

8th Global ATFM Conference
Stuart Ratcliffe

Airbus ProSky Assisting ANSPs

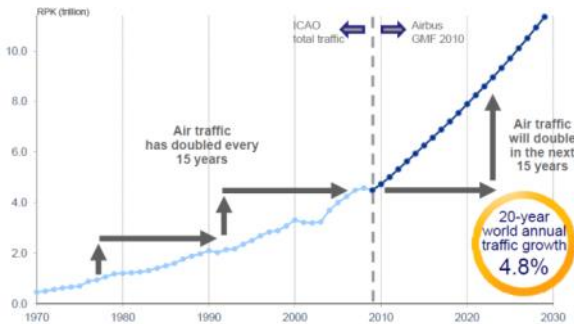


Global Market Dynamics

Demand Growth

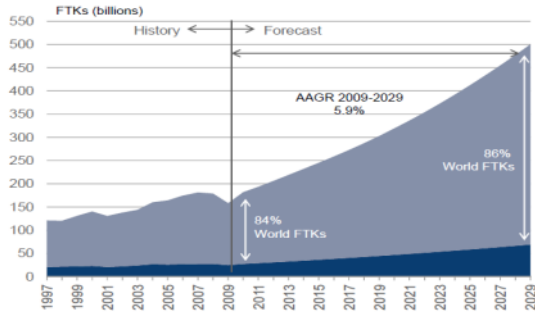
- Air traffic demand growth is the central challenge facing the industry

Passenger Air Traffic to Double by 2025



Source: ICAO, Airbus GMF 2010

Cargo Air Traffic to Triple by 2030

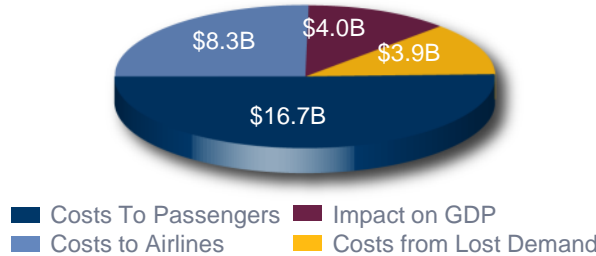


Source: ICAO, Airbus GMF 2010

Economic Cost of Delay

- Economic cost of delay is enormous and will only get worse as traffic demand grows

Annual Cost of US Delays 2010: \$ 32.9B



Source: FAA NEXTOR Delay Impact Study 2010

Cost per Every Minute of Delay: \$102

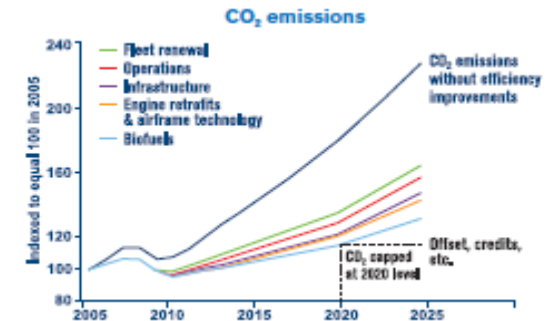
Delay costs per minute (€)	Tactical without network effect		Tactical with network effect		Strategic	
	Ground	Airborne	Ground	Airborne	Ground	Airborne
Fuel costs	1	15	1	15	1	15
Maintenance costs	1	1	1	1	-	12
Crew costs	9	9	11	11	12	12
Ground and passenger handling	-	-	-	-	-	-
Airport charges	0	0	0	0	-	-
Aircraft ownership costs (DRL)	-	-	-	-	10	10
Passenger compensation	14	14	26	26	-	-
Direct cost to an airline	25	40	39	54	22	49
Passenger opportunity cost	22	22	39	39	-	-
Overall cost	47	62	78	93	22	49

Source: Eurocontrol Westminster Cost of Delay Study

Environmental Cost of Delay

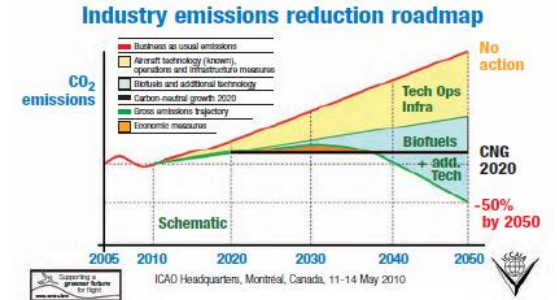
- Carbon footprint of aviation growing with demand while environmental pressures increase

