ATFM Tools and Capabilities

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ATFM Goals

- 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

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What are the ATFM Goals and Needs of Your ANSP?

Provide *efficient* and *equitable* ATFM while maximizing throughput and minimizing delays?

- Efficient: Least impactful departure time adjustments to balance demand to available airspace and airport capacity
- Equitable: Delay allocation is not excessive relative to other flights

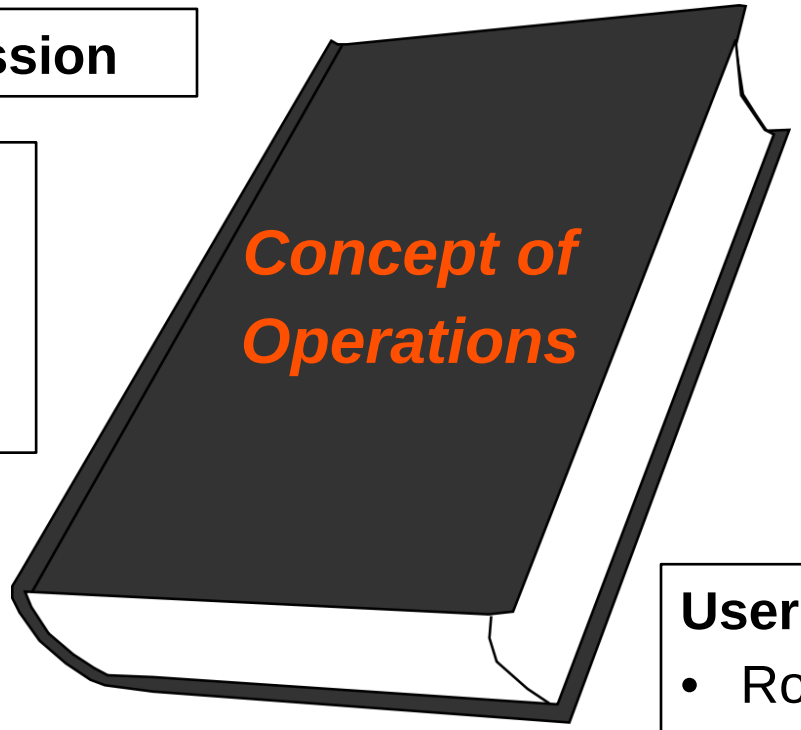
- Balance arrival and departure demand at airports?
- Manage demand over a certain FIX, Sector or Airway?
- Reroute aircraft away from severe weather or CNS outages?
- Meter flights across neighboring ANSP boundary to comply with MIT or MINIT?
- Level-Cap flights to avoid upper sector airspace?
- Avoid military airspace?
- Support CDM with stakeholders?
- Meet ICAO ASBUs ATFM timeline?

ATFM Concept of Operations

Vision and Mission

System Support

System Tools
- Capabilities
- Procedures
- Authorized user roles



Operational Scenarios
- Normal conditions
- Failure events
- Handling exceptions

Operational Needs
- Organizational structure
- Staff requirements
- Personnel profile
- Competencies
- Training
- Stakeholders

Quality Assurance
- Reports
- Reviews
- Compliance

User-Oriented Operational Description
- Roles and Responsibilities
- Procedures
- Personnel interactions
- When and in what order operations take place

Describes system characteristics from an operational perspective

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ConOps: Regional/Multi-Nodal versus Traditional/Domestic ATFM

- ATFM processes in use by the FAA, EUROCONTROL, ATNS, Airservices Australia, and Aerocivil Colombia generally use GDPs and AFPs to manage **domestic** demand to airports and through en route sectors
- LAC region is comprised of geographically smaller ANSPs with much of their demand to and from **international** origins and destinations

Sufficient domestic demand within 1500nm of destination airport or airspace sector

~1500 nm across

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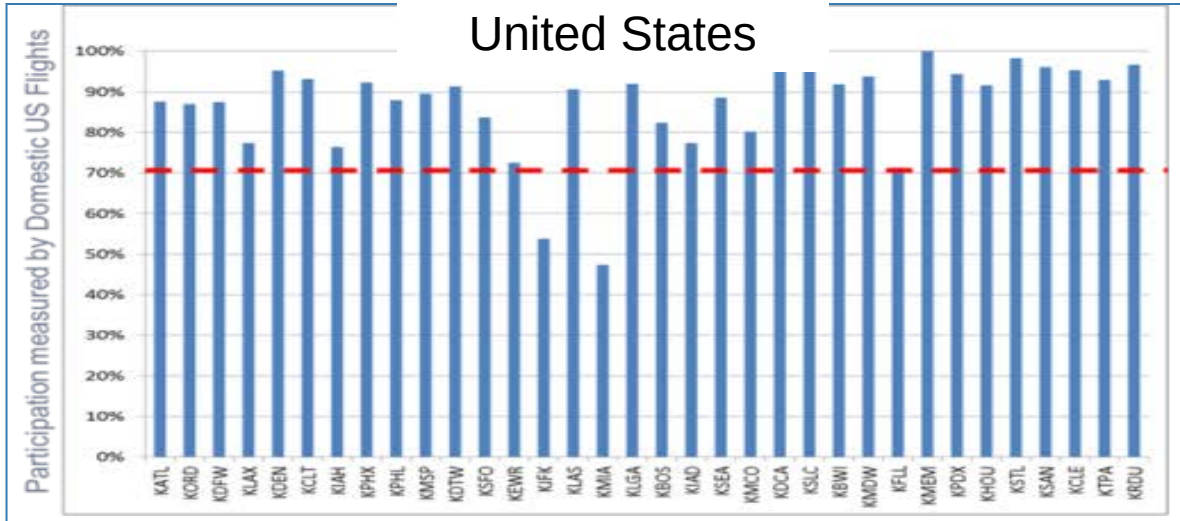
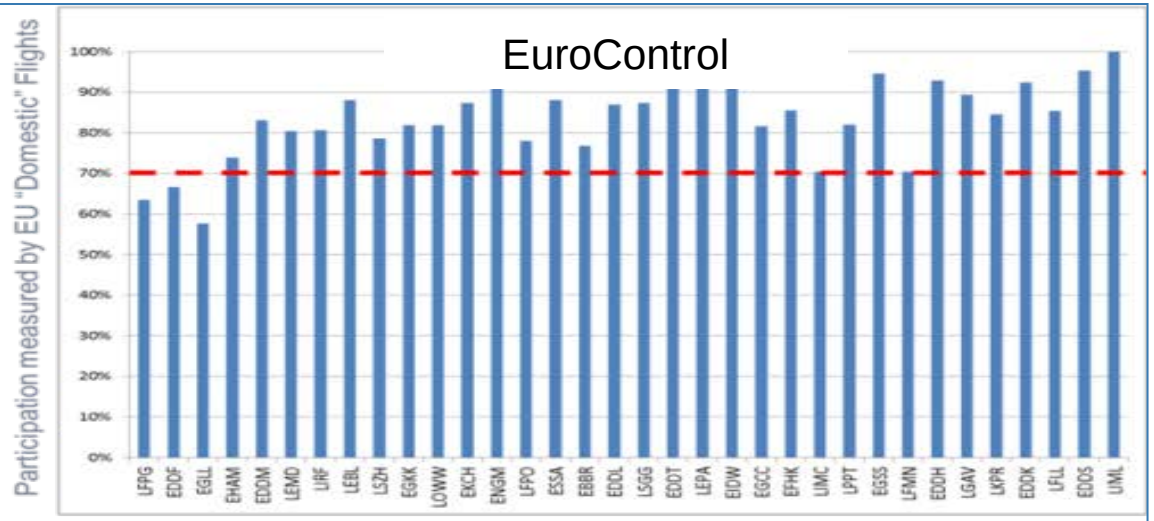
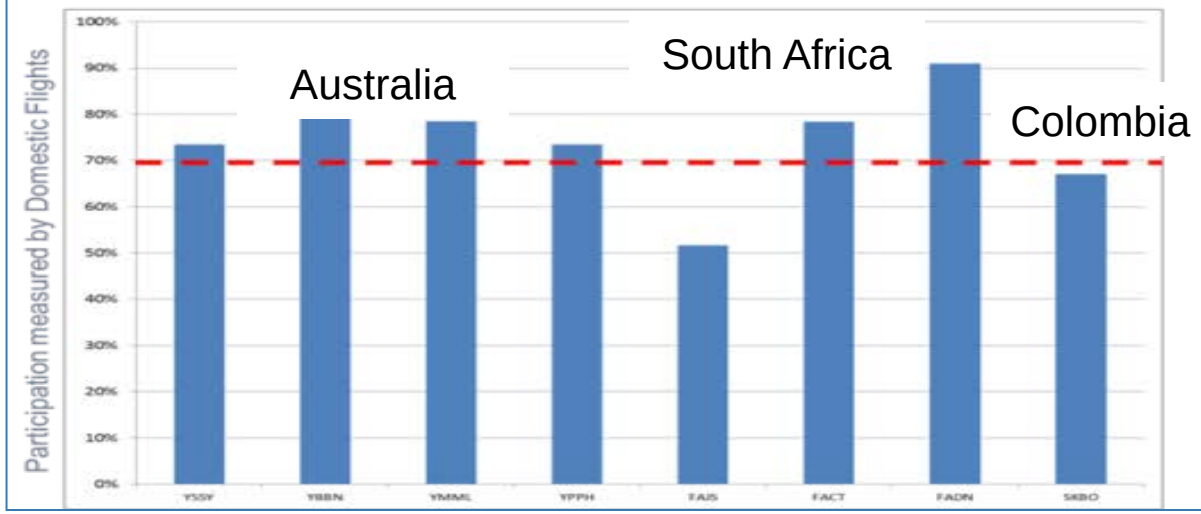
Why Regional/Multi-Nodal ATFM for Latin America and Caribbean?

