Presented by

Stuart Ratcliffe

ATFM and A-CDM How they Fit Together

A-CDM Seminar Bahrain

11-13 October 2015

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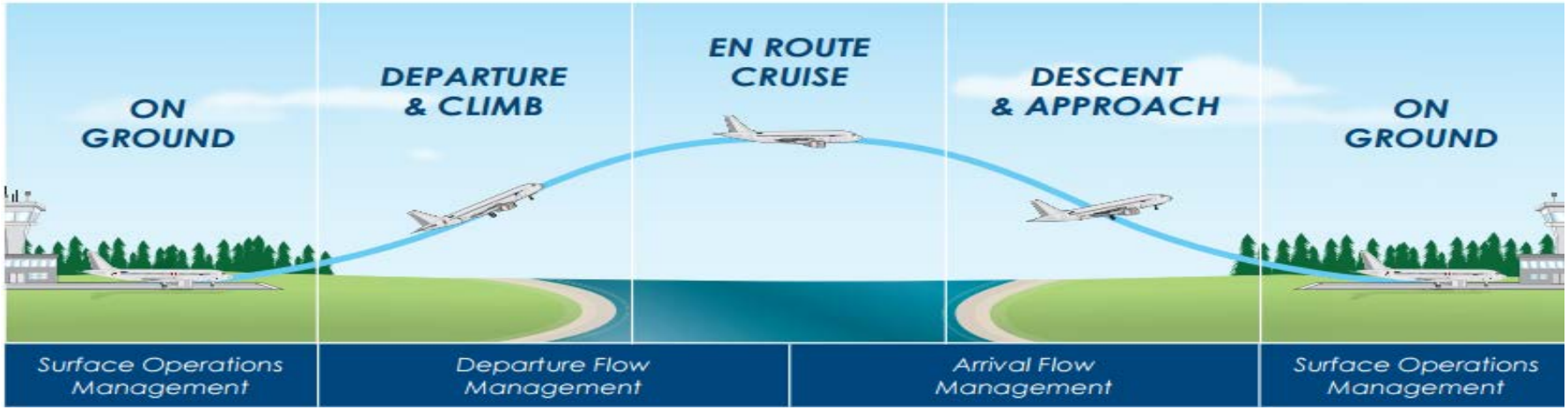
Phases of Flight being Managed

- Managing Passengers luggage from Kerb to Kerb
- Managing flights from Gate to Gate



- This is done by 3 main processes
  - A-CDM
  - ATM
    - ATC
    - ATFM

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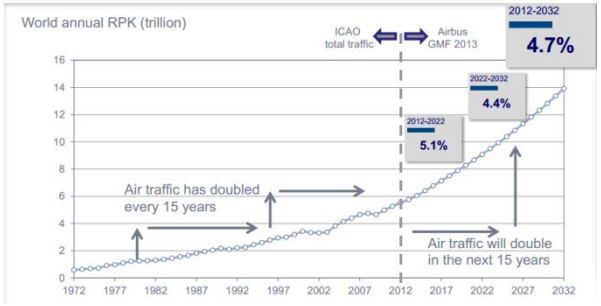
Challenges Facing The Aviation Industry

Demand Growth

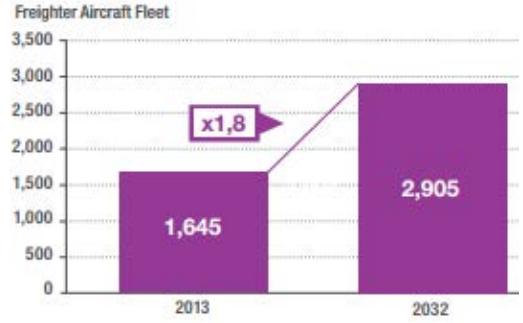
- Air traffic demand growth is the central challenge facing the industry

Passenger Air Traffic to Double by 2027



Source: Airbus GMF 2013

Freighter Fleet to Nearly Double by 2032

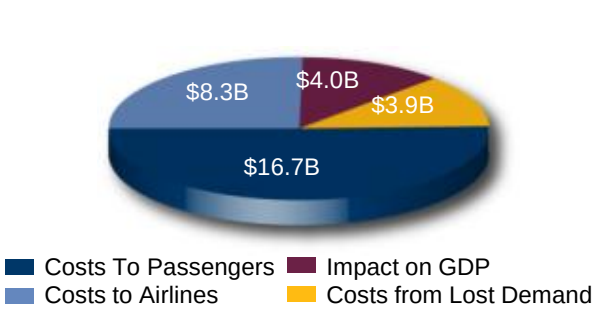


Source: Airbus GMF 2013

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

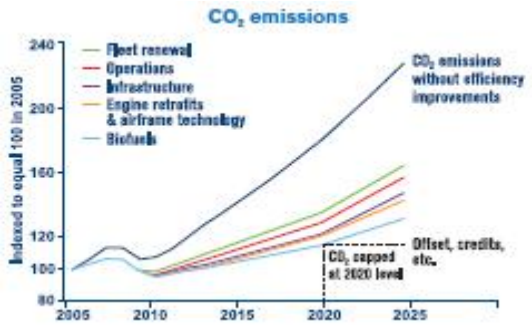
Delay costs per minute (€)	Tactical without network effect		Tactical with network effect		Strategic	
	Ground	Airborne	Ground	Airborne	Ground	Airborne
Fuel costs	1	15	1	15	1	15
Maintenance costs	1	1	1	1	-	12
Crew costs	9	9	11	11	12	12
Ground and passenger handling	-	-	-	-	-	-
Airport charges	0	-0	0	0	-	-
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 WesATFM Measurenster Cost of Delay Study