Carbon Reductions Require Efficiencies



Source: IATA Pathway to Carbon Neutral Aviation 2010

Emissions Reduced 50% by 2050

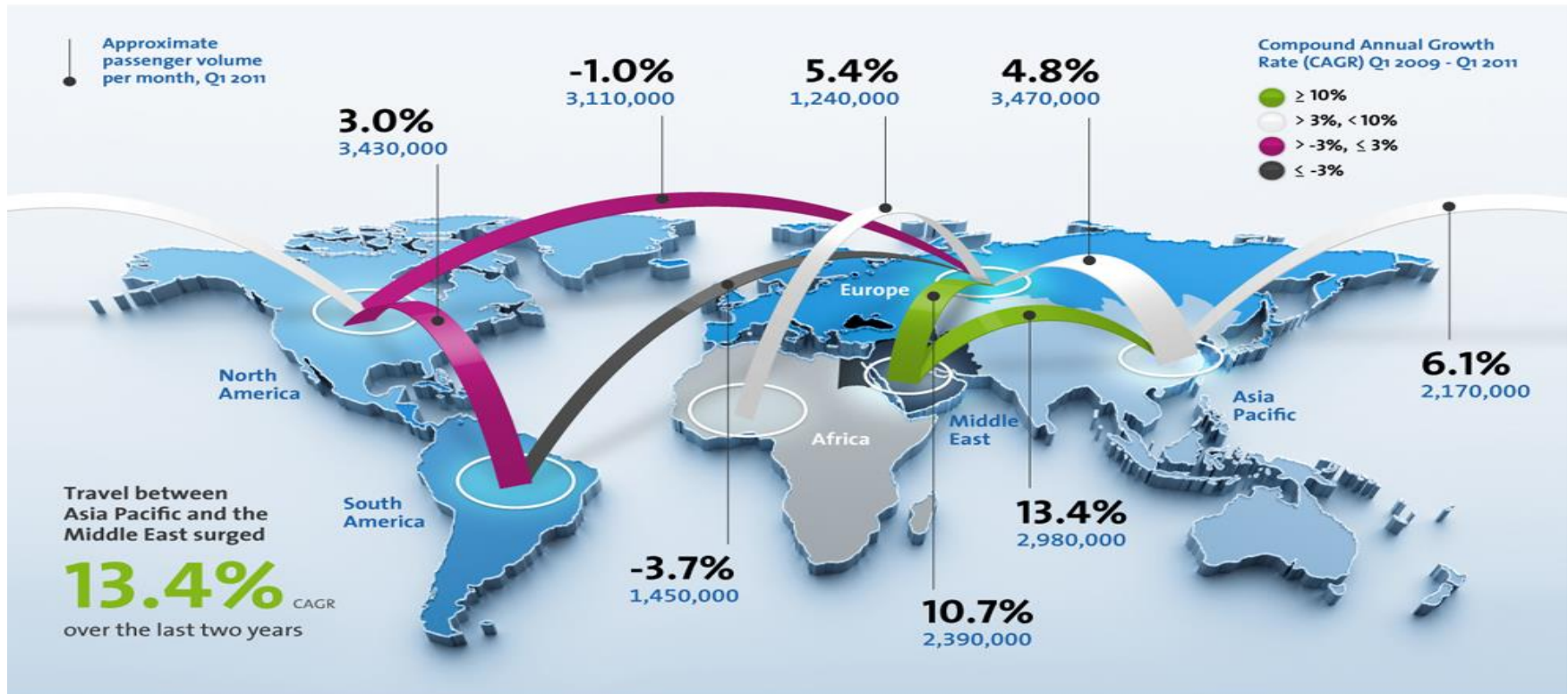


Source: ICAO Environmental Report 2010

Global Market Dynamics

Global airline traffic trends

Analysis by Amadeus and its partner airconomy reveals that Asia Pacific, the Middle East and Europe have become hot spots for inter-regional airline traffic. The BRIC countries are also global drivers of growth in aviation

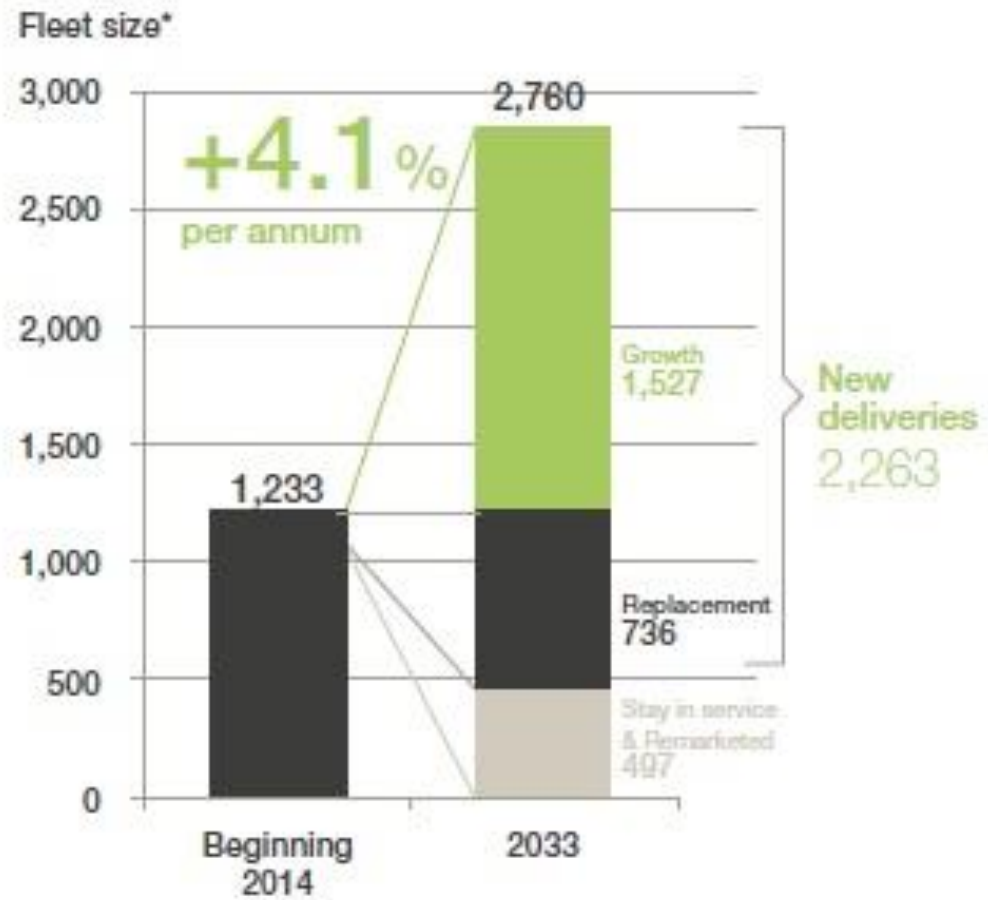


The global emerging economic centres are also leading in domestic growth. Domestic traffic has increased in :