Rule of thumb for *efficient* and *equitable* ATFM

- > 70% participation within 1500 nm of destination airport







United States, Europe, Australia and Colombia have sufficient participation from domestic flights

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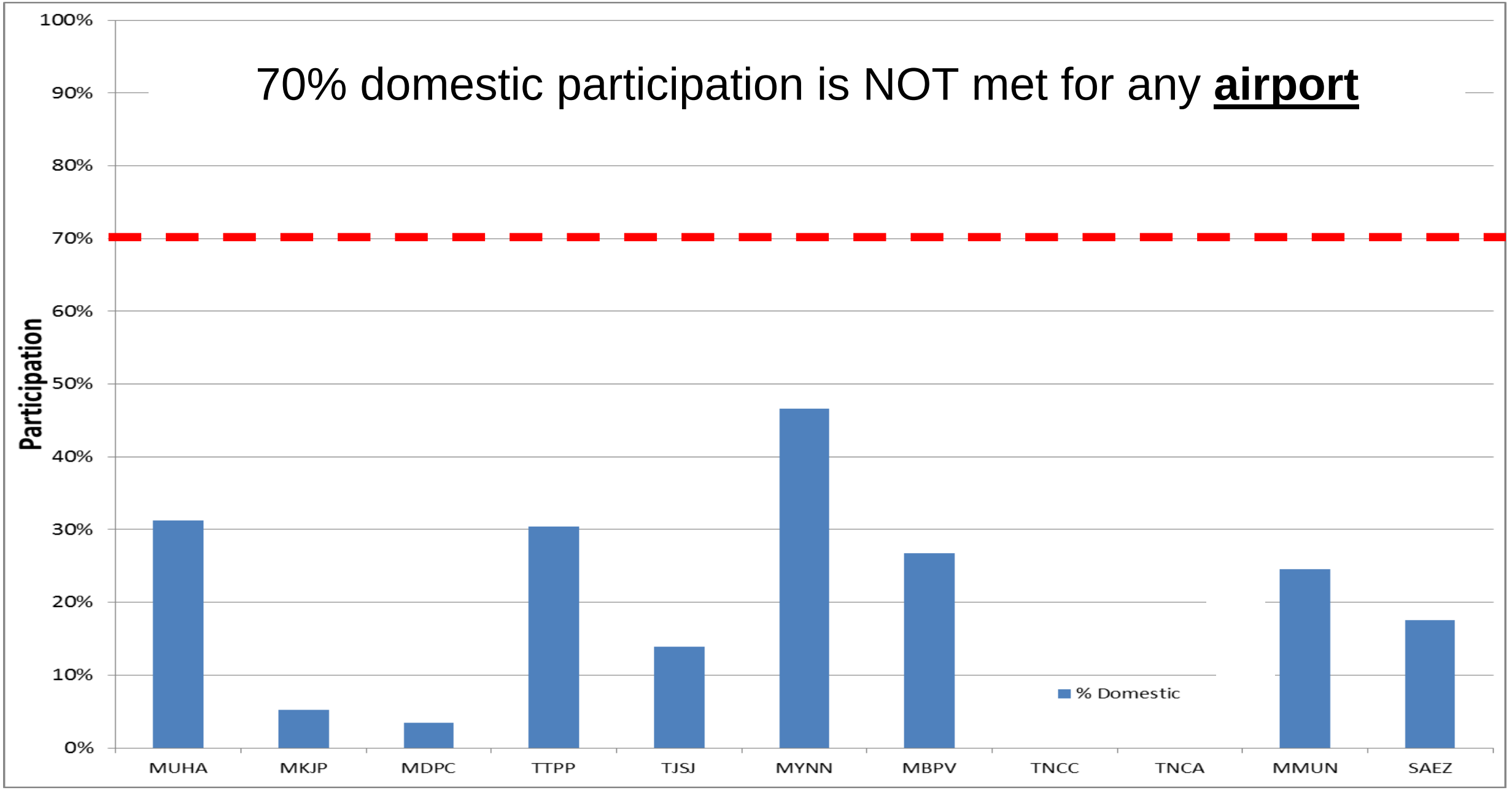
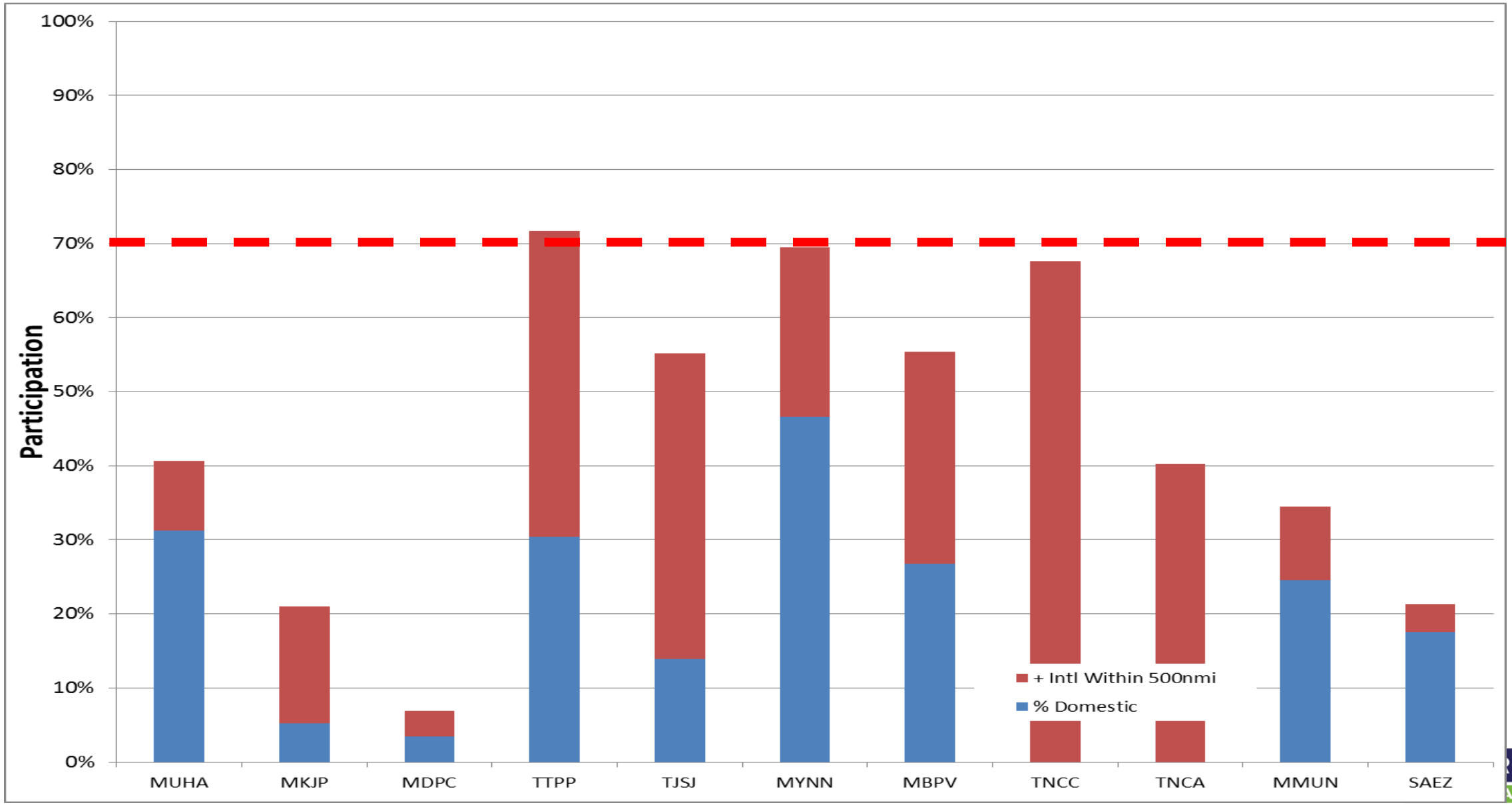
Caribbean ATFM Participation Analysis (Domestic)



Caribbean ATFM Participation (Domestic + International 500nm)



