



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



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

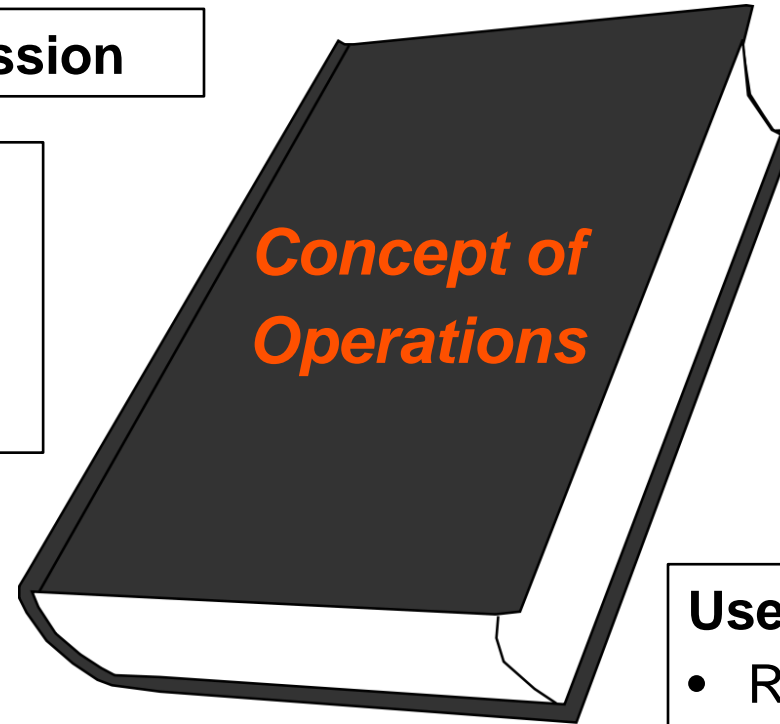
Vision and Mission

System Tools

- Capabilities
- Procedures
- Authorized user roles

Operational Needs

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



Quality Assurance

- Reports
- Reviews
- Compliance

System Support

Operational Scenarios

- Normal conditions
- Failure events
- Handling exceptions

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

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



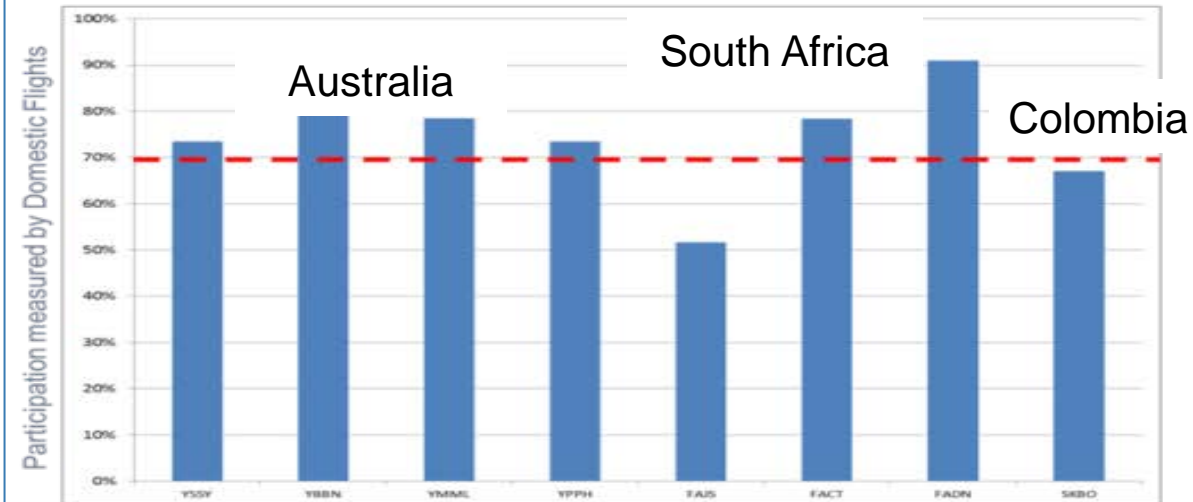
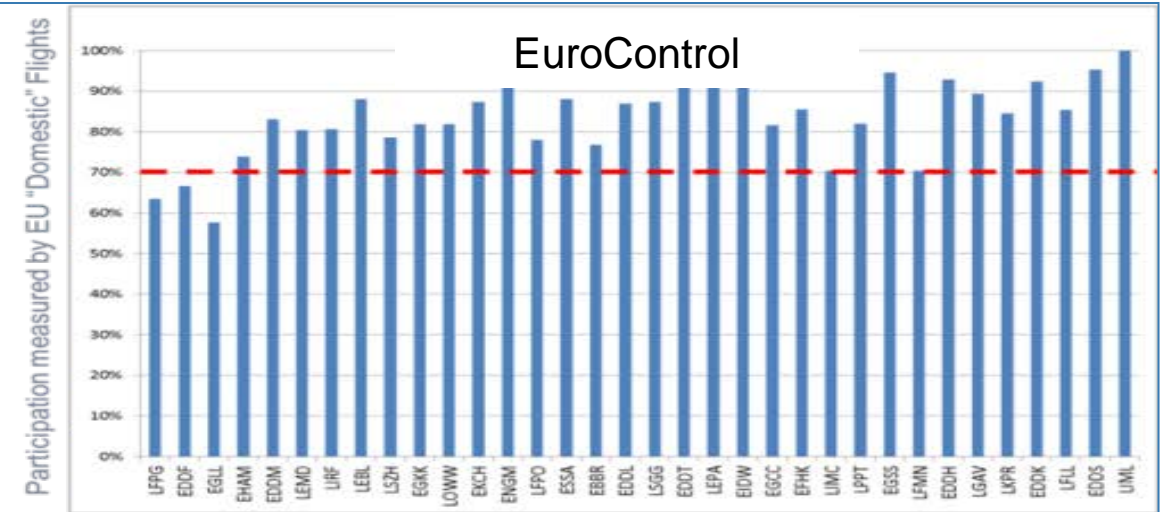
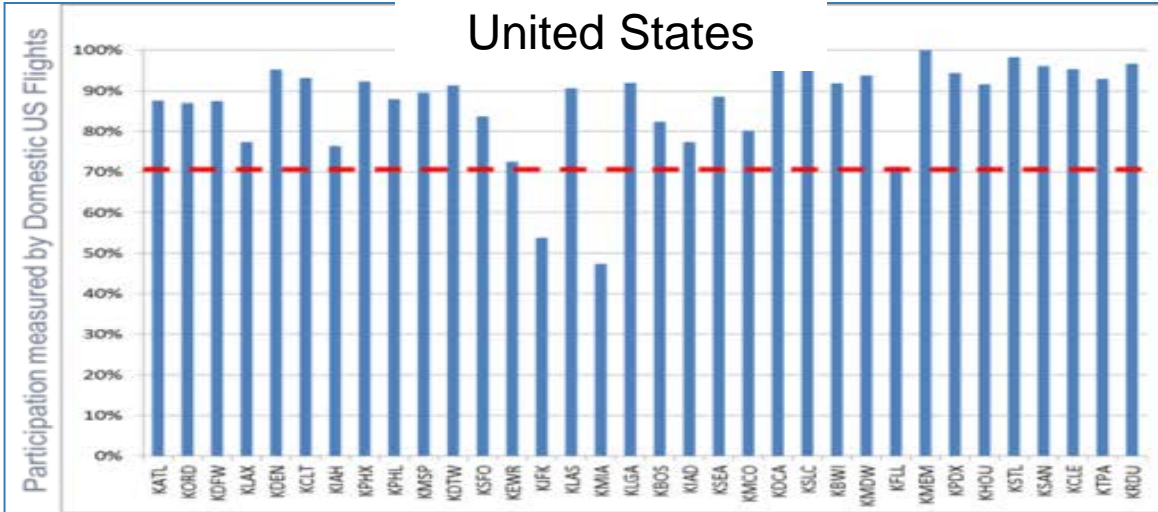
Sufficient domestic demand within 1500nm of destination airport or airspace sector