Brazil by **28%** Russia by **23%** China by **14%** India by **14%**

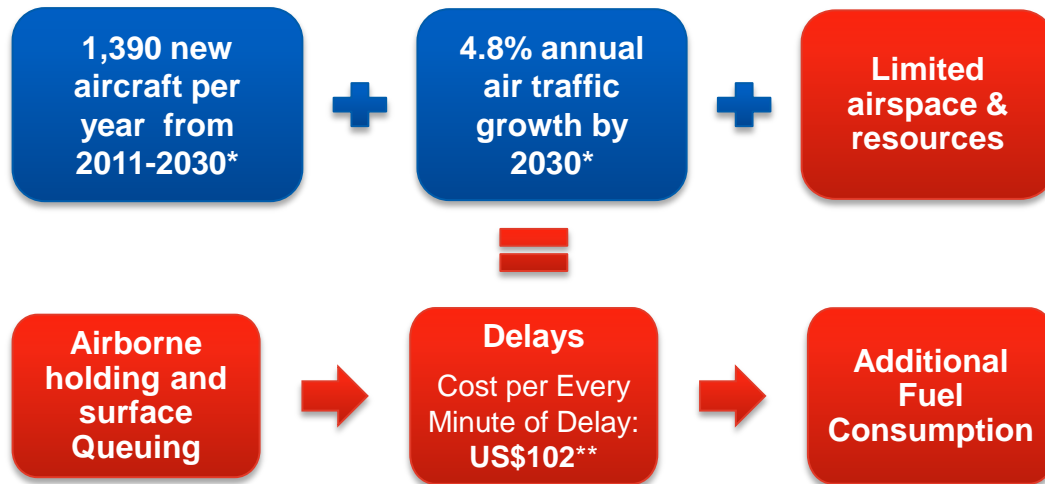


Central America Aircraft Deliveries - 2033



Tackling Today's Challenges

ATM performance has become a bottleneck for Aviation Stakeholders



*Data from Airbus Global Market Forecast 2012-2030

** Source: Eurocontrol Westminster Cost of Delay Study

Airbus ProSky

ATM Performance Improvement Solutions

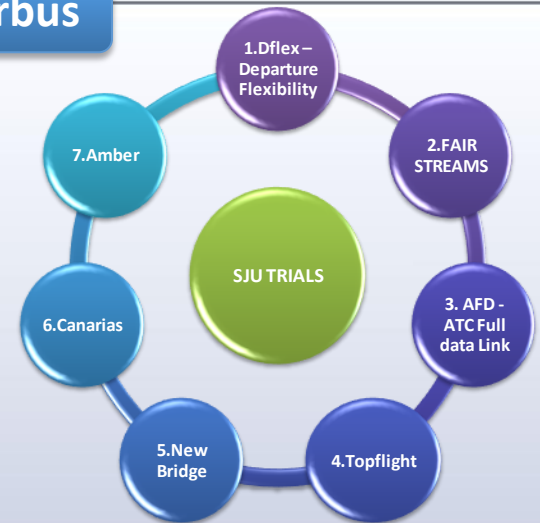
- Airbus ProSky was launched in early 2011 as an independent subsidiary of Airbus to advance global ATM performance while supporting and accelerating NextGen and SESAR programs
- Airbus ProSky is comprised of recognized ATM experts --, Metron Aviation, Quovadis and ATRiCS -- brought together to improve the performance and efficiency of the global airspace
- Airbus ProSky includes best-in-class innovators and offer modern technologies to maximize efficiency, capacity and environmental sustainability
- Airbus ProSky delivers
 - Groundbreaking ATM research and development
 - Highest quality Airspace Management services focused on capacity enhancement including vast PBN/RNP experience
 - World leading ATFM / CDM solutions and services
 - Best in class Airport Solutions



A leading player in ATM Modernization programs

Airbus ProSky participation to SESAR projects led by Airbus

- **Member of the SESAR JU:** future operational concepts and aircraft capabilities
- **SESAR Industrial Support :** monitor, assess and provide technical guidance to the SESAR program
- **SESAR integrated flight trials:** to support quick win deployment



Contribution to NEXTGEN and SE2020

- **Boeing and Airbus** signed an MOU in 2008 to ensure a Global Interoperability of ATM systems.
- **SE2020:** Airbus granted a research task to maximize the advantages of PBN capability across the US airspace (Greener Skies Initiative 2).
- **SE2020:** Metron Aviation 1.15B US\$ 10 year contract on key R&D areas

Metron Aviation Overview

Pioneer & World Leader

- Advanced Aviation Research & Concept Engineering
- Air Traffic Flow Management (ATFM)
- Collaborative Decision Making (CDM)
- Airport CDM (A-CDM), Surface Operations
- Airspace Design
- Environmental and Energy Analysis

Metron Aviation fuses advanced science and mathematics with unparalleled air traffic management expertise to provide ground-breaking optimization and collaborative decision making solutions for the world's leading Air Navigation Service Providers, Airports, Airlines, Logistics and other Service Providers to the Air Transport Industry

