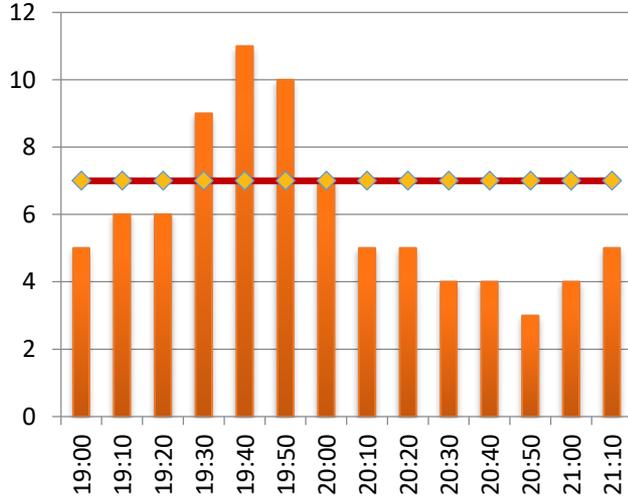
- The objective of ATFM is to safely increase air traffic management (ATM) efficiency and effectiveness
- To equitably balance air traffic capacity and demand
- To improve predictability and deliver cost efficiencies that enable global interoperability of the air transport industry
- To enhance the environmental sustainability of an ATM system



ATFM Concepts

A service established with the following objectives:

- Contribute to a safe, orderly and expeditious flow of air traffic
- Ensure that Air Traffic Control (ATC) capacity is utilized to the maximum extent possible
- Ensure that the traffic volume is compatible with the capacities declared by the appropriate air navigation service provider (ANSP)



CDM Objectives

- Provide real-time operational information to stakeholders to facilitate a common and accurate view of demand and system constraints
- Enhance decision making and capacity utilization
- Requiring that all system stakeholders function in an equitable manner for the betterment of the system.
- Exchanging decision-making information among the stakeholders to optimize system capacity and thus improve:
 - Operational quality and stability
 - Operational reliability and predictability
 - Demand and capacity balancing
 - Air space organization, which is critical for maximizing capacity and enhancing system safety.
- Improve ATM performance, while balancing the needs of individual ATM community members