 ~1500 nm across

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

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

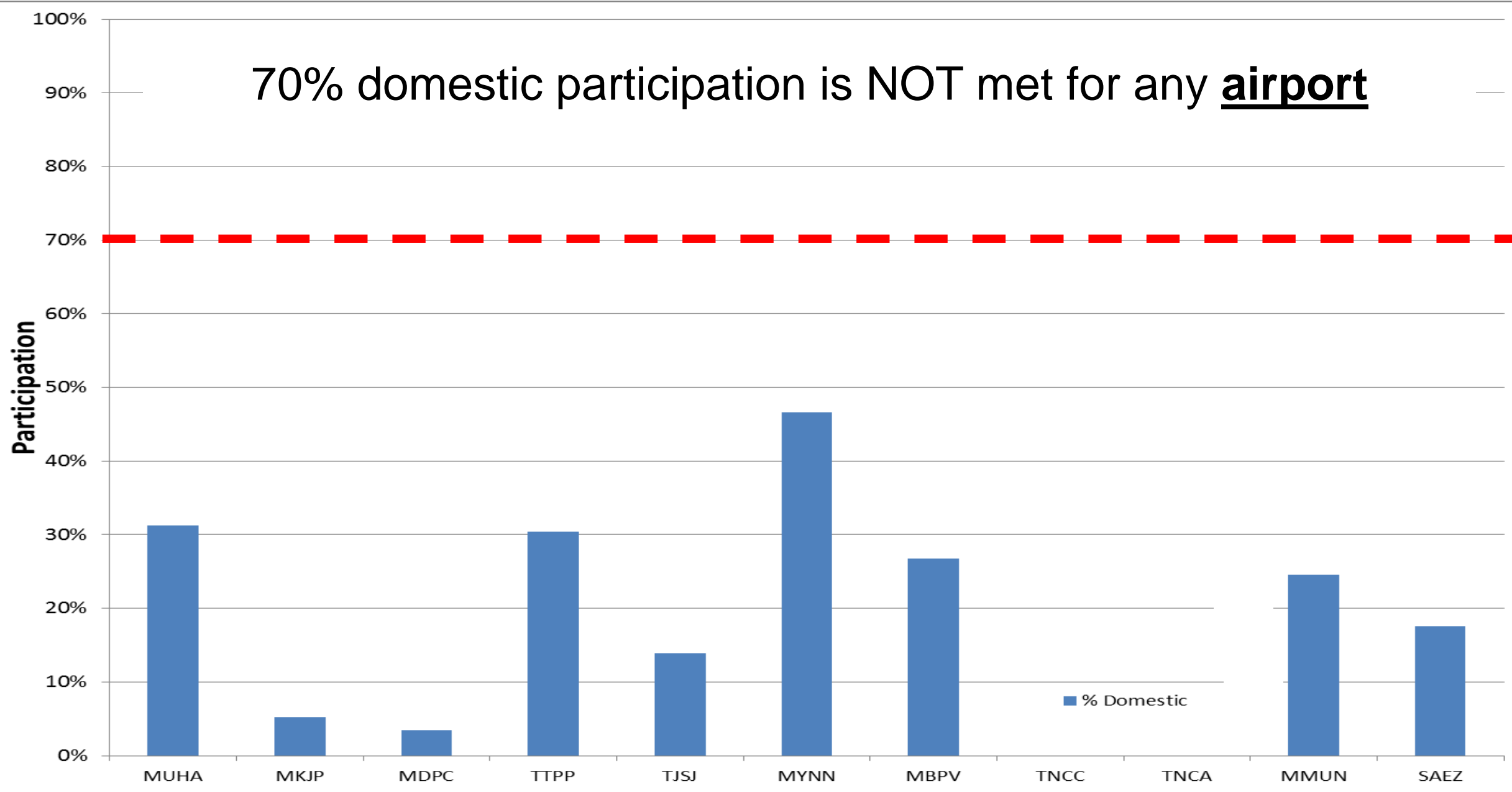
- > 70% participation within 1500 nm of destination airport



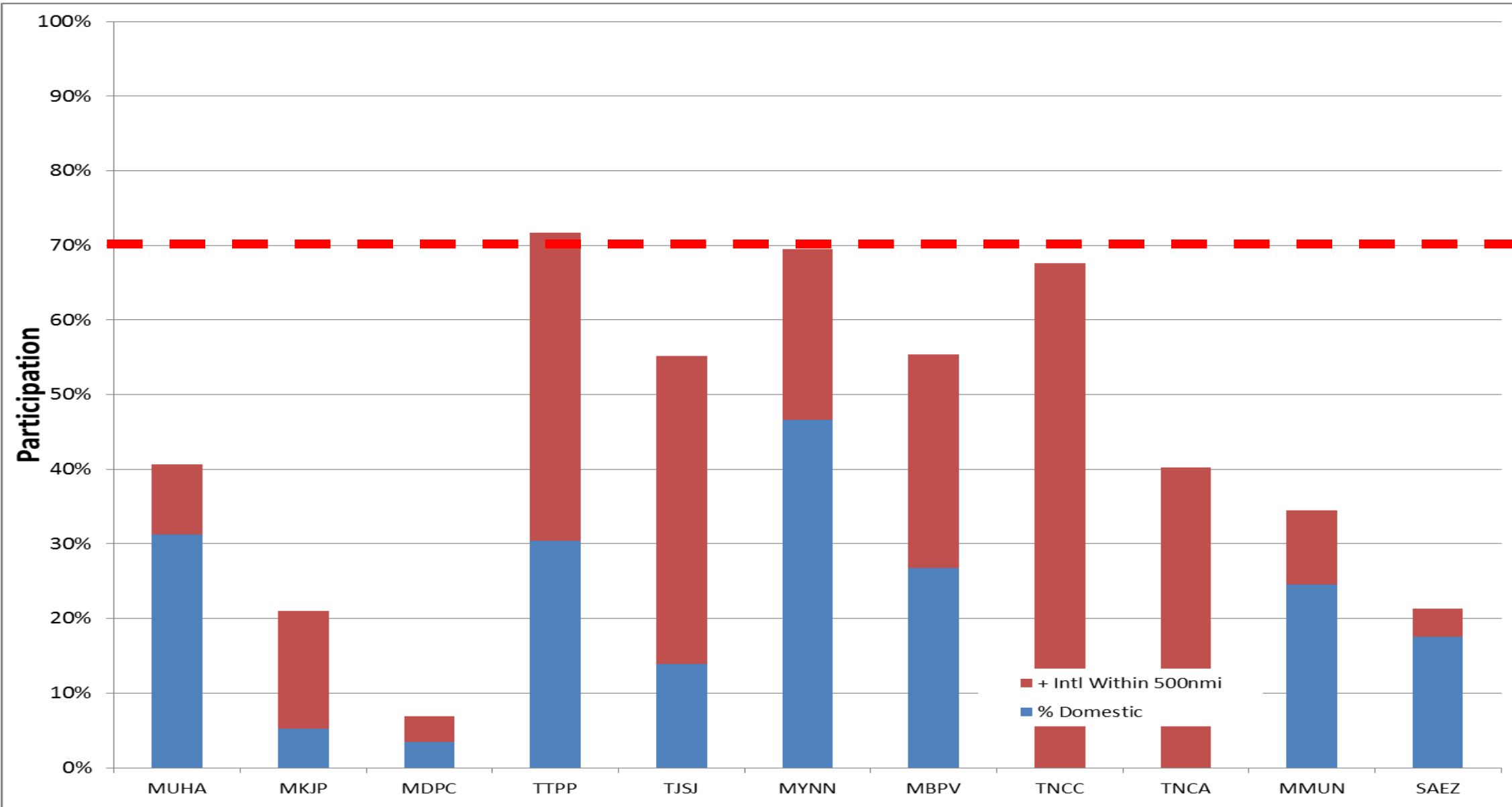
United States, Europe, Australia and Colombia have sufficient participation from domestic flights

Caribbean ATFM Participation Analysis (Domestic)