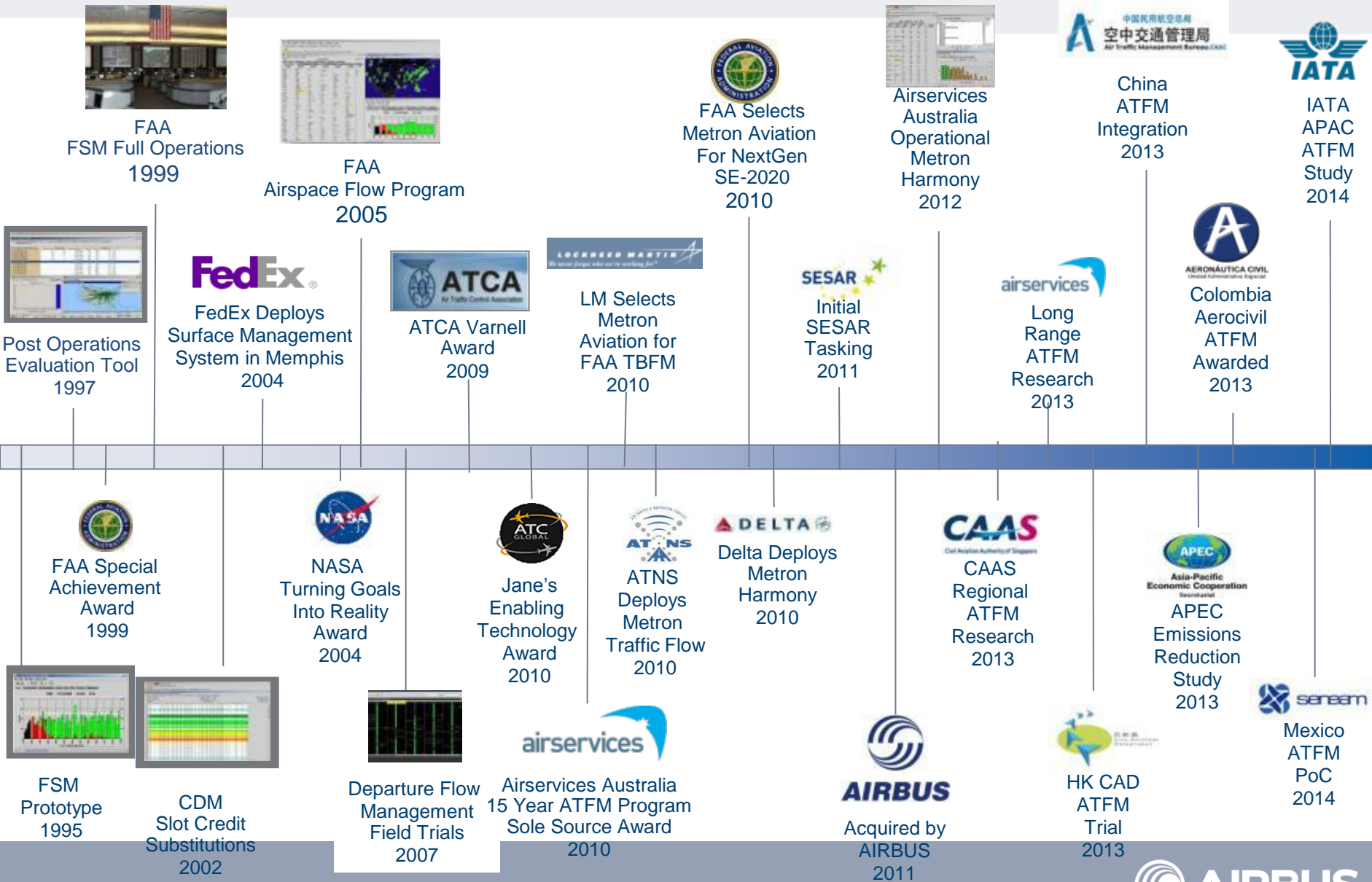
Impressive Track Record

- Innovation: Industry's first ATFM platform and CDM solution
- Customer Value: Significant, measurable economic and environmental benefits
- Excellence: Numerous awards from FAA, NASA, ATCA, Jane's ATC Global

Growing Presence and Capabilities

- Headquartered in Dulles, VA with offices in DC and NJ
- 2 Business Units – Advanced Research & Engineering; Commercial Products & Solutions
- 180 Employees – Operational, technical and scientific expertise
- Commitment to Quality: ISO 9001 Certification, DO278, CMMI

Heritage of Innovation and Success



CAA, ANSP & Airport Customers



Airbus ProSky Airline Customers



ATFM / CDM Solutions and Services

Increase **ground**
efficiency

Surface Management
Solutions and Services



Increase **airspace**
efficiency

Navigation Solutions
and Services



Increase **flow**
efficiency

ATFM/CDM Solutions
and Services



Delivering ATM performance

Navigation Solutions and Services

Increase **airspace** efficiency

Navigation Solutions and Services



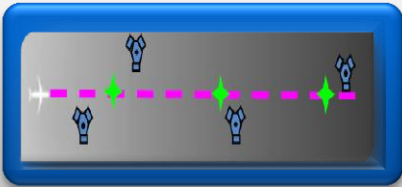
Benefits

- **Tailored procedures for congested or challenging airport operations**
- **Improves safety and capacity**
- **Reduces noise and fuel burn**

Increase Airspace Efficiency

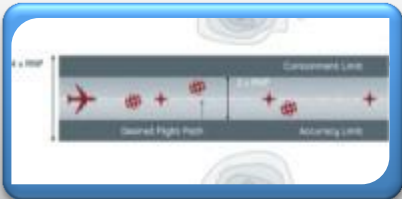
Performance Based Navigation procedures: tailored procedures for areas limited by demanding obstacles, infrastructure unavailability or high airspace congestion

RNAV: Area Navigation



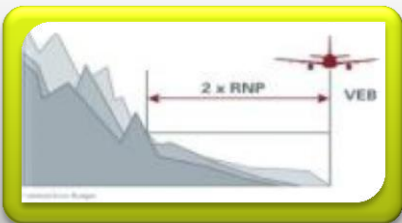
- Fly precisely along a predefined route
- Best-use of aircraft performance
- Expanded area of navigation