ATFM Functional Flow

Integrated ATFM/CDM-Functional Flow

ATFM Stakeholders



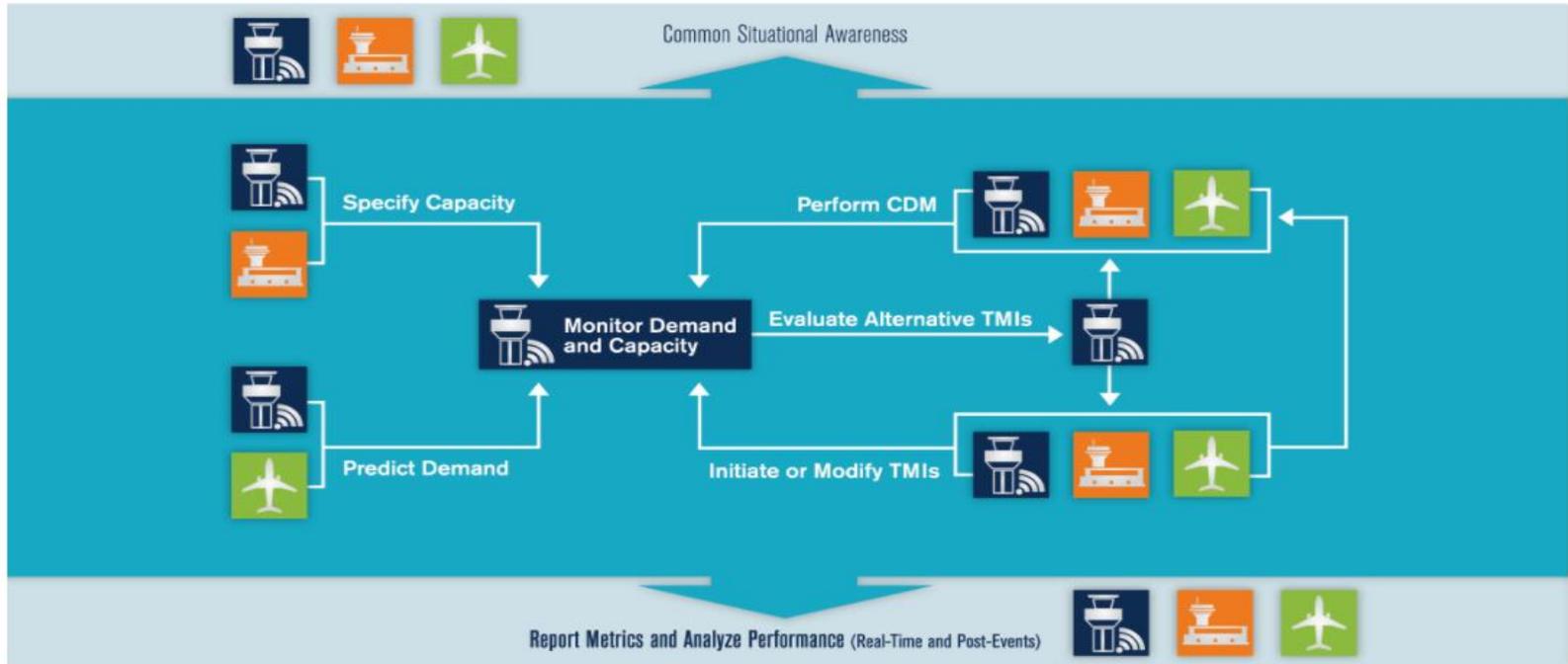
ANSP



Airports



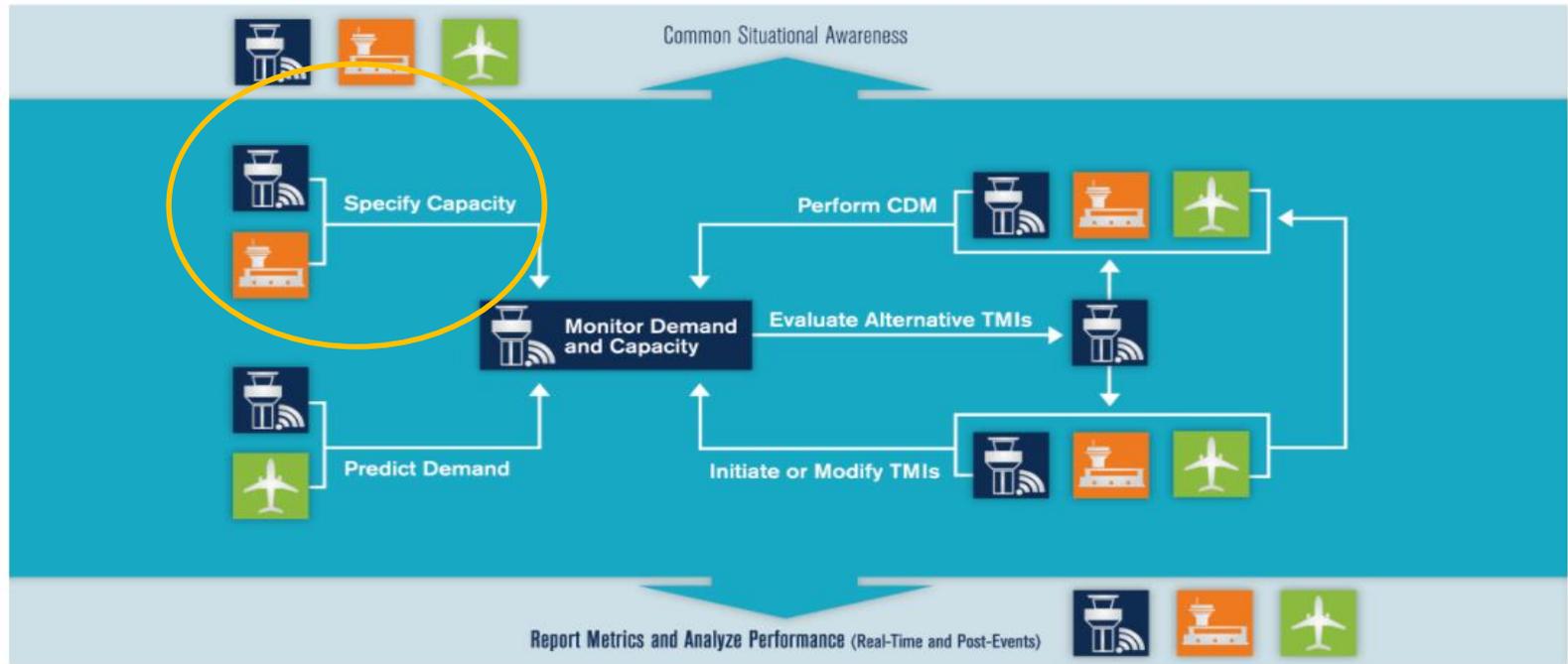