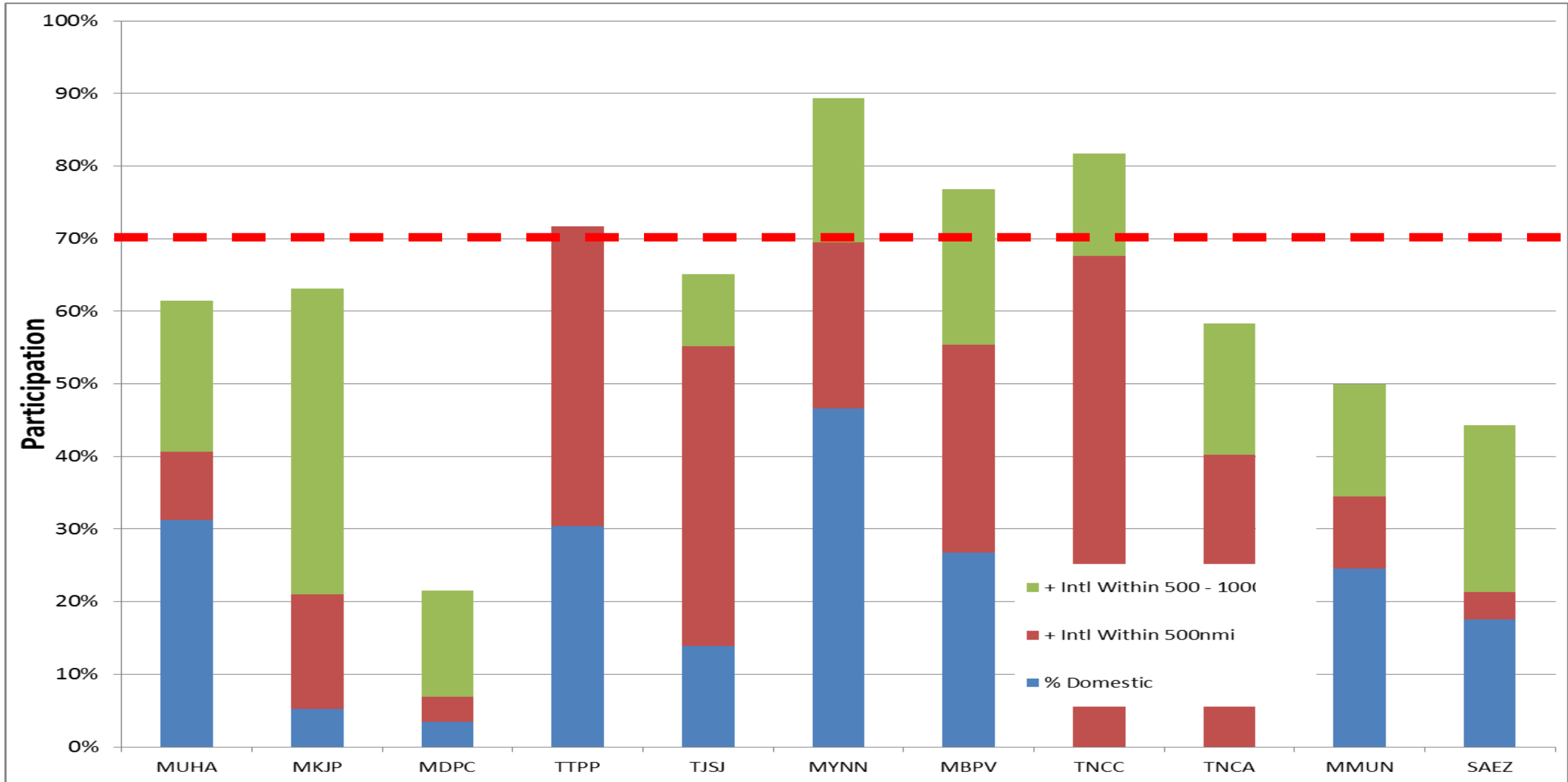
70% domestic participation is NOT met for any airport



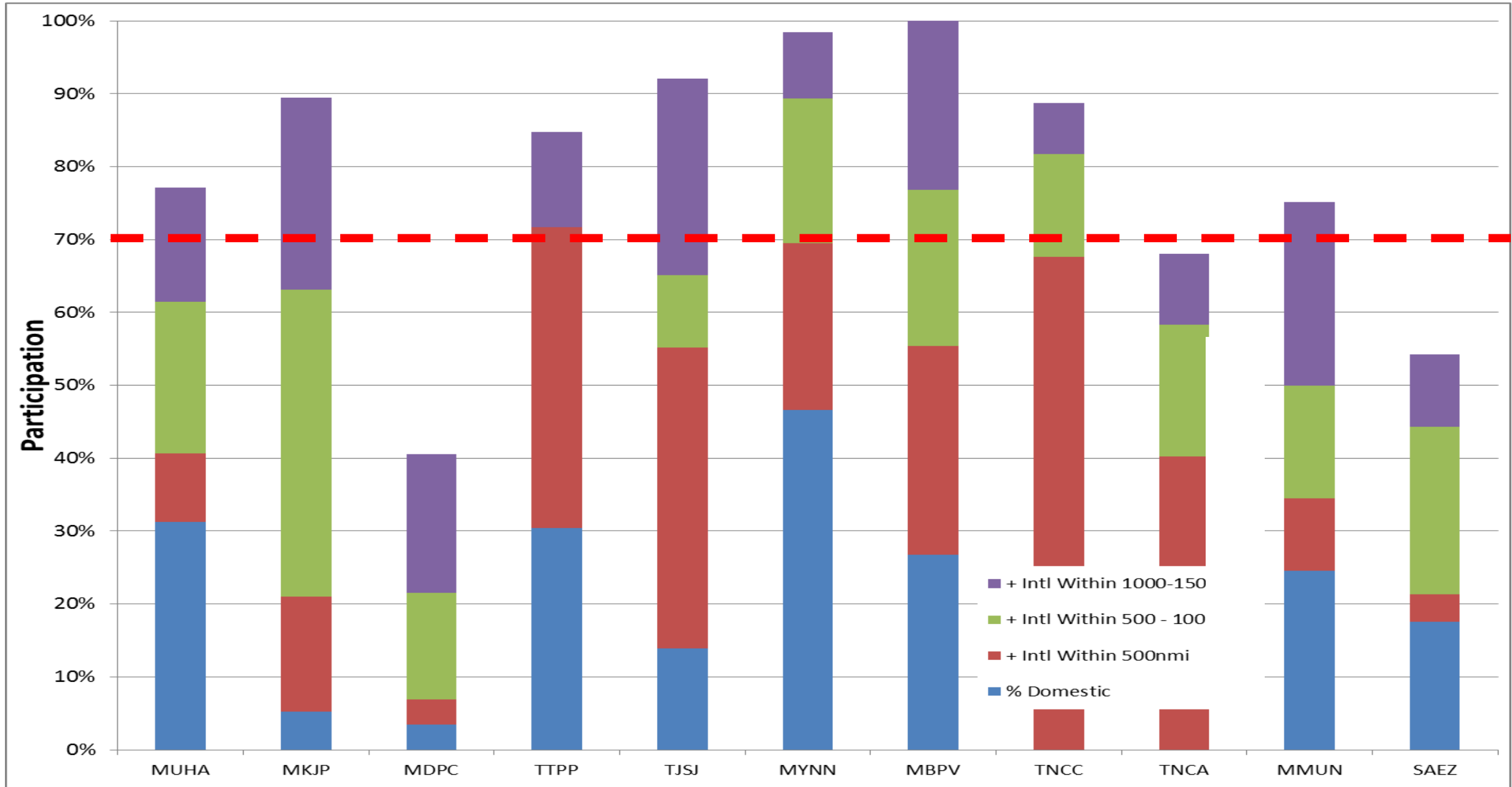
Caribbean ATFM Participation (Domestic + International 500nm)



Caribbean ATFM Participation (Domestic + International 1000nm)