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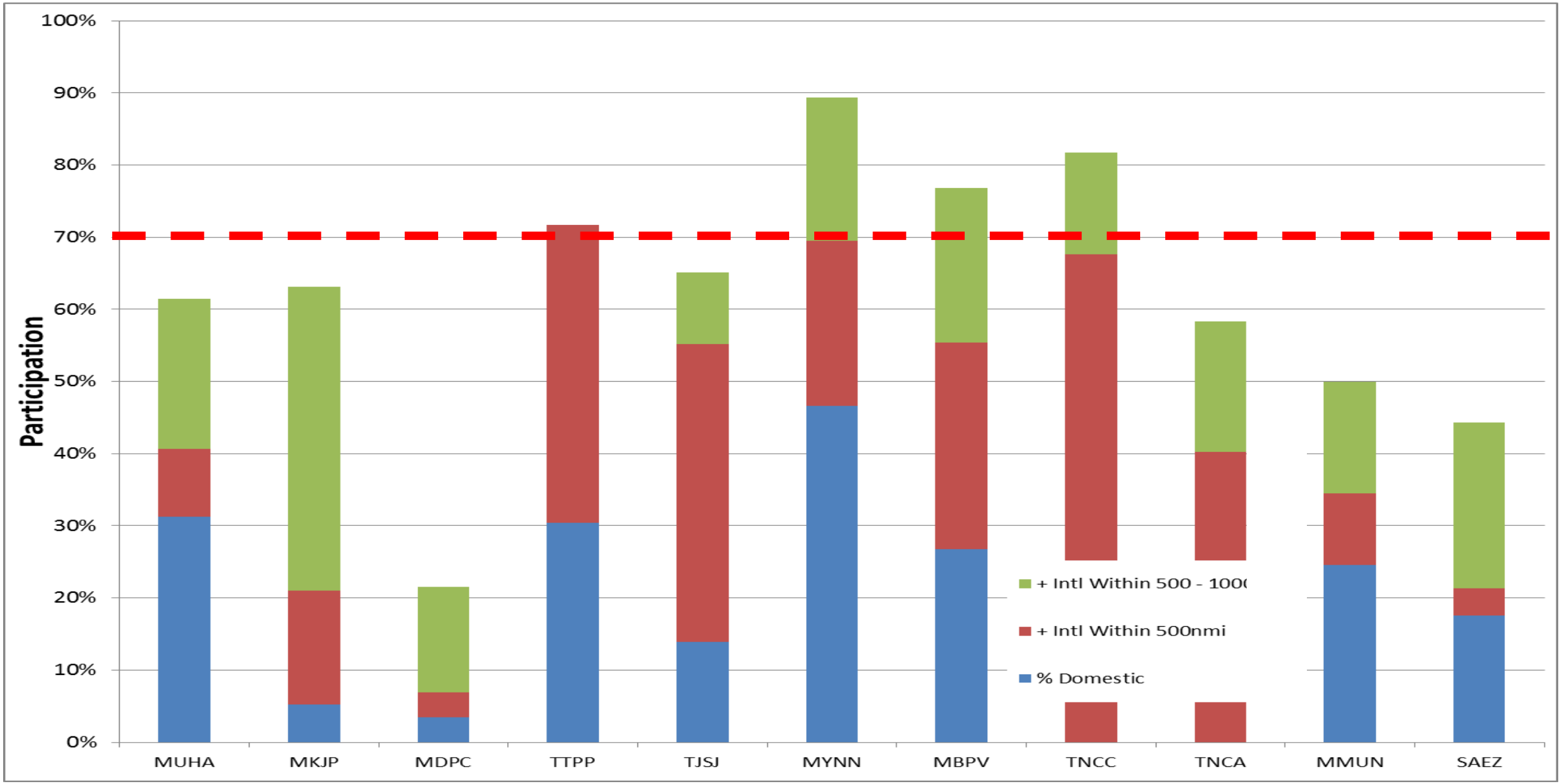

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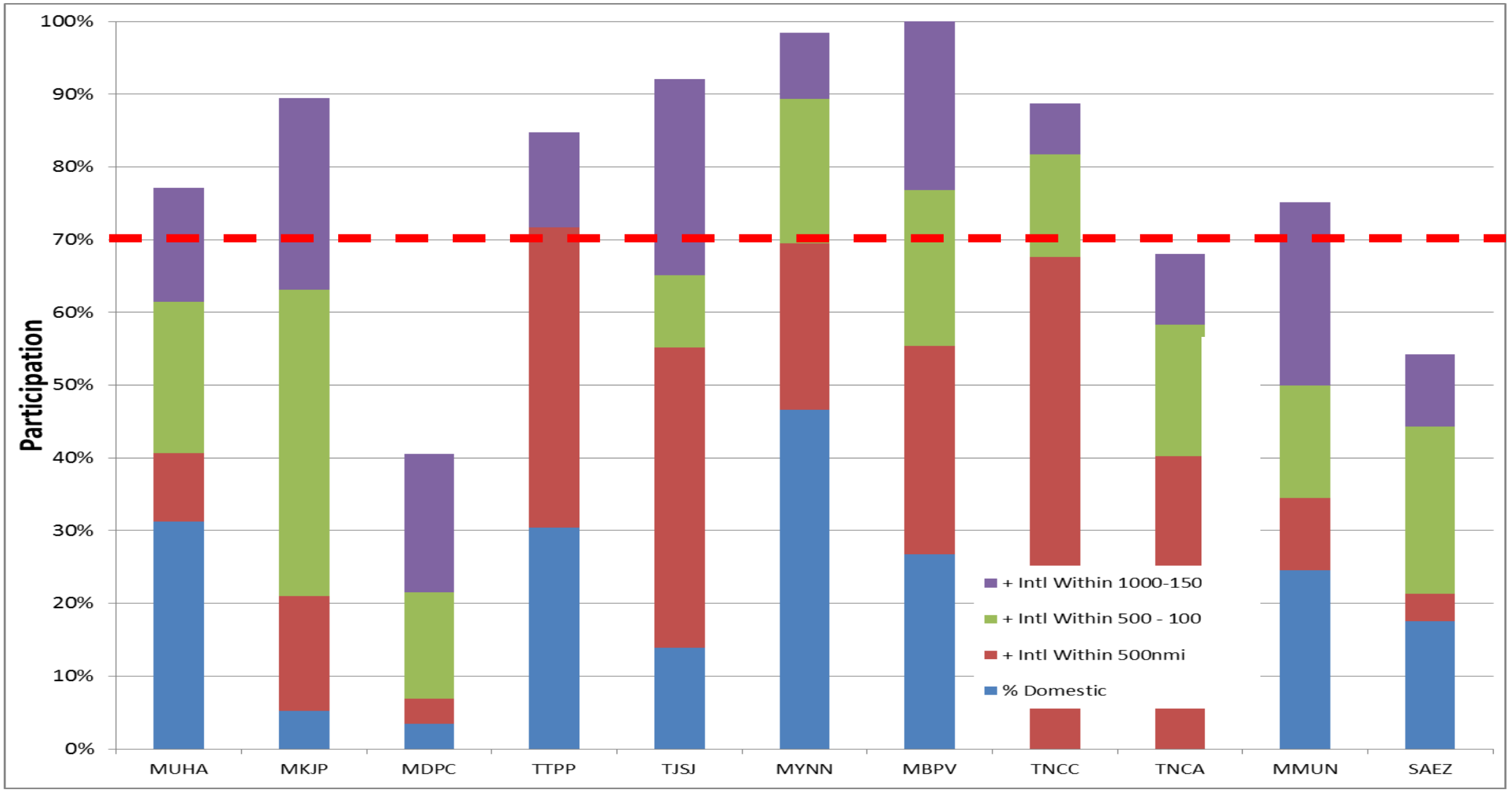
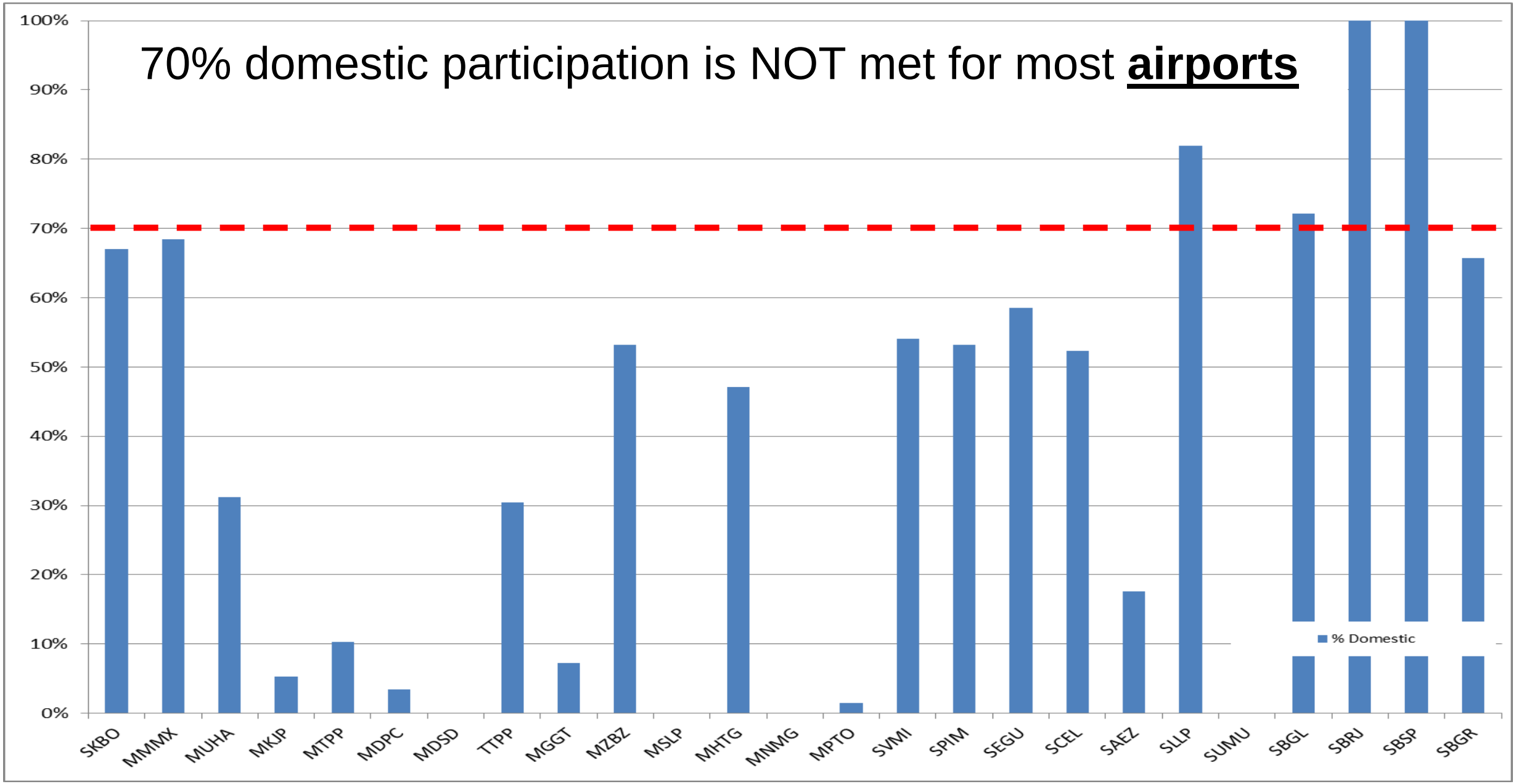