Aircraft Operator



Capacity

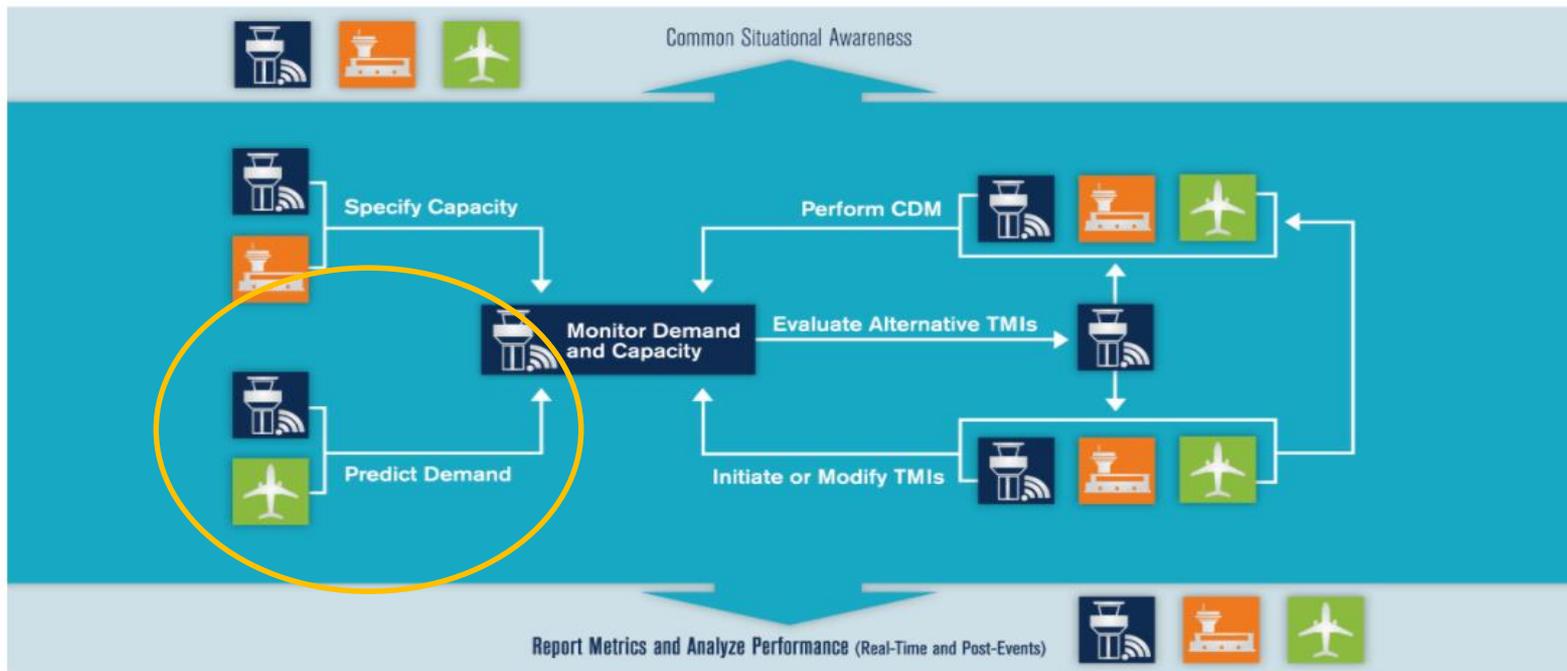
Integrated ATFM/CDM—Functional Flow

ATFM Stakeholders



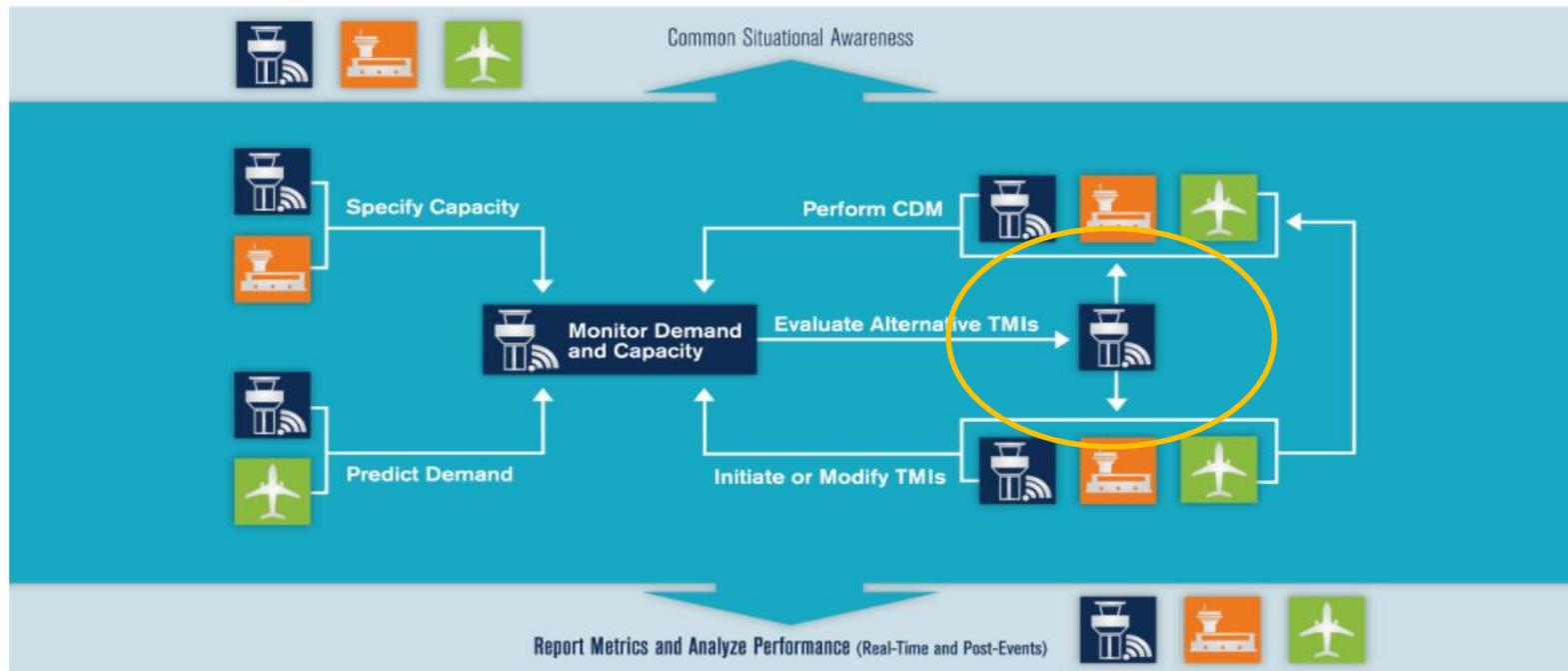