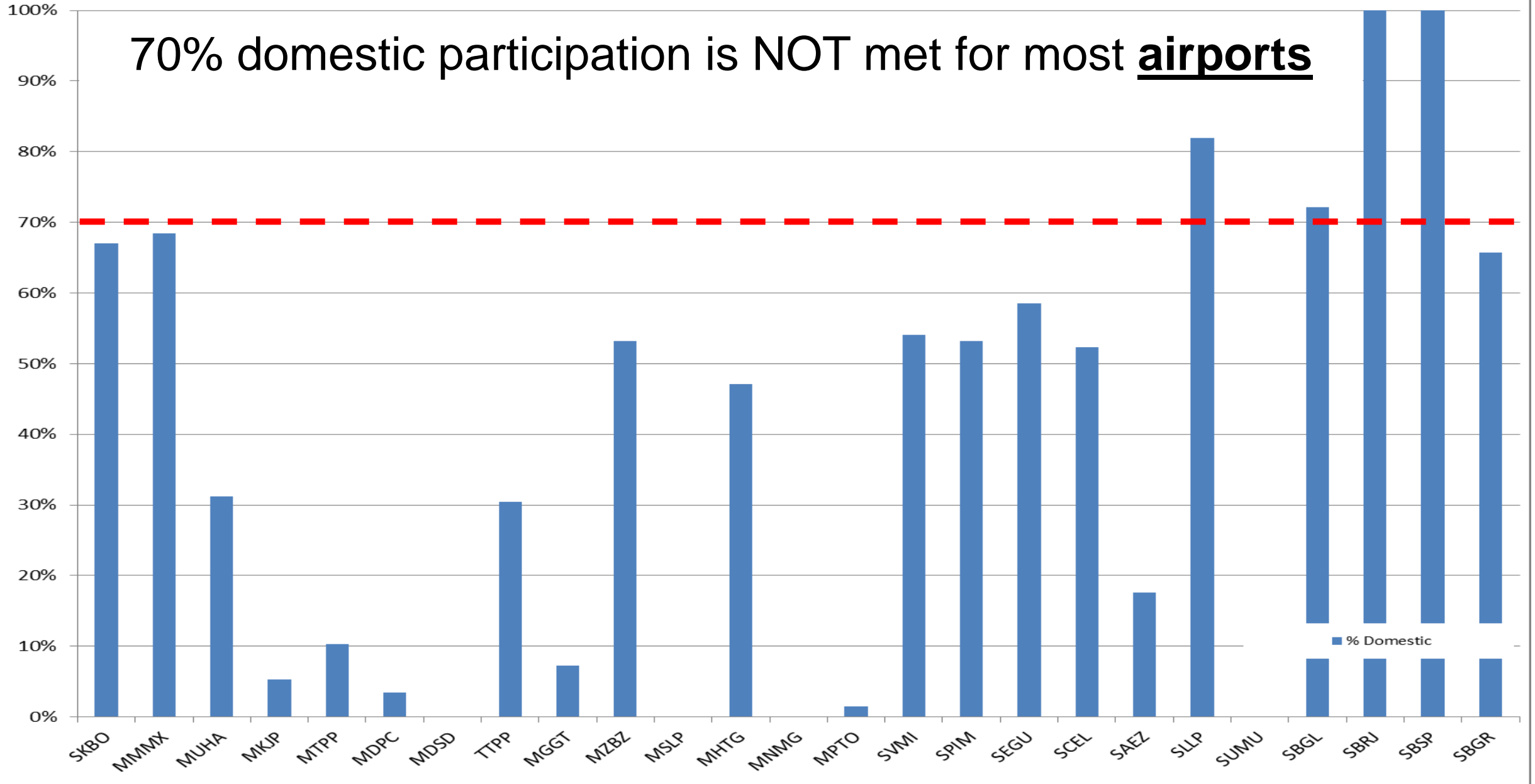


Caribbean ATFM Participation (Domestic + International 1500nm)

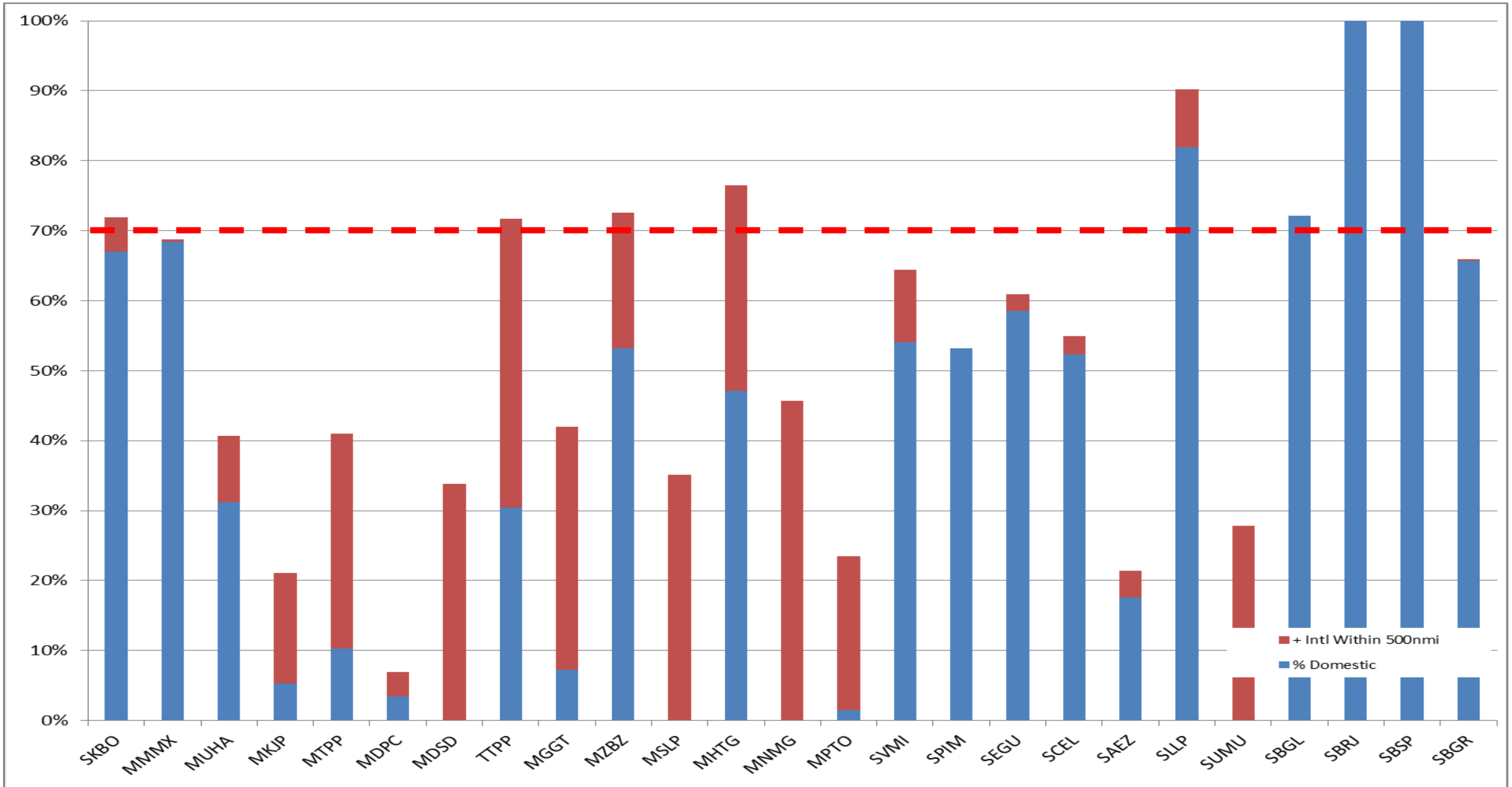


LATAM ATFM Participation (Domestic)

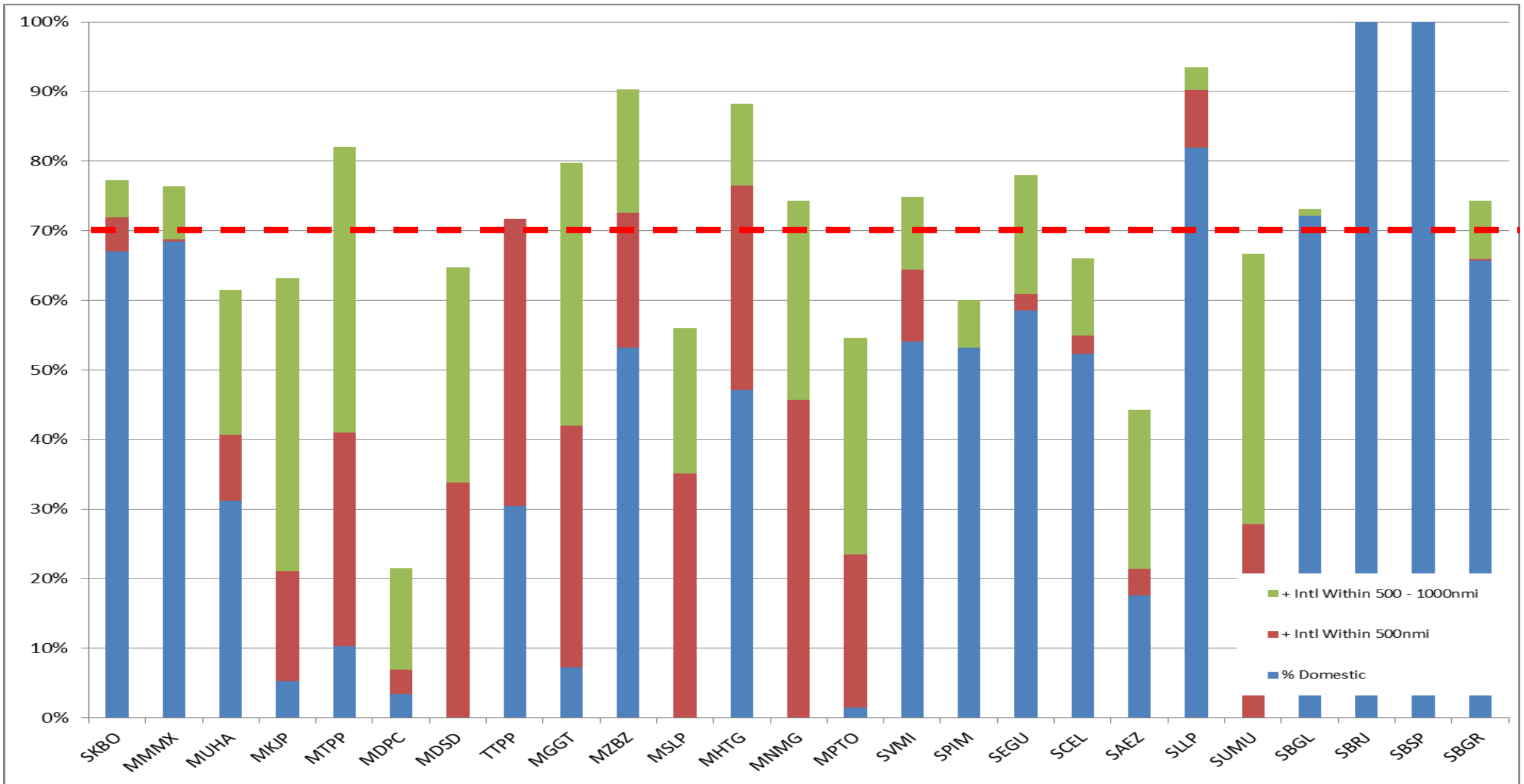
70% domestic participation is NOT met for most airports