RNP: Required Navigation Procedures



- Increased Navigation accuracy
- Onboard Monitoring and Alerting
- Removal of Circle to Land

RNP AR: Authorization required



- Lower separation Minima
- Tailored Curved flight path
- Reduce the obstacle protections
- Removal of Circle to Land



Benefits:

- Airspace capacity
- Fuel efficiency
- Operational efficiency
- Access to demanding airports

Surface Optimization

Increase **Ground** efficiency

Surface Management Solutions and Services



Benefits

- Tailored procedures for congested or challenging airport operations
- Improves safety and capacity
- Reduces noise and fuel burn

ATFM / CDM Solutions and Services

Increase **flow** efficiency

ATFM/CDM Solutions and Services



Benefits

- Reducing flight time, airborne holding, fuel burn and emissions
- Increases predictability
- Increase ability to recover
- Reduces ATC workload
- Allow Airlines to operate more flexible

Airbus ProSky's ATFM solution

- Allowing strategic, pre-tactical and tactical planning
- Balancing demand and capacity
- Integrating aircraft operators business priorities and ATM constraints
- Making possible collaborative decision making (CDM) among users, both civil and military

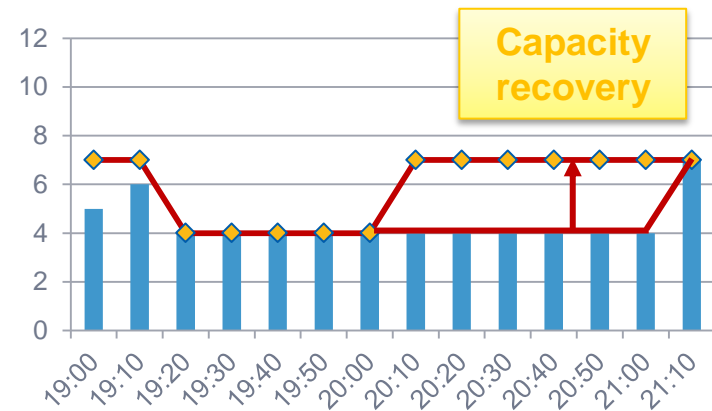
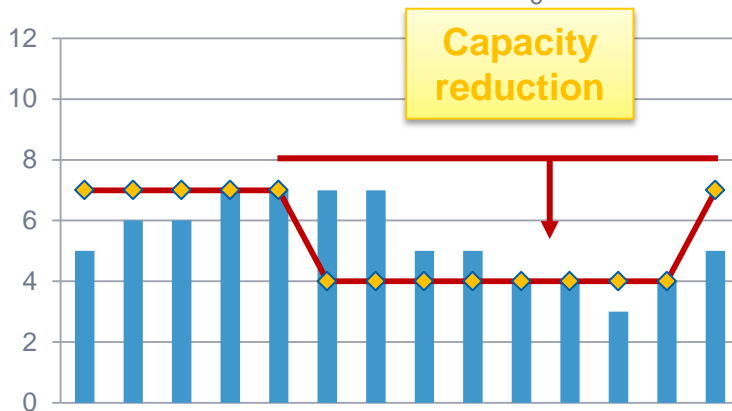


Winner of the Jane's ATC
Award 2010



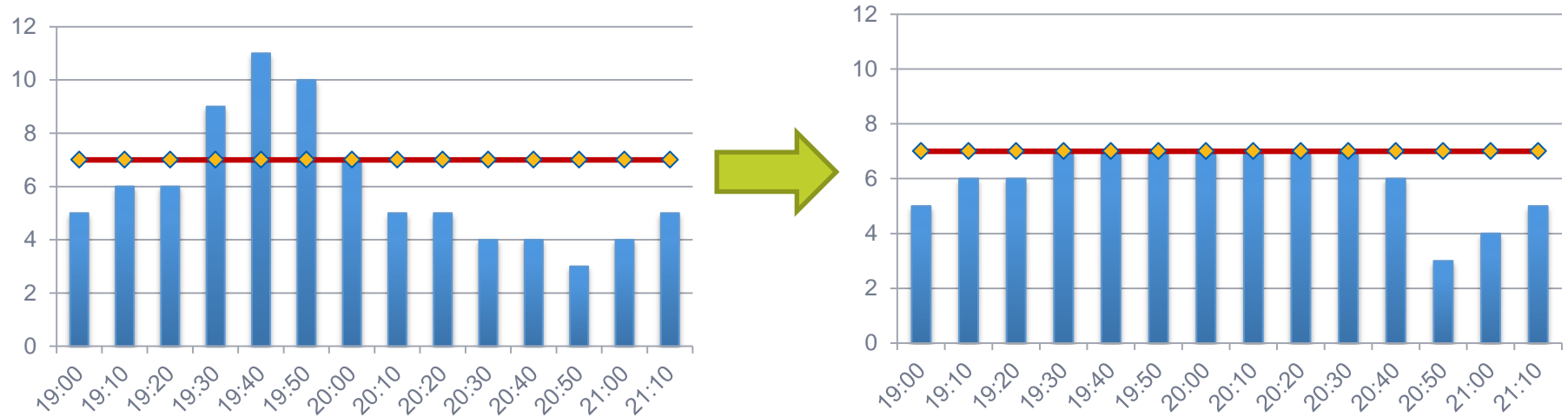
Demand & Capacity Imbalances

- Traffic demand smoothing in all ATM phases (Strategic, pre-tactical, tactical)
- Addressing the following situations:
 - Over demand in nominal capacity situations
 - Capacity reduction periods (e.g. low visibility conditions for instance, or a runway closure)
 - Capacity recovery periods.