LATAM ATFM Participation (Domestic)



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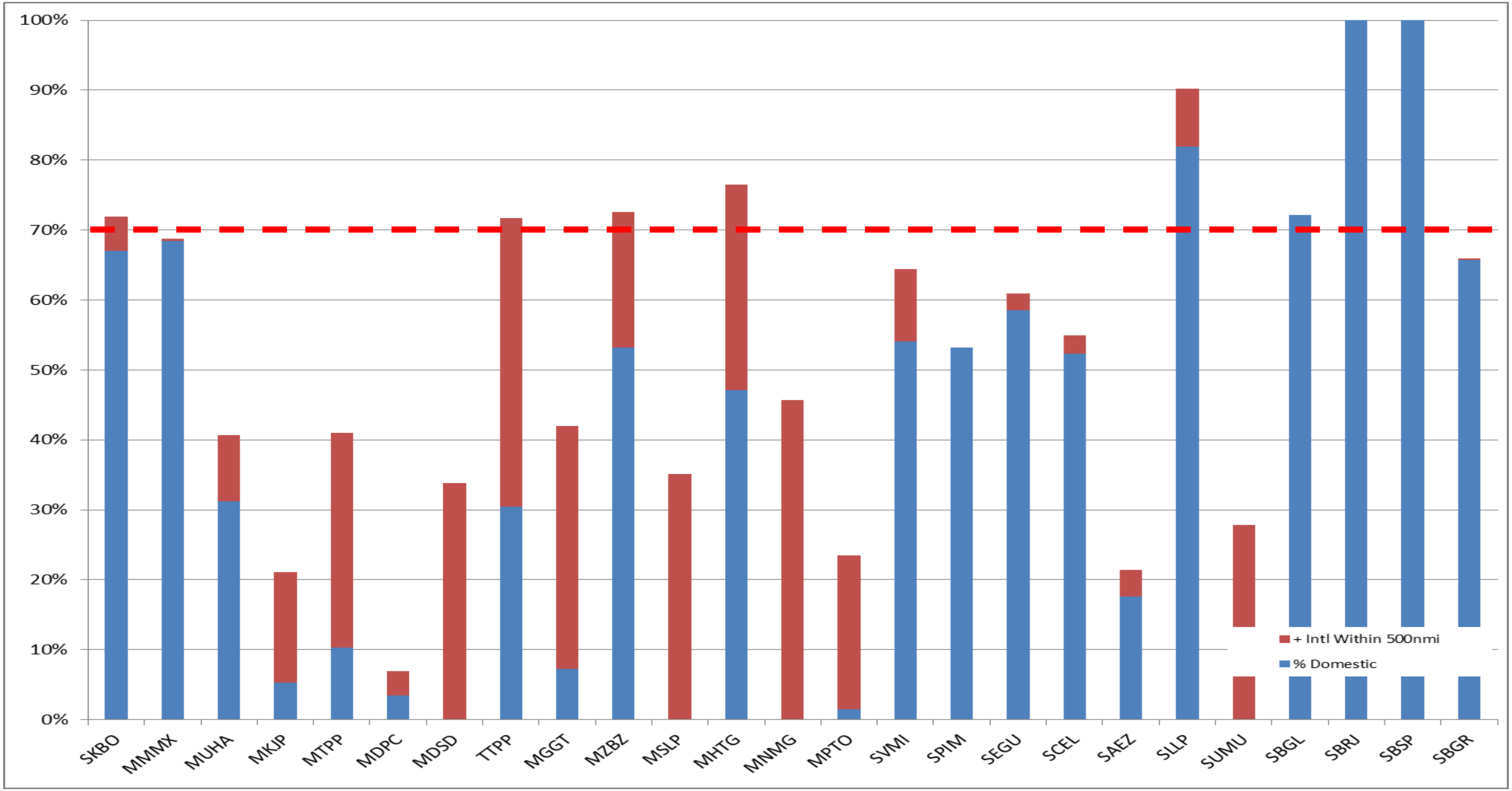

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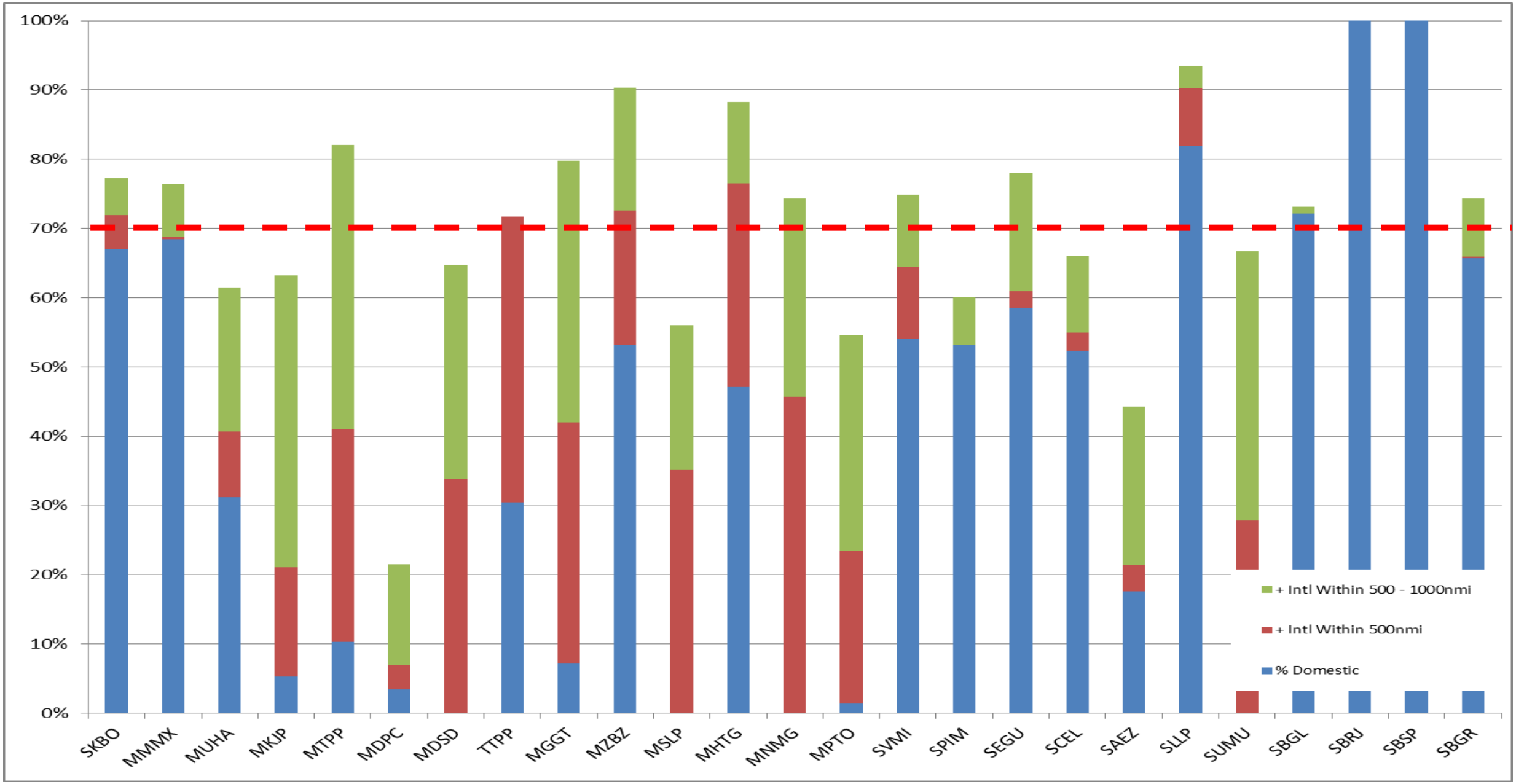