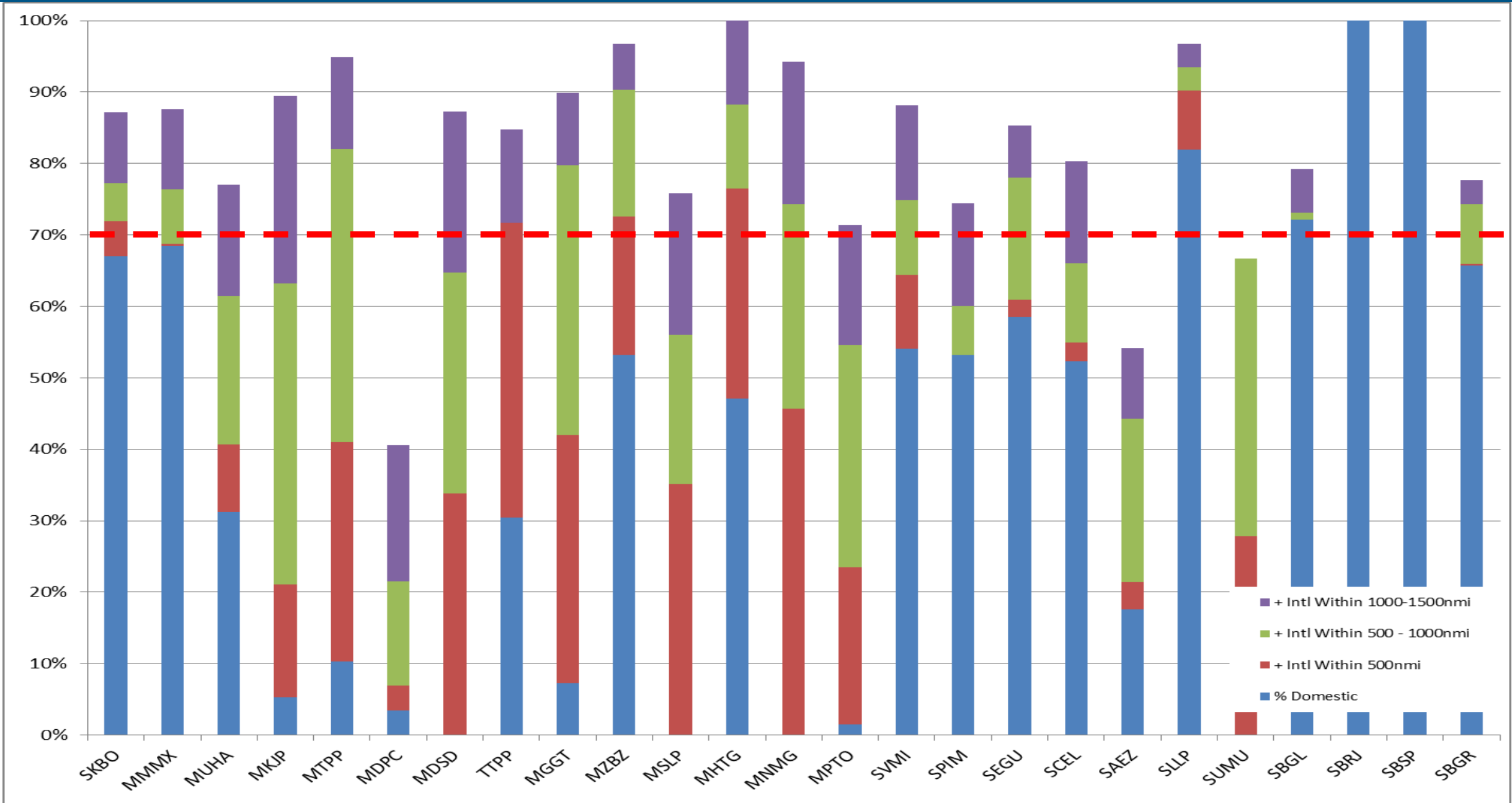
LATAM ATFM Participation (Domestic + International 500nm)



LATAM ATFM Participation (Domestic + International 1000nm)



LATAM ATFM Participation (Domestic + International 1500nm)



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 CO₂ 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

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



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

METRON AVIATION Demand Monitoring (Horizon)

MMAX (762 flights)

Info	Map	ACID	ADEP	ADDS	AC Type	SOBT	EOBT	ETOT	ATOT
✕		VOP76	MMXX	MMND	UN3N	051655	051651	051655	051655
✕		ANM43	MMXX	MSLP	E175	051559	051555	051559	051559
✕		LUAL485	MMXX	KJAI	CRJ7	051614	051610	051614	051614
✕		ASG25	MMXX	KLAX	UN3N	051625	051621	051625	051625
✕		LUAL806	MMXX	KSF0	UN3N	051629	051625	051629	051629
✕		ACAP97	MMXX	CYVR	UN3N	051635	051631	051635	051635
✕		VIV1783	MMXX	MMNY	UN3N	051648	051644	051648	051648
✕		VCI380	MMXX	MMNY	UN3N	051648	051644	051648	051648
✕		AMX335	MMXX	MMND	UN3N	051648	051644	051648	051648
✕		AMX388	MMXX	MMNY	E175	051648	051644	051648	051648
✕		ALZ228	MMXX	MMGL	UN3N	051648	051644	051648	051648
✕		AMX182	MMXX	MMGL	UN3N	051648	051644	051648	051648
✕		CMP795	MMXX	MPTO	UN3N	051648	051644	051648	051648
✕		AMX632	MMXX	MMAS	E175	051644	051644	051648	051648
✕		AMX528	MMXX	MMNT	E175	051644	051644	051648	051648
✕		AMX546	MMXX	KLAX	UN3N	051644	051644	051648	051648
✕		AMX262	MMXX	MMCN	E175	051644	051644	051648	051648
✕		AMX008	MMXX	MMTC	E175	051658	051658	051654	051654
✕		ALZ454	MMXX	MMHO	UN3N	051658	051658	051654	051654
✕		AMX208	MMXX	MMAM	E175	051655	051655	051659	051659
✕		YQZ724	MMXX	MMCU	UN3N	051655	051655	051659	051659
✕		DAL364	MMXX	KATL	UN3N	051655	051655	051659	051659
✕		AMX551	MMXX	MMTC	E175	051655	051655	051659	051659
✕		AMX19	SPM	MMXX	UN3N	051134	051130	051134	051134
✕		ALZ940	MMXX	MMGP	UN3N	051659	051659	051703	051703
✕		ALZ966	MMXX	KMA	UN3N	051659	051659	051703	051703
✕		AMX284	MMXX	MMNR	E175	051659	051659	051703	051703
✕		AMX212	MMXX	MMCU	UN3N	051659	051659	051703	051703
✕		VIV218	MMXX	MMEX	UN3N	051659	051659	051703	051703
✕		AMX247	MMXX	MMXX	E135	051659	051659	051654	051654
✕		AMX31	KLAX	MMXX	UN3N	051438	051406	051438	051438
✕		AMX259	MMSP	MMXX	E175	051648	051648	051644	051644
✕		AMX419	MMXX	MMTM	E175	051795	051795	051799	051799
✕		TAD332	MMXX	MMCV	AT43	051795	051795	051799	051799
✕		ALZ363	MMXX	MMCV	UN3N	051795	051795	051799	051799
✕		MSL665	MMGL	MMXX	B763	051648	051648	051644	051644