Smooth the demand with an ATFM solution

ATFM: service with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.



When a demand/capacity imbalance is predicted, ATFM smoothes the demand to the available capacity through the **adjustment of departure times** for flights at the departing airport resulting in a **reduction of airborne holding** at the arriving airport.

ATFM/CDM with Metron Harmony

A solution based on **Collaborative Decision Making** principles: **taking into account** the stakeholders' **priorities**



Perform CDM

- ANSPs perform initial slots allocation
- Web accessible slot substitution functionality for aircraft operators to prioritize their flights
- Capability to allow “blind” transfer of slots between aircraft operators

The screenshot displays a flight schedule application with a 'Flight Schedule' table and a 'Slot Substitution' window. The flight schedule table lists various flights with columns for ACID, Major, ADEP, ADES, OBT, IBT, Type, CNX, AC Reg, ELOBT, ELBT, and ADEP Terminal. The 'Slot Substitution' window shows 'Traffic Management Initiatives' and a 'YSSY Slots List' table. The 'YSSY Slots List' table has columns for Slot, Slot Hold, ACID, Major, AC_REG, ADEP, IOBT, ELOBT, COBT, ETD, and AD. The 'YSSY Canceled Flights List' table is currently empty.

ACID*	Major*	ADEP*	ADES*	OBT*	IBT*	Type*	CNX*	AC Reg*	ELOBT	ELBT	ADEP Terminal
1 ARG707	QFA	YXGL	YBVY	13/1228	13/1433	CL80	N	KRH			
2 DHL57	DHL	YOSB	YXEG	13/0055	13/0545	B712	N	QTWB			
3 TST866	TST	YXFR	EGLK	13/1148	13/1409	DHC7	N	TYGTE			
4 CSN738	QFA	KAEL	SVSC	21/1512	21/2348	C130	N	S			
5 CFH176	CFH	YRLL	KTVR	13/0042	13/1127	BE76	N	Q			
6 QLK390	QFA	YBEV	YKJU	28/1956	27/0537	C337	N	CLFU			
7 AZW321	AZW	KBYH	SNC			BE99	N	AJWW			
8 EFA300	QFA	KTCM	LTFC	201107132315	201107130443	SH33	N	XJOT			
9 PAC101	QFA	YCUO	KYNG	13/0013	13/0202	B789	N	DFR			
10 CS192	CS	EHRD	SAZL	11/0717	11/1138	PAY3	N	W			
11 AFL541	AFL	YLR5	YSTM	20/1625							
12 SRO647	SRO	YOAD	YGSC	13/0856							
13 HAL674	QFA	KMGT	YMOY	19/0020							
14 JAL852	QFA	SBPN	RJOM	13/0442							
15 AXF788	AXF	YRMA	YIGB	13/1131							
16 MEA989	QFA	FACT	KSMX	13/0526							
17 VR165	VOZ	SKMR	YIER	13/0326							
18 AWK484	AWK	YKAI	KPLN	30/0355							
19 CDN655	QFA	YIGM	SCNM	201107							
20 EFA901	QFA	GMTT	OJAM	13/1027							
21 ACA817	QFA	KBAM	YBMA	201107							
22 ANE714	ANE	YAU5	YGMD	22/1052							
23 PAO22	QFA	YLCS	OPTA	13/0817							
24 CDN360	QFA	KAGC	LSGK	19/0753							
25 UAE875	QFA	LFBL	MMA	12/0156							
26 CFS850	QFA	CYZX	HI SH	13/0108							

Slot	Slot Hold	ACID	Major	AC_REG	ADEP	IOBT	ELOBT	COBT	ETD	AD
27/1900										
27/1902		YAU2	VOZ		KLAX	27/0410		27/0410	27/0417	
27/1905		QFA588	QFA	VHEBM	YPPH	27/1500		27/1510	27/1514	
27/1907		BAW3	QFA	GBNLX	VTBS	27/1005		27/1005	27/1012	
27/1910										
27/1912										

Airbus ProSky ATFM Customers



Harmony in North America

FAA's challenge

- World's largest ANSP responsible for more than 30 million sq. miles of U.S. airspace and approximately 80,000 flights/day
- In 1990, huge traffic increase brought unprecedented delays
- Limited common situational awareness and no access to delay information

The Solution

- For more than 15 years, the FAA partners with Metron Aviation on systematic approach to ATFM/CDM strategies & deployment

Benefits

- Since commissioning the Collaborative ATFM system in 1998, stakeholders have saved more than:
 - 70 million minutes of delays
 - 191 million liters of fuel
 - 590 thousand metric tons of CO2 emissions
 - Over US\$7.0 Billion in operating costs



Stakeholders



Harmony in South Africa

Air Traffic Navigation Services' (ATNS) challenge

- Johannesburg airport (JNB) experienced a daily average of 350 total minutes of airborne holding
- Need to address projected demand growth during the FIFA 2010 World Cup

The Solution

- Harmony allowed ATNS to efficiently manage South African airspace during the FIFA 2010 World Cup
- Training and operations support with ATFM Subject Matters Experts on site

Benefits

Airborne holding has been eliminated at JNB airport

- +US\$1.2M in savings per annum for every one minute of saving at runway hold cost jet A1 "Jet Fuel Burn"
- +US\$0.7M reduction in airborne hold due to weather disruption
- +US\$0.4M in additional fuel burn savings
- = **US\$2.3M in total savings per annum**