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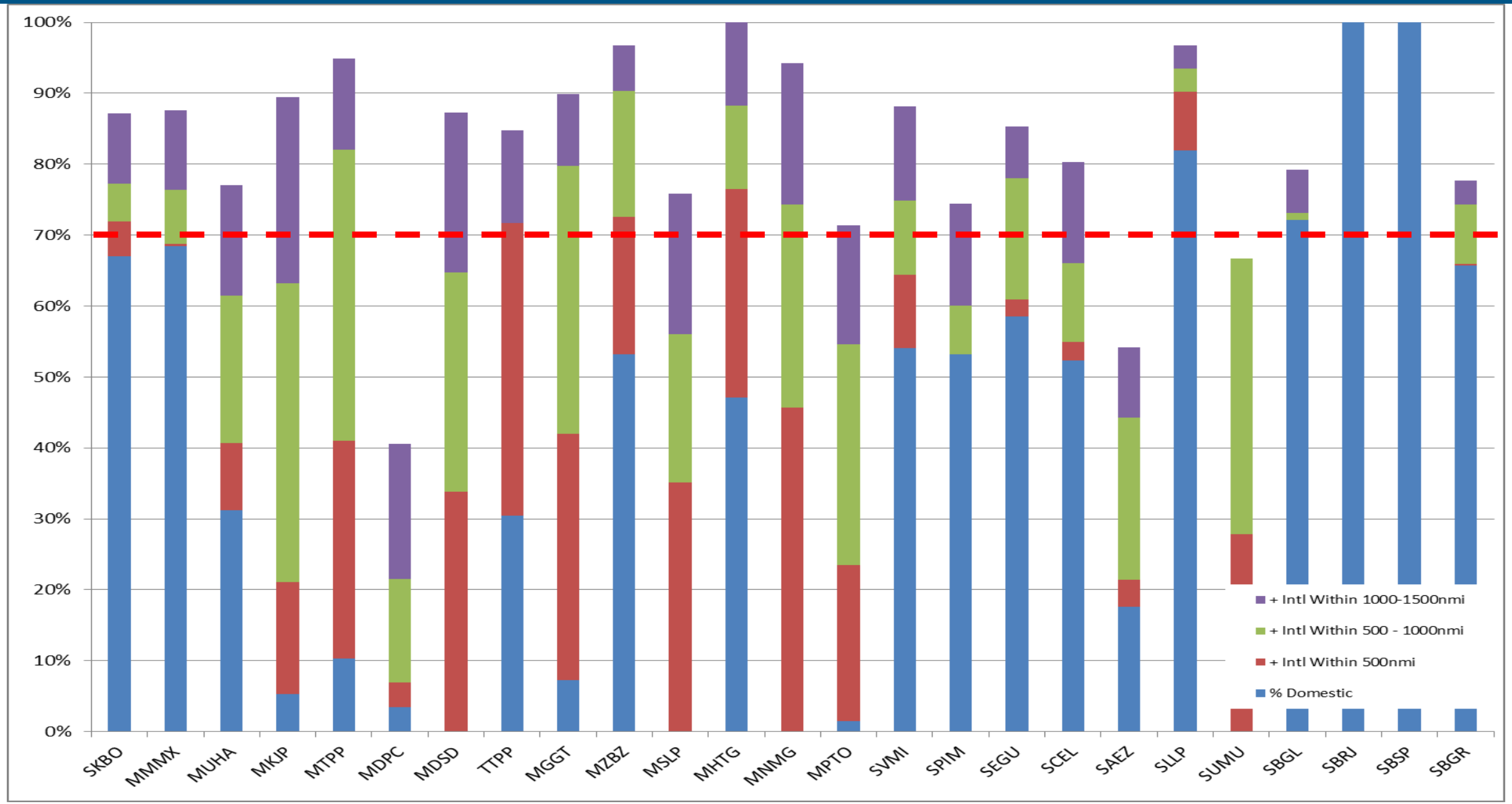

Objectives of AFTM Tools and Capabilities (Regional or Domestic)

Provide the digital exchange of the best information to the right stakeholders at the right time to:

- Improve ATFM decision-making
- Provide appropriate flow solutions that meet operational requirements
- Utilize airspace and aerodrome capacity effectively, efficiently, and safely
- Enable common situational awareness
- Reduce ground and in-flight delays
- Cause the least operational impact to ANSPs and stakeholders
- Improve fuel efficiency resulting in reduced CO_2 emissions
- Report operational performance analysis
- Support collaborative decision-making processes

System-wide understanding of demand and constraints on resources from the surface, departure, en route and arrival

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Minimum Expected Capabilities of ATFM Tools

AFTM tools should at least provide the capability to:

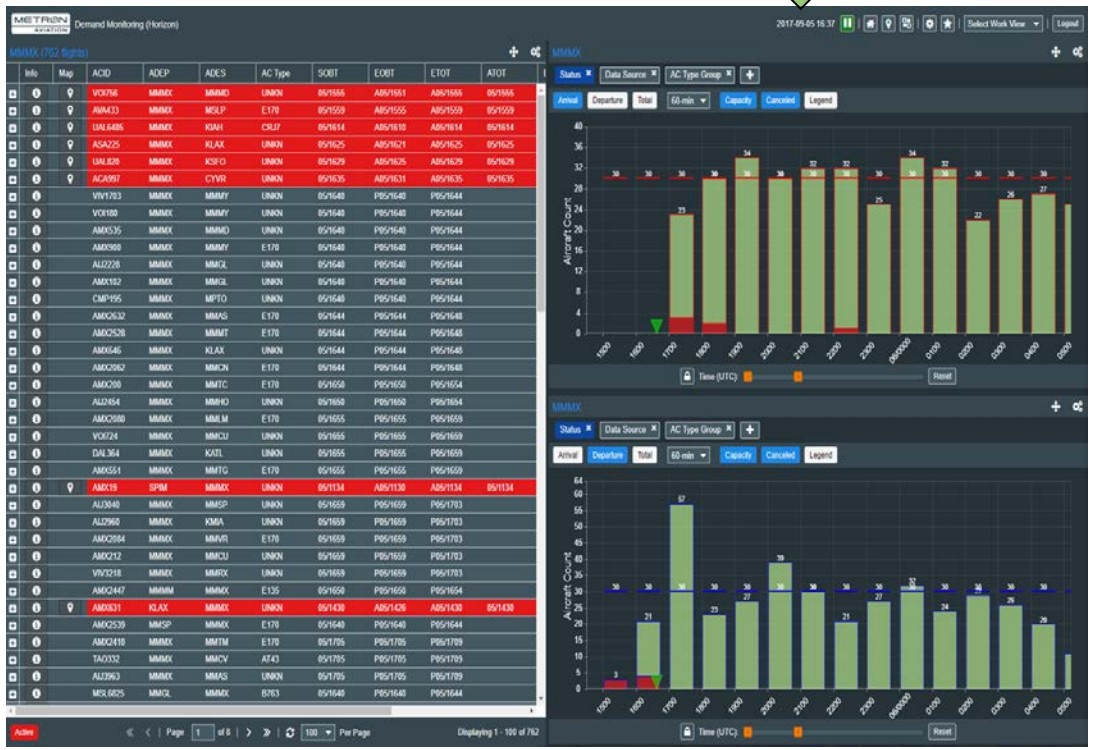
- **Predict** and **monitor** demand and resulting imbalances for airports and airspace
- **Model** collaborative solutions to ensure the least restrictive TMM
- Provide **decision** support metrics for ATFM measures
- **Balance** demand to capacity of selected resources through initiation, monitoring, and revision of an automated ATFM measure
- **Exchange** automated ATFM measures to adjacent ATFM systems
- Automate **CDM** with aircraft operators, airport operators, and other ANSPs
- Provide common situational **awareness** for all stakeholders
- Perform post-operation **analysis** to support and align with agreed KPIs

Automated CDM with other ANSPs supports regional integration of ATFM/CDM through participation in the host ANSPs TMM and data from other ANSPs ATFM/CDM system