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

Monitor Demand Data in Usable Format

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



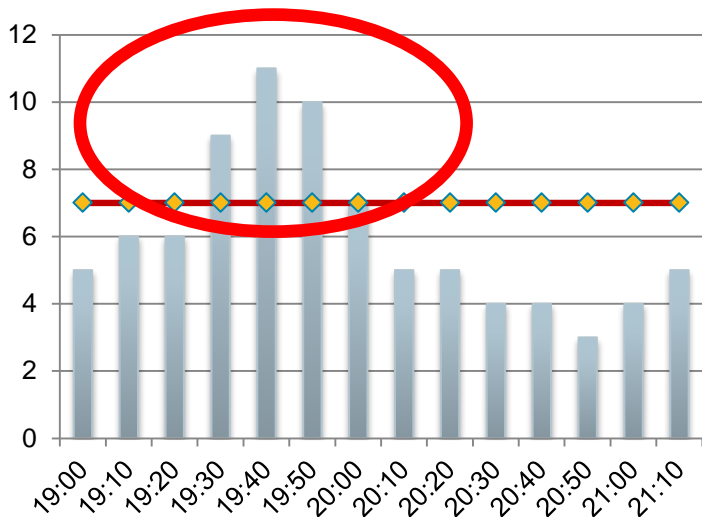
Demand Monitoring Tool Requirements

- 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

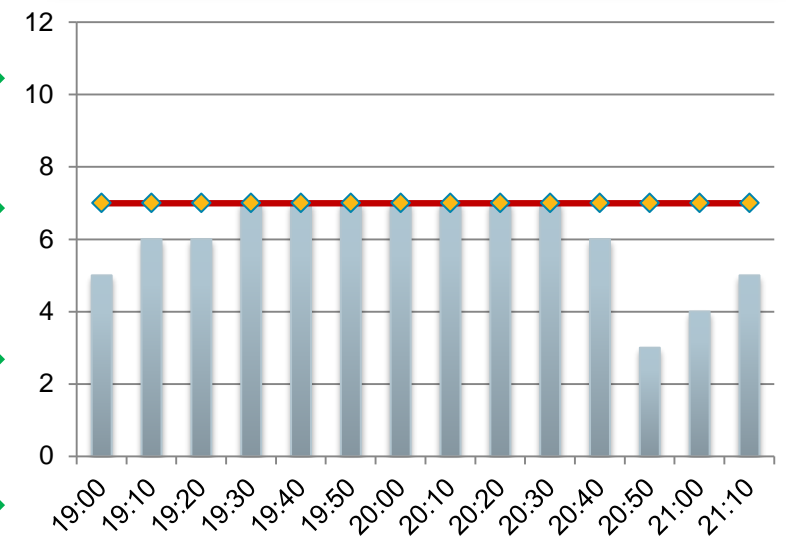


Automated ATFM Measures for Balancing Demand to Capacity



ATFM 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

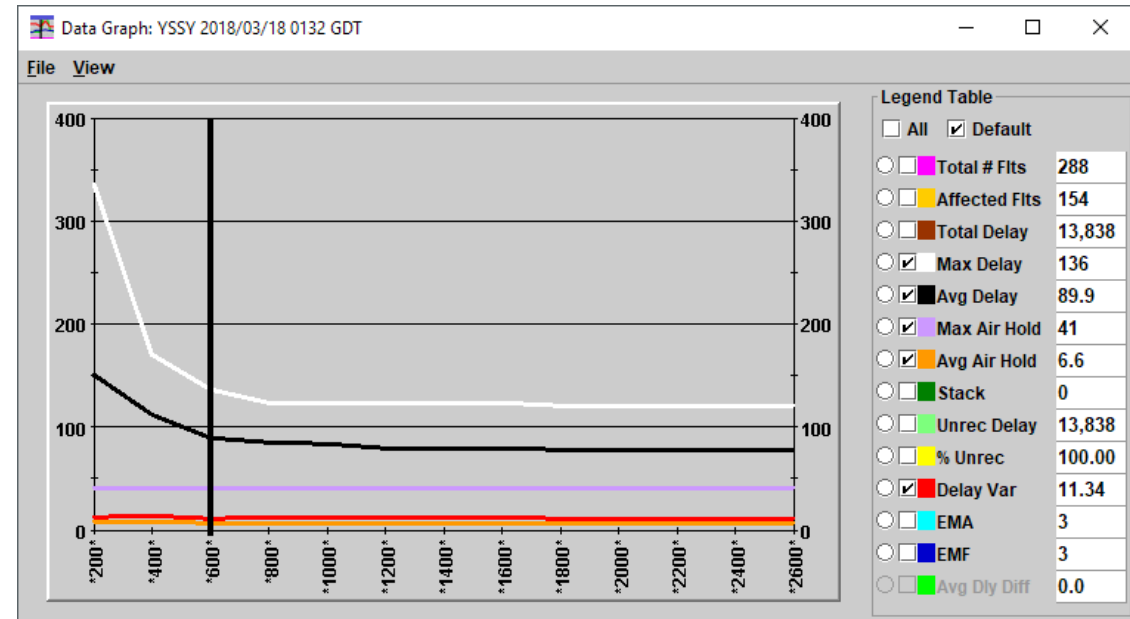
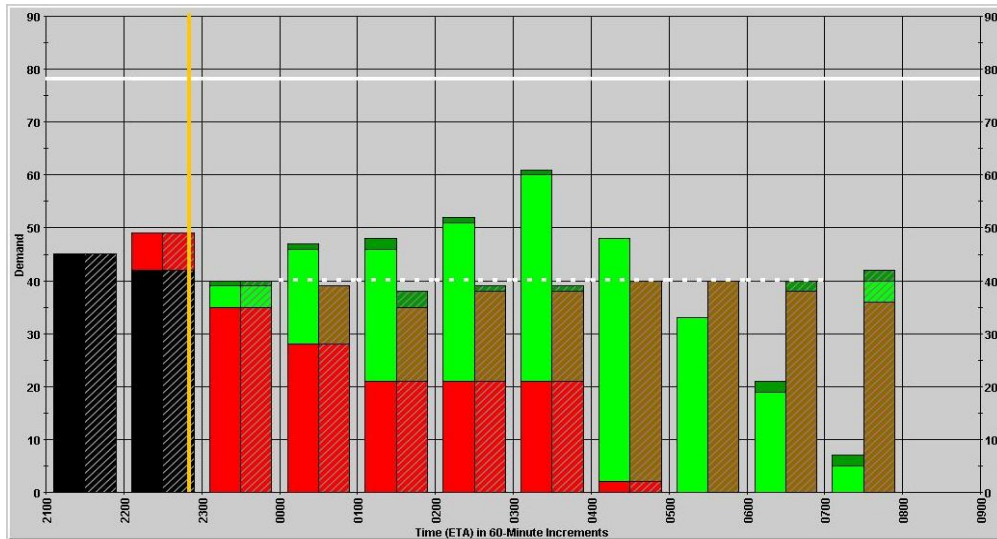