Stakeholders



Harmony in Australia

Airservices Australia's (ASA) challenge

- 3 million flights and traffic increasing by 3% annually
- Already experiencing demand and capacity imbalances
 - Increased airborne holding

The Solution

- Harmony (operational in Australia since March 2012)
 - Sydney, Perth, Brisbane, and Melbourne
- Training with ATFM Subject Matters Experts on site

Benefits

- **Airborne holding reduced by 33%** in peak hours representing:
 - **Average flight time reduced by 5 min** in MEL-SYD city pair,
 - **US\$39M of annual fuel savings** (based on first two months of operations for only Sydney)
 - Equivalent to over **40,000 tonnes of CO2 reduced** per year
 - Enhanced safety



Stakeholders



ATM Technologies Cooperation in China

Memorandum of Understanding signed between Airbus and China's Air Traffic Management Bureau (ATMB)

- Cooperate on modernizing the country's Air Traffic Management System and to implement the latest Air Traffic Management (ATM) technologies.

Within the MoU framework, four projects started as part of Phase 1 in 2013:

- Air Traffic Flow Management (ATFM)
- Airport Collaborative Decision Making (A-CDM),
- Chengdu Airport capacity assessment and RNP AR to ILS implementation
- Instrument Landing Systems at Beijing Capital Airport performance improvement

Phase 2 MoU signed 26 March 2014 continuing previous 4 projects and adding 2 additional projects:

- Continuous Descent Operations (CDO) and Continuous Climb Operations (CCO) operation at Shenyang airport
- Support for establishment of Technical Center for ATMB

Completed ATFM/ACDM Human in the Loop Exercise in Shanghai 26-28 March 2014 Demonstrating:

- Harmony ATFM system integrated with East China Regional System
- Significant savings in Beijing using Harmony GDPs vs current KMIT restrictions

Participating Stakeholders:

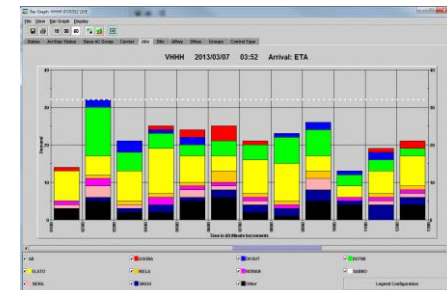
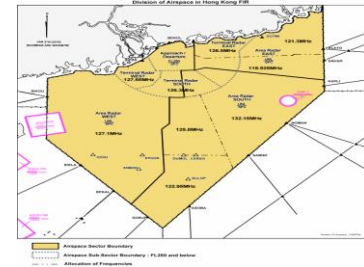


海南航空
Hainan Airlines



Hong Kong ATFM Trial

- Hong Kong FIR Challenges
 - HKIA accepts traffic from up to 9 different arrival fixes
 - Manual procedures currently used to smooth arrival fix demand with HKIA capacity
 - Airborne flow restrictions passed to neighboring FIRs creates potential for inefficiency and inequity
- Hong Kong CAD ATFM Trial Project
 - Awarded to Airbus ProSky on August 22, 2013
 - 6 month ATFM Trial using Harmony for ANSPs
 - Improved arrival fix and HKIA demand/capacity prediction
 - Automated tools for modeling and implementing ATFM measures
 - Outcomes:
 - Efficiency of HKIA maintained and improved
 - Improved efficiency & equity in airborne flow restrictions
 - Increased situational awareness



ATM Emissions Reduction Project

- Asia-Pacific Economic Cooperation (APEC) contract awarded to Metron Aviation on June 19, 2013
- Project Scope
 - Analyze flow between Bangkok and Kuala Lumpur to identify applications of ATFM/CDM technologies to reduce emissions
 - Estimate benefits of optimizing traffic flow and managing flow rates through common choke points (e.g., airports, airspaces)
 - Recommendations aligned with ICAO principles for ATFM
- Project Activities
 - Identify stakeholder team (ANSP, airlines, airport authorities) from host economy (Thailand), Malaysia, FAA and observers from Indonesia
 - Site visits to ATC facilities, airline operations centers, and airports
 - Report of findings delivered and accepted in December, 2013



APAC ATFM Strategy Study for IATA



- IATA contract awarded to Airbus ProSky on 11 April 2014 supported by ICAO Asia Pacific ATFM Steering Group and the participating States

- Project Scope

- Survey ATFM capabilities and interoperability among APAC States
- Develop ATFM implementation strategy for APAC
- Communicate recommendations to ICAO and APAC states

- Project Activities

- Based on survey inputs, collate and evaluate current ATFM initiatives among APAC States and international organizations to form coherent picture and timeline of ATFM capabilities and initiatives with focus on multi-FIR programs
- Perform analysis and make recommendations on the establishment of sub-regional ATFM via an implementation strategy
- Present survey findings and implementation strategy for consideration by ICAO APAC ATFM Steering Group in September 2014

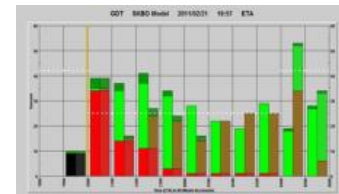


Colombia ATFM/CDM System

- Aeronautica Civil Challenges
 - Volume of air traffic at El Dorado International Airport (SKBO) in Bogotá, Colombia has increased substantially particularly due to the considerable growth in domestic traffic.
 - El Dorado serves as a hub for domestic and international traffic
 - Current slot assignment performed manually with participation of the major airlines
 - Lack of visibility with the demand for remote regions, such as El Yopal
- Colombia ATFM/CDM System
 - Awarded to Airbus ProSky on December 31, 2013
 - ATFM Deployment and 5 year Support using Harmony for ANSPs
 - Improved demand/capacity prediction for airports and airspaces
 - Automated tools for modeling and implementing ATFM measures
 - CDM capabilities for Aeronautica Civil, aircraft operators, and airports
 - Anticipated outcomes:
 - Efficient use of resource capacity
 - Fuel and emission reductions
 - Improved visibility of demand for remote regions