Predict Demand

Integrated ATFM/CDM—Functional Flow



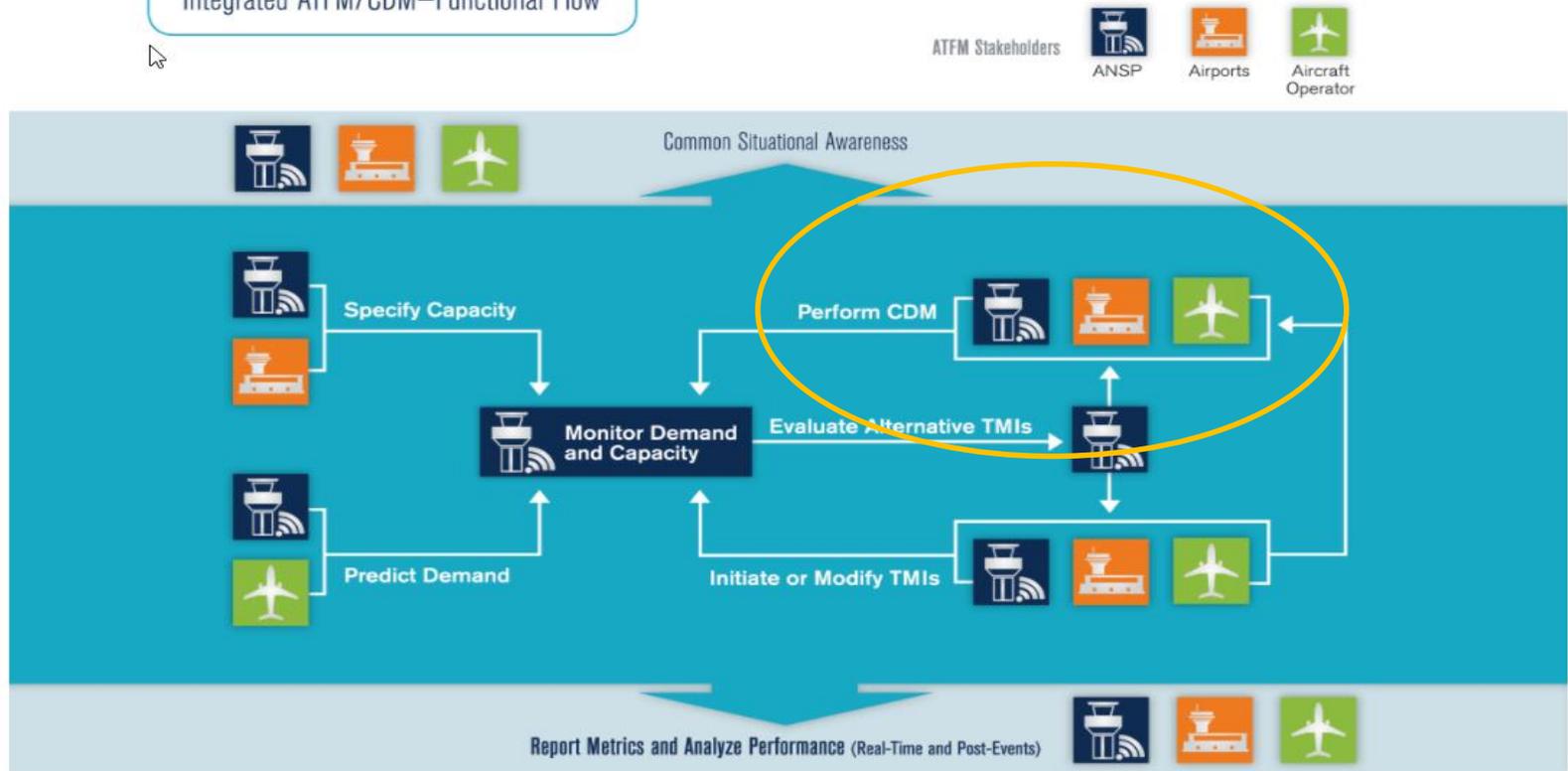
Evaluate ATFM Solutions

Integrated ATFM/CDM-Functional Flow