ATFM measures to balance demand to available capacity

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

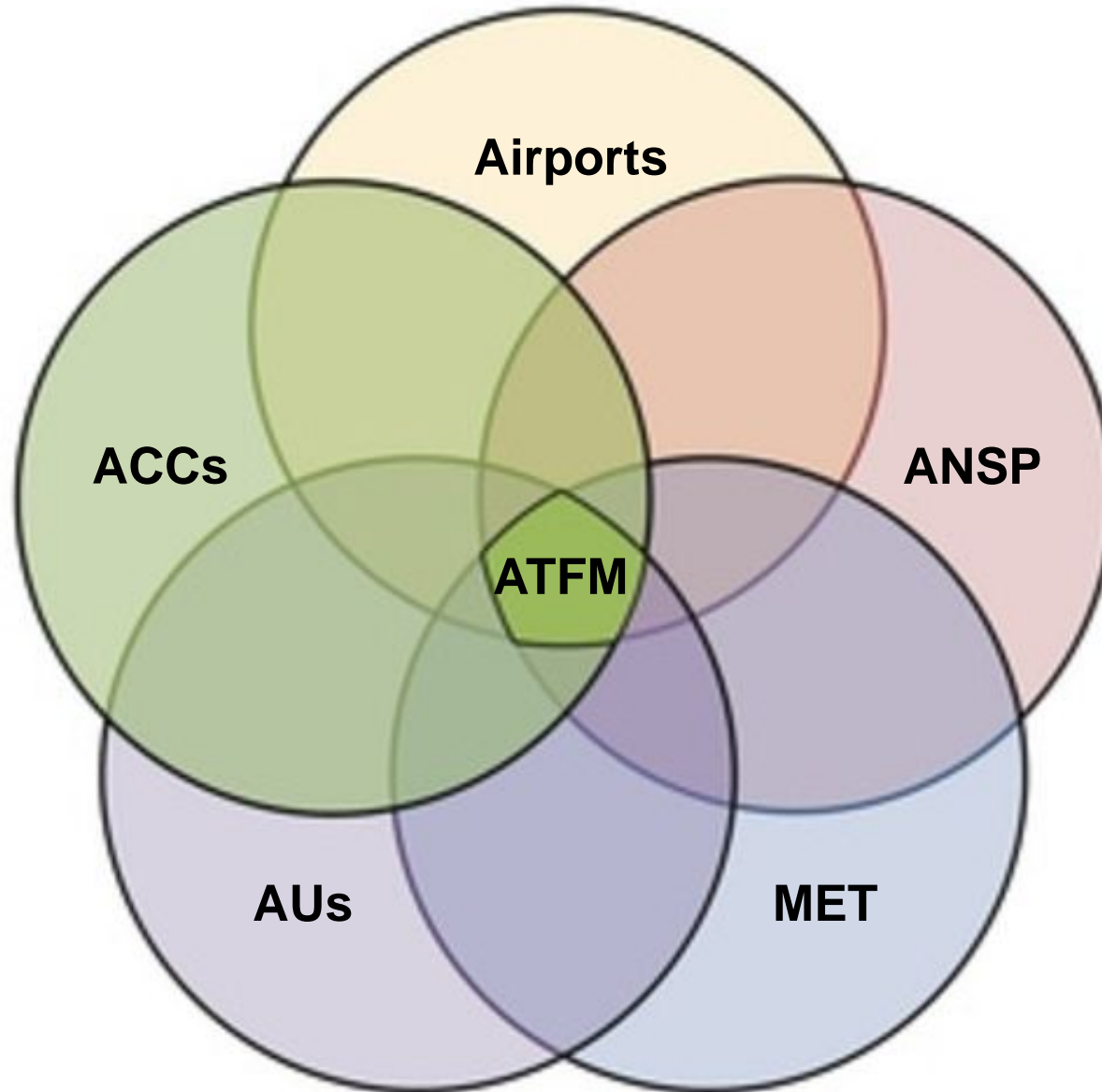
- Supports **CDM** with airlines through flight intent, schedule management, and slot substitution
- Supports **Regional/Multi-Nodal** ATFM
- **Integrates** with local ATM systems
 - AMAN, DMAN, A-CDM



Supports Regional / Multi-Nodal DCB Operations

ATFM Collaborative Decision Making – A Systems Approach

Common
Situational
Awareness



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 Cancellations
- Schedule Optimization
 - Slot Swapping
 - Inter-Operator Slot Exchanges

YMMML 10/31/2012 17:46Z - Enhanced Substitution Module

File Edit Update View Options Tools Flight Messages Reports Help

Freeze Updates Highlight Earlier Shift Earlier Shift Later Swap Slots Insert & Shift Cancel & Sub Aircraft Operator Compress Undo Redo Reset Create Subs

YMMML 10/31/2012 17:46Z YMMML GDP-A (31/1700 - 01/1014) Available Cancelled: 0 (+0 ISE)

Number of flights: 38 Available Delayed: 0 (+0 ISE)

Bridging: ON Unheld Cancelled: 1

MOD	CHK	AC	ID	ADEP	CR_Type	DEPT	COBT	ELOBT	LOBT	IBT	LBT	ADJ_ETA	ETA	SLOT	HOLD	AIRWY	SIWY	ISE	Program_Delay	Gr
1	✓	-	GFA 7311	YBER	GDP	1130	0750	1130	1130	1356	1345	1010	1010			15	-	-	0	
2	✓	-	GFA 649	YPPH	GDP	1625	1618	1625	1625	2005	2005	1839	1839	311840A		16	-	-	0	
3	✓	-	GFA 10	WSSS	GDP	1220	1313	1250	1220	1945	1945	1945	1945	311945A		16	-	-	25	
4	✓	-	KAL 125	RHSS	ODP	0920	0941	0920	-	1955	-	2000	2000	312005A		16	-	-	15	
5	✓	-	CPA 135	VH-HH	ODP	1110	1131	1110	-	2000	-	2002	2002	312010A		16	-	-	15	
6	✓	-	GFA 30	VH-HH	ODP	1055	1158	1145	1055	2005	2005	2031	2031	312035A		16	-	-	15	
7	✓	-	MAS 149	WMKK	ODP	1410	1411	1410	-	2131	-	2132	2132	312135A		16	-	-	9	
8	✓	-	GFA 716	WMI	ODP	1525	1526	1525	-	2125	-	2141	2141	312145A		16	-	-	25	
9	✓	-	GFA 84	KLAV	ODP	0830	0648	0830	-	2138	-	2150	2150	312152A		16	-	-	10	
10	✓	-	GFA 010	YMHJ	ODP	2005	2102	2005	2005	2114	2120	2205	2205	312205A		16	-	-	57	
11	✓	-	YRN 781	YMTS	ODP	1320	1316	1320	-	2303	-	2303	2309	312309A		16	-	-	13	
12	✓	-	GFA 401	YSSY	ODP	2000	2052	2000	2000	2126	2135	2215	2215	312315A		16	-	-	52	
13	✓	-	QLK 770	YMA	ODP	2035	2137	2035	2035	2138	2140	2235	2235	312235A		16	-	-	82	
14	✓	-	QLK 2800	YMLT	ODP	2030	2141	2030	2030	2138	2140	2245	2245	312245A		16	-	-	71	
15	✓	-	GFA 132	NZAA	ODP	1850	1855	1850	1850	2300	2300	2300	2300	312300A		16	-	+50	5	
16	✓	-	GFA 795	YSCB	ODP	2040	2215	2040	2040	2141	2150	2310	2310	312310A		16	-	-	95	
17	✓	-	QLK 50	YDRG	ODP	2030	2206	2030	2030	2144	2145	2315	2315	312315A		16	-	-	96	
18	✓	-	CEB 737	ZBPO	ODP	1300	1300	-	-	2322	-	2317	2317	312322A		16	-	-	50	
19	✓	-	GFA 670	YPAD	ODP	2035	2225	2035	2035	2146	2155	2330	2330	312330A		16	-	-	110	
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23	✓	-	GFA 411	YSSY	ODP	2130	2304	2130	2130	2302	2305	0030	0030	010030A		16	-	+51	94	
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25	✓	-	GFA 674	YPAD	ODP	2200	2335	2200	2200	2311	2320	0040	0040	010040A		16	-	+50	95	
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27	✓	-	QLK 770	YMA	ODP	2040	2002	1935	-	0103	-	0100	0100	010100A		16	-	-	267	
28	✓	-	GFA 2814	YWLM	ODP	2145	2339	2145	2145	2317	2320	0105	0105	010105A		16	-	+66	114	
29	✓	-	GFA 415	YSSY	ODP	2200	2347	2200	2200	2329	2335	0110	0110	010110A		16	-	+78	107	
30	✓	-	GFA 2816	YWLM	ODP	2200	2349	2200	2200	2332	2335	0115	0115	010115A		16	-	+81	109	
31	✓	-	THA 465	VTBS	ODP	1715	1718	1715	-	0147	-	0145	0145	010145A		16	-	-	3	
32	✓	-	QLK 282	YMLT	ODP	2345	0058	2345	-	0107	-	0215	0215	010215A		16	-	+177	71	