Demand Data for ATFM Decision Support

Aggregated Flight Demand Information

Data Source	Strategic	Pre-Tactical	Tactical
ANSP		ANSP Flight Data	ANSP Flight Data ANSP Surveillance
Stakeholder	Airport Slot Data Aircraft Operator Schedule Data	Aircraft Operator Flight Intent Update	Aircraft Operator Flight Movement Airport CDM Data Regional ATFM Surveillance
Commercial	3rd Party Airline Schedules		Surveillance



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Demand Prediction Requirements

- Integrate data from external interfaces to provide a single instance of each flight
- Predict demand for multiple resources – airspace and aerodromes
  - At a minimum, if the data is available, the system should support a look ahead time of several days
- Provide best estimates for flight times including OBT, TOT, landing time, and IBT
  - Actual
  - Real-time updates (integration with Flight Data Processor)
  - Estimated
  - ATS Message or Aircraft Operator Schedule Update
  - Historical flight plans (RPL and/or historical database)
  - IATA WSG Slots - Strategic Airport Slot Data
  - Third-party airline marketing schedule data (e.g. Official Airline Guide OAG)
- Calculate estimated flight path and transit times including: taxi out, terminal departure, en route, terminal arrival, and taxi in, based on aircraft performance, flight plan route, dynamic modeling, and use of forecast wind data

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Monitor Demand Data in Usable Format

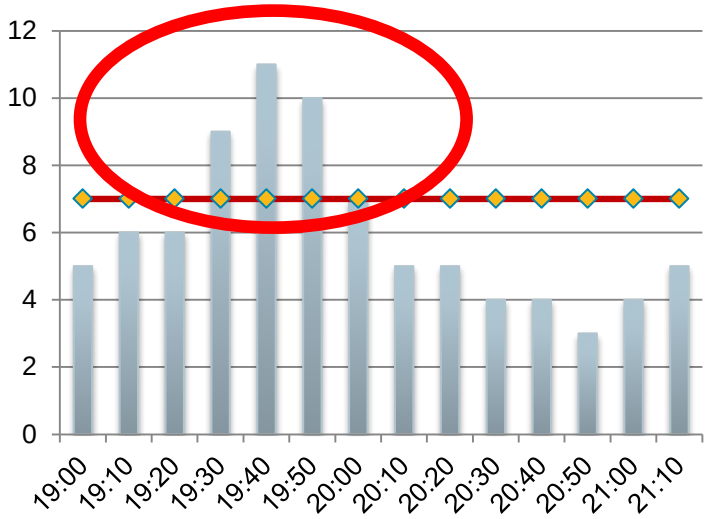
Monitor the overall demand of arrivals, departures and overflights to identify current or future imbalances

Demand Monitoring Tool Requirements

- Capability to access real-time, future and historical data
- Aggregate and flight specific interfaces including, but not limited to:
  - Load Graphs: aggregate views of resource demand and capacity versus time
  - Timelines: flight-specific view of resource demand versus time
  - Flight Lists: Aggregate view of flight-specific attributes
- Map-based display
  - Flight positions for each flight currently operating
  - Graphic representation of convective weather on the map
- Ability to map a flow-controlled area – adapted and free-form to monitor:
  - Airspace demand load

Balancing Demand to Capacity

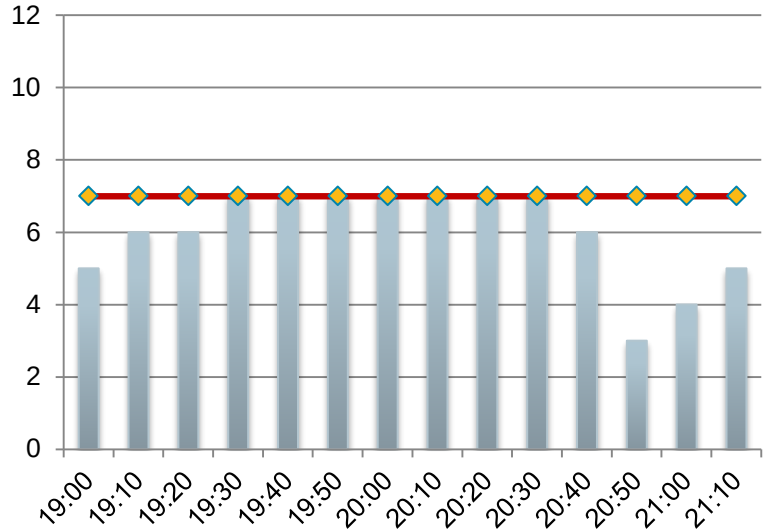
Automated ATFM Measures for Balancing Demand to Capacity



ATFM measures to balance demand to available capacity

ATFM Measure
Fix Balancing and Re-Route
Off-Load Route
Level Capping
Kilometers/Miles in Trail
Minutes In Trail
Minimum Departure Interval
Ground Delay Program
Airspace Flow Program
Ground Stop

Use most appropriate and least restrictive ATFM measure



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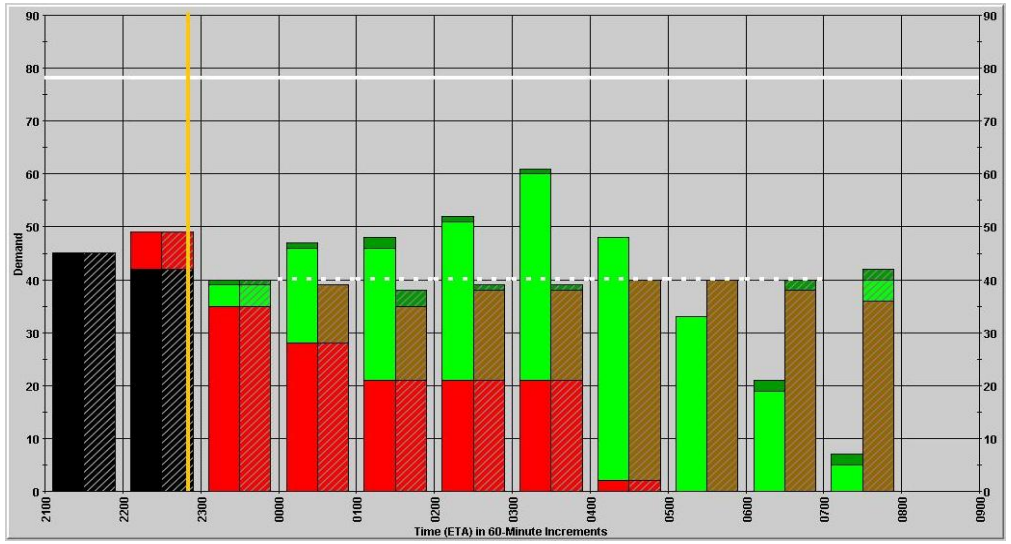
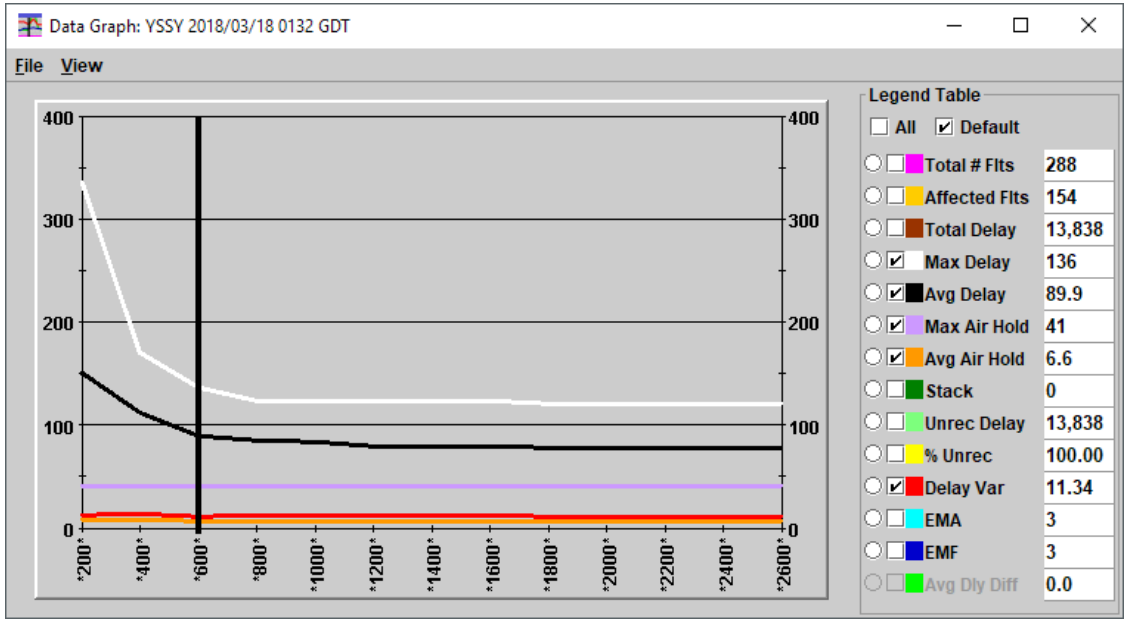
ATFM Demand Capacity Balancing Requirements