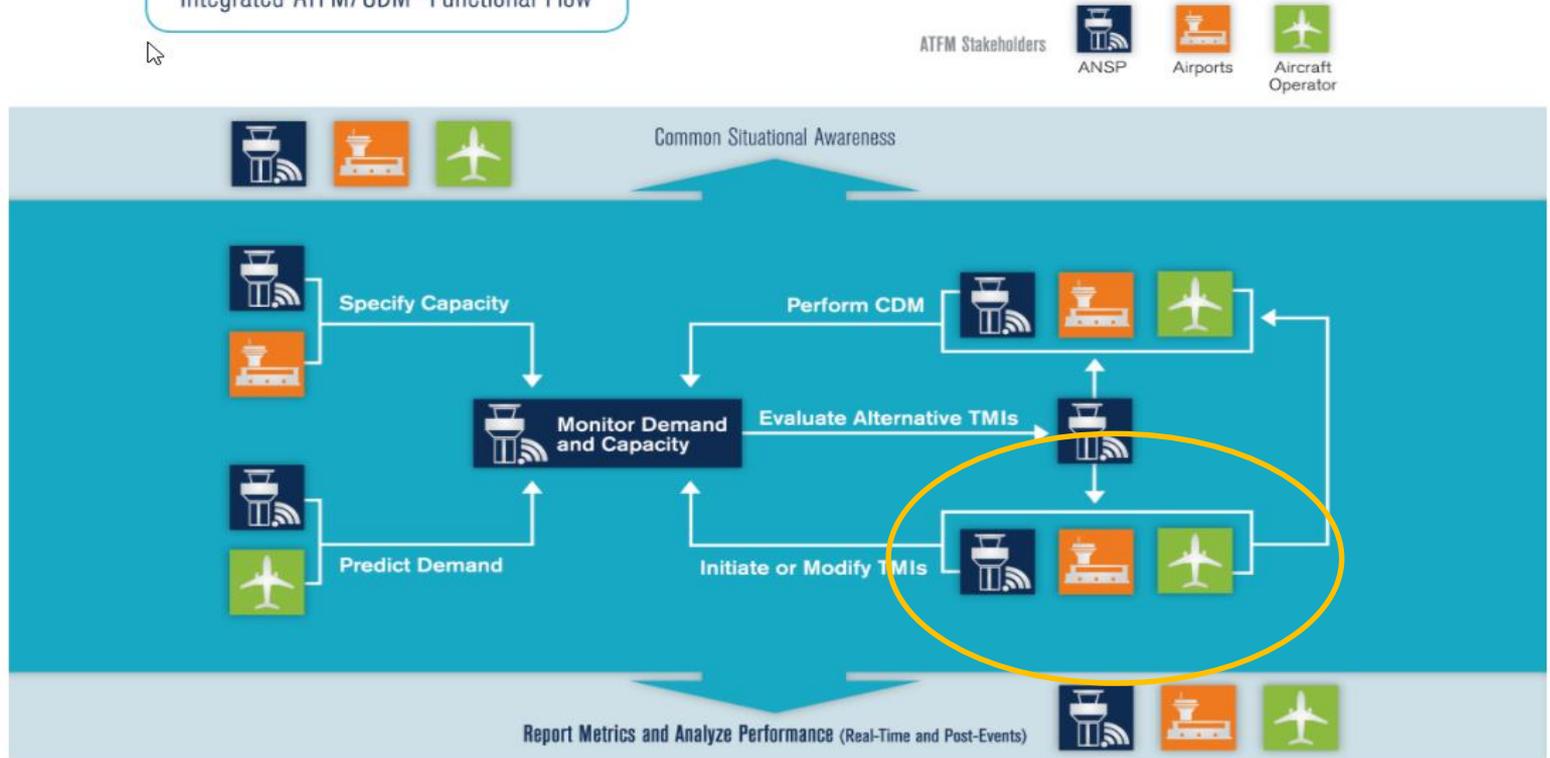
Perform CDM

Integrated ATFM/CDM—Functional Flow



Initiate ATFM Solutions

Integrated ATFM/CDM—Functional Flow



How Does an ATFM Service Operate?

National/Regional/
International
perspective



Central ATFMU

National perspective



ACC

Local perspective



TMA

Airport perspective



TWR