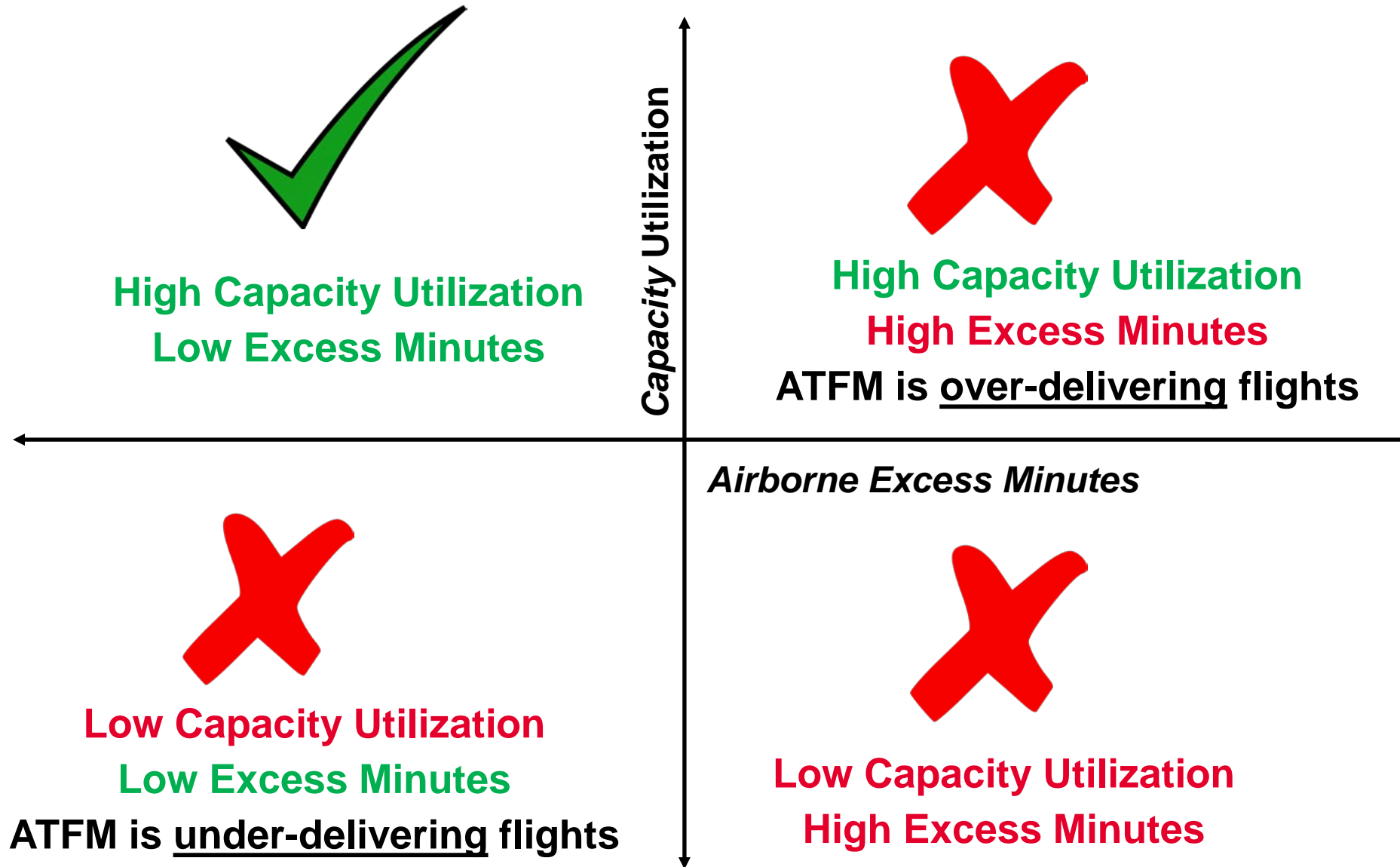


Common situational awareness platform enables data sharing and AO schedule optimization within prescribed ATFM TMM parameters

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	07/1913	07/1913	
07/1914	WSSS	GDP	07/1914	07/1914	
07/1724	FCALINE	AFP	07/1724	07/1724	
07/1936	FCALINE	AFP	07/1936	07/1936	
08/1801	FCALINE1	AFP	08/1801	08/1801	

Showing 1 to 5 of 5 entries

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

Overview

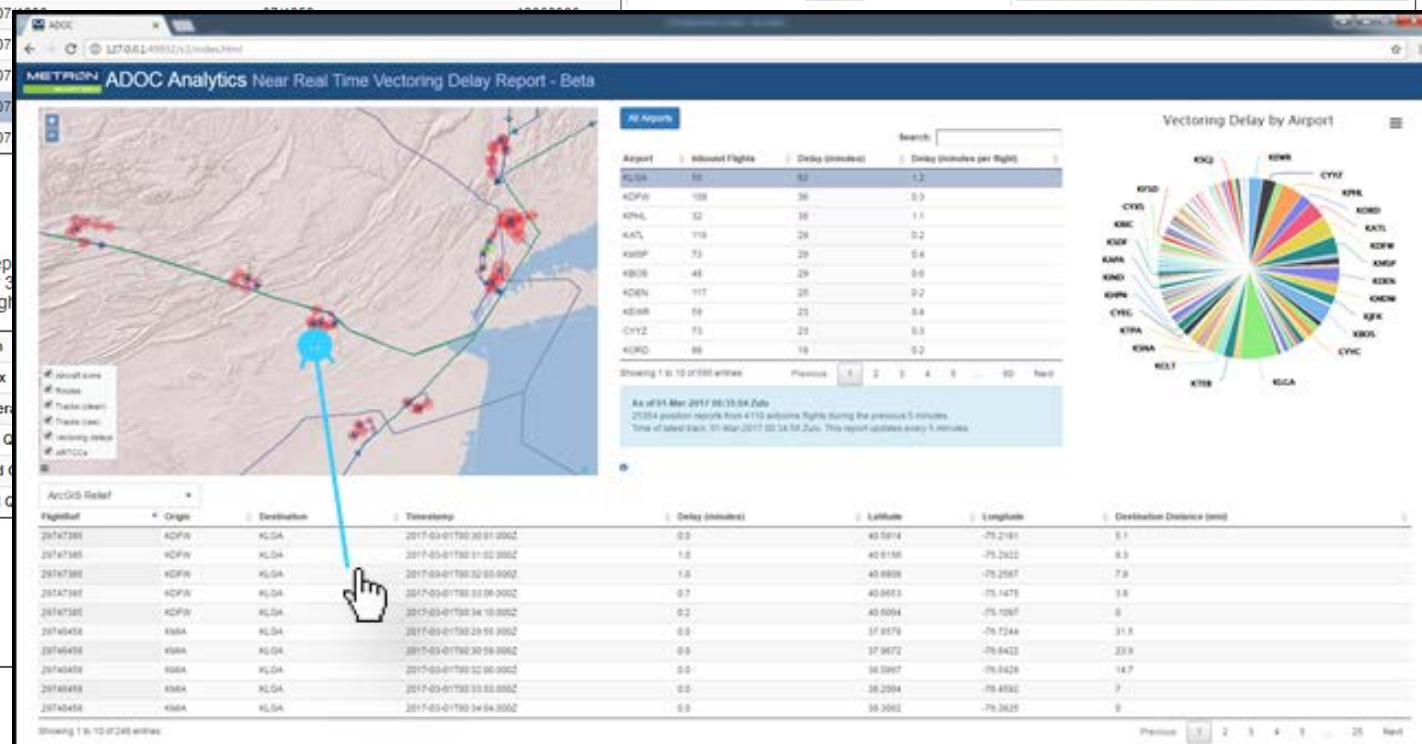
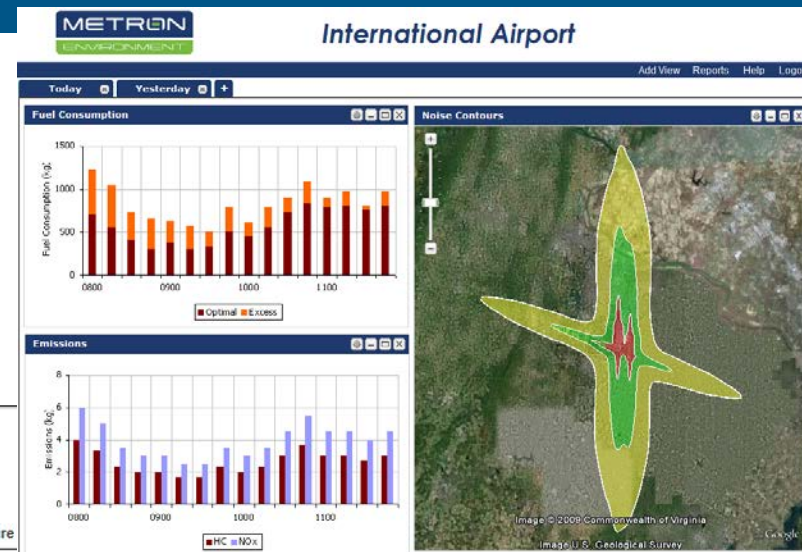
Flights	67
Exempt	37
Non-Exempt	30
Compliant*	15
Non-Compliant*	15
Total Delay (minutes)	17603
Average Delay (minutes)	263
Max Delay (minutes)	1398

* Compliance window -5 to +10 minutes

Departure Compliance Overview

Click slice for drilldown by carrier

Non-Compliant: 22%
Exempt: 55%
Compliant: 22%



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

Thank You

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AN AIRBUS COMPANY

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