- Airport and Airspace **Monitoring**
- ATFM Measure **Modelling**
- **Automate** demand balancing:
  - Airport Ground Delay Program
  - Airspace Flow Program
  - Ground Stop
  - Miles-In-Trail/Minutes-In-Trail

- Supports **CDM** with airlines through flight intent, schedule management, and slot substitution
- Supports **Regional/Multi-Nodal** ATFM
- **Integrates** with local ATM systems
  - AMAN, DMAN, A-CDM





Supports Regional / Multi-Nodal DCB Operations

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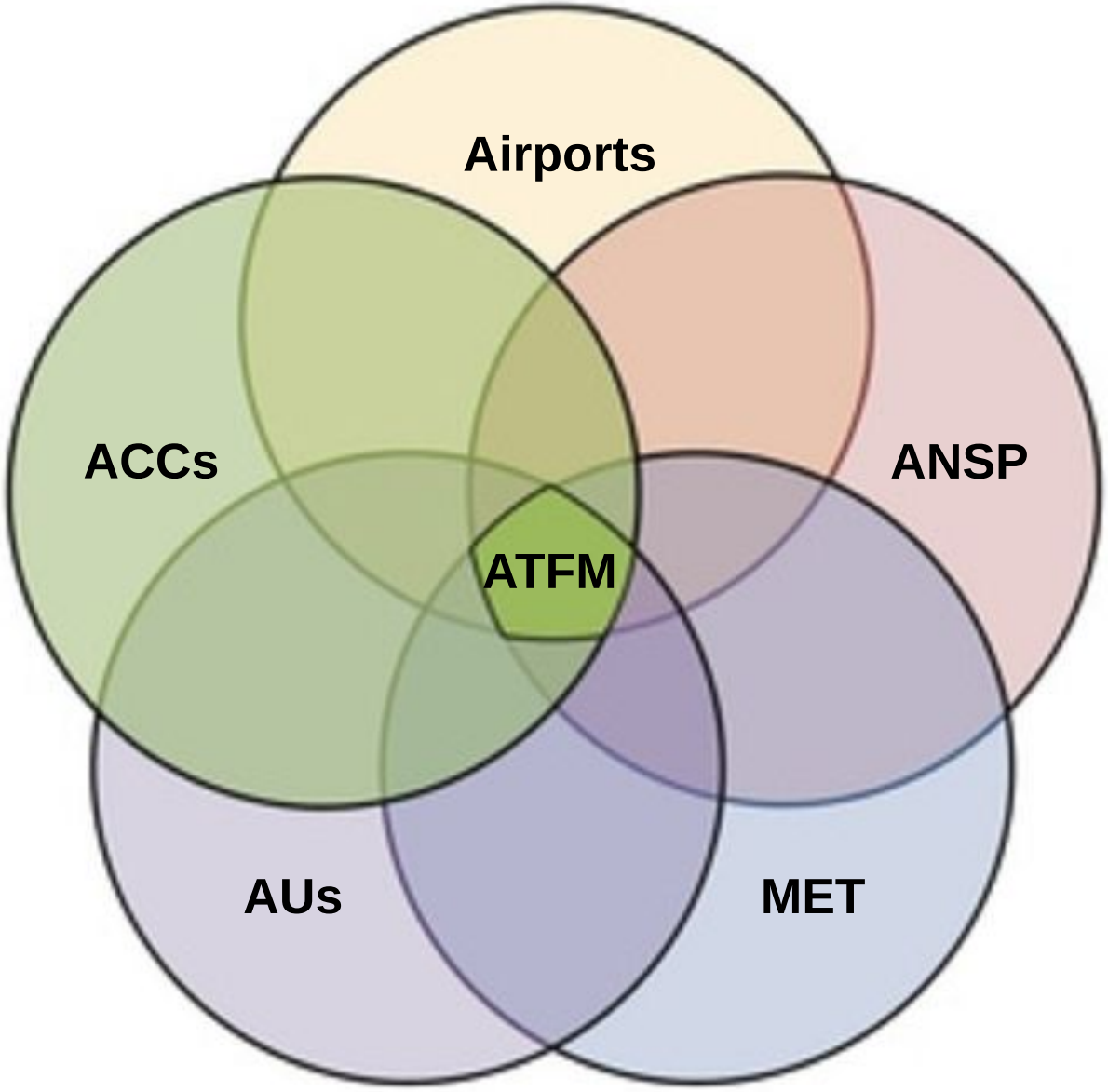
ATFM Collaborative Decision Making – A Systems Approach

Common Situational Awareness



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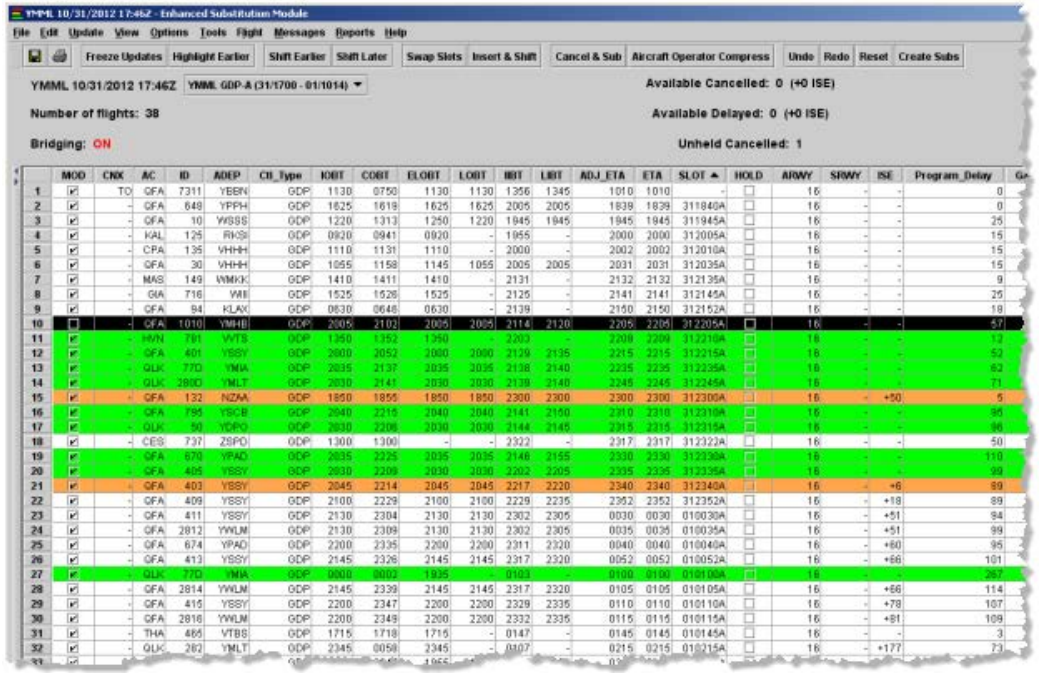
Common Situational Awareness of Demand and Capacities

- Airport Demand / Capacity Monitoring
- Airspace Demand Monitoring
- Airport Slot Uploads
- Flight Schedule Uploads



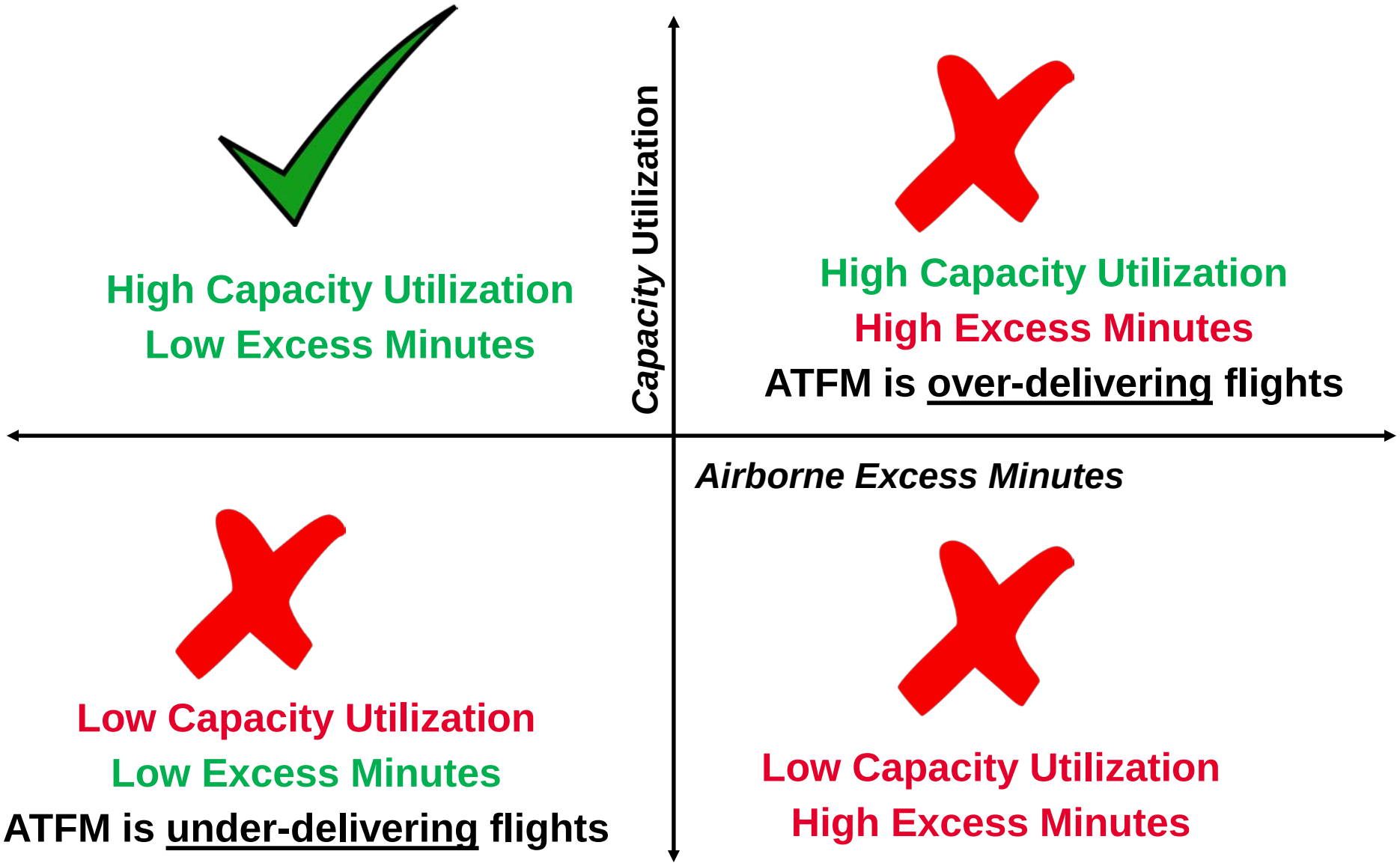
- Notification of Delays
- Notification of Cancelations
- Schedule Optimization
  - Slot Swapping
  - Inter-Operator Slot Exchanges