AERONÁUTICA CIVIL
Unidad Administrativa Especial



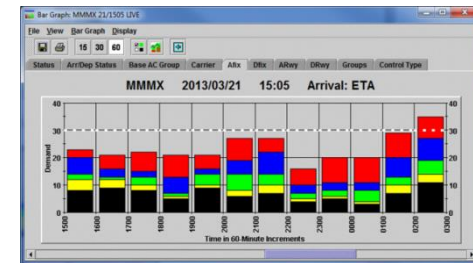
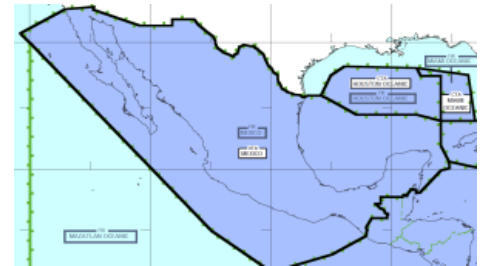
Mexico ATFM Trial

- Mexico ATFM Challenges

- Mexico air traffic experienced more than 9% percent growth in 2013
- Traffic expected to double by 2025
- Demand and Capacity imbalances at Benito Juárez International Airport, Mexico City (MMMM)

- Mexico ATFM Trial Project

- Awarded to Airbus ProSky on March 4, 2014
- Currently completing installation and training
- 6 month ATFM Trial using Harmony for ANSPs
 - Improved demand/capacity prediction for MMMX
 - Automated tools for modeling and implementing ATFM measures
 - CDM capabilities for SENEAM, aircraft operators, and airports
- Anticipated outcomes:
 - Improved situational awareness and Collaborative Decision Making
 - Improved efficiency and equity in determining airborne flow restrictions
 - Opportunity for operational use of Ground Delay Programs for demand capacity balancing



Harmony for Airlines – FedEx

- Commissioned in 2004 at FedEx's Global Hub in Memphis
 - Delivers 3.3 million time-sensitive packages and cargo to more than 375 destinations in 220 countries each day
 - Over 300 FedEx flight operations between 10:30pm and 4:00am (5 ½ Hours); 500 FedEx flight operations each day
- With Harmony for Airlines, FedEx:
 - Views real-time and predictive airport surface activity minutes or hours in advance
 - Proactively optimizes all aspects of surface operations
 - Adjusts operational scenarios as predicted demand dictates
 - e.g., request airport configuration changes like runway switches or openings
 - Delays push-back time when queues are long
 - Accelerates push-back time when queues are short
- Quantifiable Benefits include:
 - Reduction in average taxi time of 2.8 minutes per flight
 - Increase in departure capacity of 7.8% per year
 - Reduction in excessive taxi time (> 40 minutes) by 50%
 - Savings of over US\$10.0 Million per year



South Africa Airside Capacity Enhancement Study

- USTDA contract awarded to Metron Aviation in August 2012
- Project Scope
 - Evaluate the feasibility of utilizing capacity enhancements for airspace and airside
 - Prioritize capacity enhancements
 - Identify efficiency gains for identified improvement
 - Identify trigger points for initiating capacity enhancement initiatives
 - Develop a joint ATNS-ACSA roadmap
- Project Activities
 - Conducted site visits to ATC facilities at O R Tambo, King Shaka, and Cape Town International Airports in order to interview relevant stakeholders and assess capacity shortfalls
 - Validated baseline capacities and identified capacity enhancing capabilities
 - Assessed the financial, economic, regulatory, institutional, legal, procurement, development, and environmental impacts
 - Provided recommendations and specifications for selected enhancements
 - Developed a capacity enhancement implementation plan and roadmap
 - Recommended USA companies to undertake capacity enhancement initiatives



South Africa: ORTIA & KSIA Master Plan Updates

- ACSA contract awarded to Delta BEC in May 2014.
 - Metron Aviation is member of the team
- Project Scope
 - Produce environmentally sensitive, socially and economically balanced, cost efficient and technically feasible Master Plans for ORTIA and KSIA
- Project Activities (Preliminary)
 - Conduct stakeholder engagement sessions through the development of a Master Plan Forum
 - Review issues identified in SA Airside Capacity Enhancement Study and any others
 - Assess future demand, land use, and capacity
 - Conduct analysis of options and report on the preferred options
- Other
 - Demonstrated success on the USTDA-funded SA Airside Capacity Enhancement Study motivated the development of the RFB and the selection of the DeltaBEC team
 - ACSA and ATNS continue to consider capacity enhancements as recommended in the Capacity Enhancement report



Regional ATFM/CDM Proof of Concept

- Research project with Civil Aviation Authority of Singapore
 - Current ATFM concepts not applicable for Singapore's 100% international arrival traffic
 - Project initiated March, 2013 to develop operational concept for regional ATFM/CDM
- Research Objectives
 - Establish ATFM Technology Testbed based on Harmony for ANSPs
 - Engage local and regional stakeholders to develop viable ATFM/CDM concept for Singapore and Asia Pacific region
 - Perform fast-time simulations to quantify benefits of the regional ATFM concept
 - Conduct Human in the Loop exercises and Concept Demonstrations to validate the concept with regional stakeholders
 - HITLs conducted successfully in November and final report including the validated Concept of Operations delivered in January, 2014



Thank You

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