Common situational awareness platform enables data sharing and AO schedule optimization within prescribed ATFM TMM parameters

Collaborative Decision Making Tool Requirements

- System-to-system interface for authorized external systems to exchange flight data, resources, and ATFM Measures
- Allows authorized AO users to update predeparture flight data including:
  - Aircraft Identification
  - Aircraft Registration
  - Aircraft Type
  - Scheduled or estimated operational times
  - Flight Cancellations
  - Flight cancellation Slot-Hold for later substitution
- Provides an Operational Information System to exchange information on:
  - ATFM Daily Plan
  - NOTAMs
  - Current and predicted ATFM measures

Post-Operational Analysis



Post-Operations Performance Analysis

Visibility into Operational Performance

- Reports metrics and analyze performance
  - Answers the question: how did we do?

5 ATFM Measures implemented between 2018-03-07 18:00 and 2018-03-08 18:00

Export

Event Time	Element	ATFM Measure Type	Start Time	End Time	ATFM Measure
07/1913	VHHH	GDP	07		
07/1914	WSSS	GDP	07		
07/1724	FCALINE	AFP	07		
07/1936	FCALINE	AFP	07		
08/1801	FCALINE1	AFP	07		

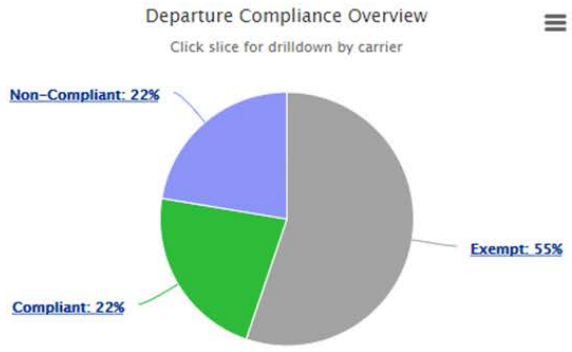
Showing 1 to 5 of 5 entries

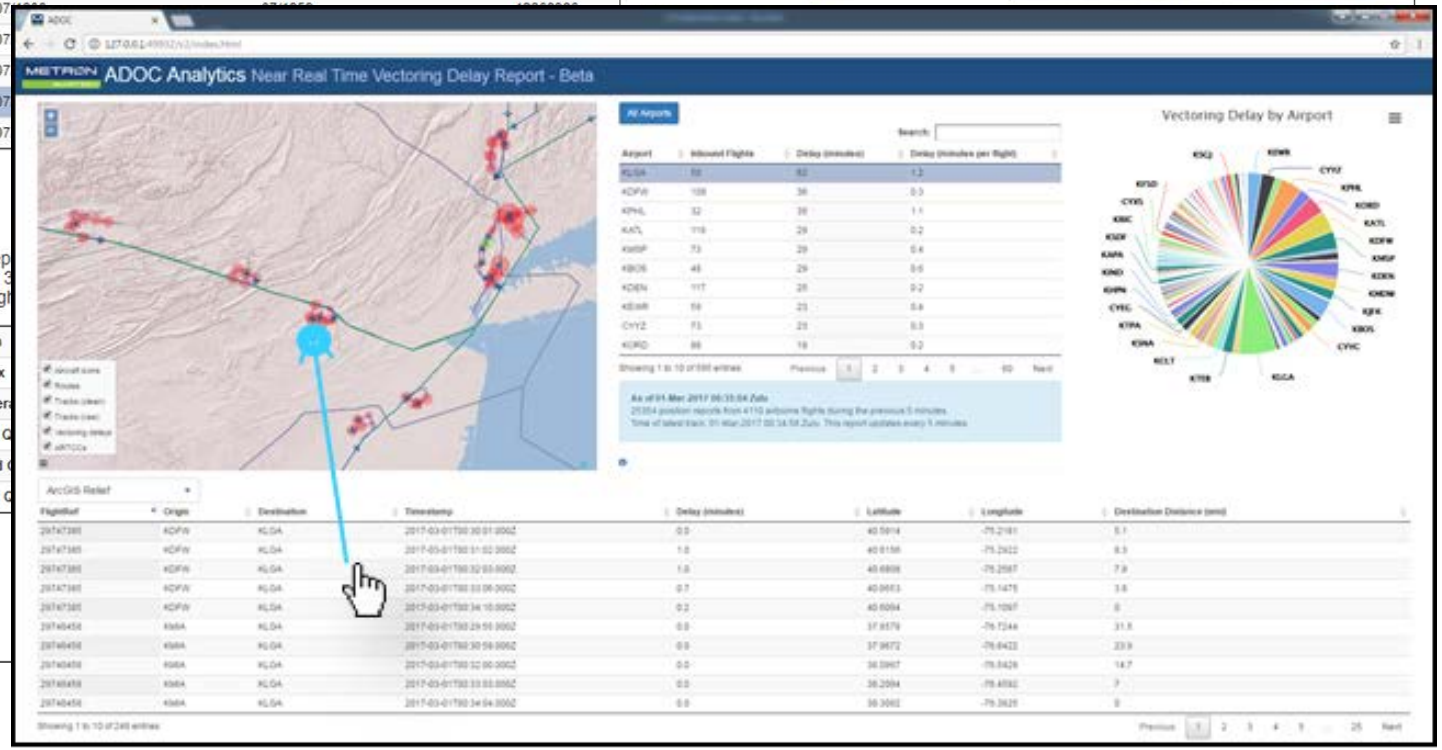
ATFM Measure Performance for FCALINE: AFP(07/1800 - 08/1759)

Overview

Flights	67
Exempt	37
Non-Exempt	30
Compliant*	15
Non-Compliant*	15
Total Delay (minutes)	17603
Average Delay (minutes)	263
Max Delay (minutes)	1398

* Compliance window -5 to +10 minutes





Post Operations Analysis Tool Requirements

- Continuous collection of all operational data events within a database
- Standard reports plus flexibility for ad-hoc reporting
- Provides users with an analysis capability to create, execute, save, and retrieve reports from the recorded operational data
- Automated reports on the performance of an ATFM Measure, Flight compliance with calculated times, and the benefits / cost of each ATFM measure

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Thank You

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Data Exchange

The provision, retention and distribution and safeguards of ATFM data should be covered by an ATFM data policy

- ATFM data is normally supplied for operational ATFM purposes. An ATFM data policy should define:
  - duration and back-up of data storage for investigation and post-operational purposes
  - restrictions on the release of data to the public and commercial organizations
  - provisions for the release of data to State, judicial and investigative agencies
  - restrictions on the use of ATFM data for other than operational ATM purposes
  - restrictions regarding the provision of data on military and other special flights

Traffic Management Measures

GDP: Provides the ANSP user with the capability to Purge or Modify an existing ATFM Measure.

GS: Provides the ANSP user with the capability to model a Ground Stop ATFM Measure that identifies flights to halt departures to a constrained resource.

AFP:

Air Holding: Provides the ANSP user with the capability to analyze expected airborne holding based on the predicted demand and capacity for a specific resource (e.g., airport arrivals, airport departures, airspaces)

Unexpected demand: Assigns an ATFM slot for a flight that was not known to the system when the ATFM Measure was initiated