Environmental Cost of Delay

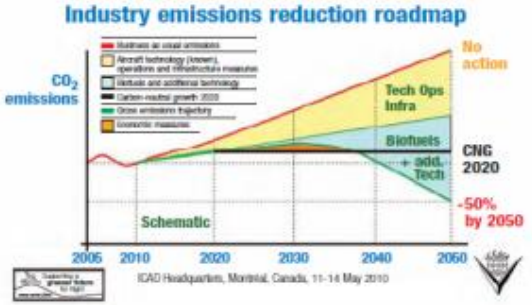
- Carbon footprint of aviation growing with demand while environmental pressures increase

Carbon Reductions Require Efficiencies



Source: IATA Pathway to Carbon Neutral Aviation 2010

Emissions Reduced 50% by 2050



Source: ICAO Environmental Report 2010

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What is the Current Situation?

Systemic delays are resulting in:

- Higher aircraft operator costs through increased fuel burn
  - Airborne holding
  - Taxi in/out delays
- Environmental impacts of increased emissions
- Passenger impacts
  - Travel delays
  - Missed connections



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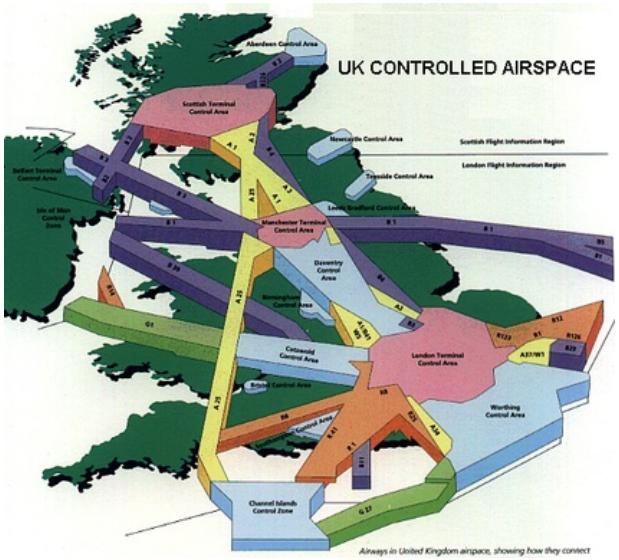
How is the Problem Addressed?

Continually Grow Airspace and Airport Capacity

- Grow/build new airports
- Increase sectors
- Optimize existing operations
- New Technologies

- Not always easy:
  - Major infrastructure development takes time and can be expensive
  - Increasing airspace capacity can be reached until certain limit:
    - ❖ Airspace restrictions don't always allow capacity growth (e.g., military, geographical and political boundaries)



Airways in United Kingdom airspace, showing how they connect

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ATFM

- ***Air Traffic Flow Management (ATFM)*** is an Air traffic Management service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that an Air Traffic Control (ATC) service is provided in an environment where system capacity (airports and airspace) is optimized and the demand is balanced against that system capacity.

- ***Collaborative decision-making (CDM)*** is defined as a process focused on how to decide on a course of action articulated between two or more community members. Through this process, ATM community members share information related to that decision and agree on and apply the decision-making approach and principles. The overall objective of the process is to improve the performance of the ATM system as a whole while balancing the needs of individual ATM community members.” - ICAO

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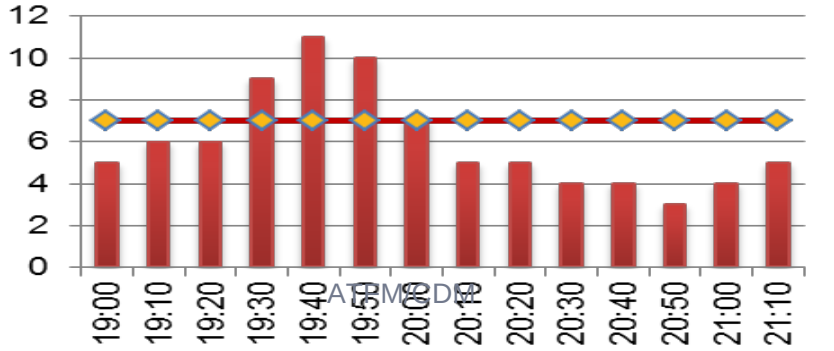
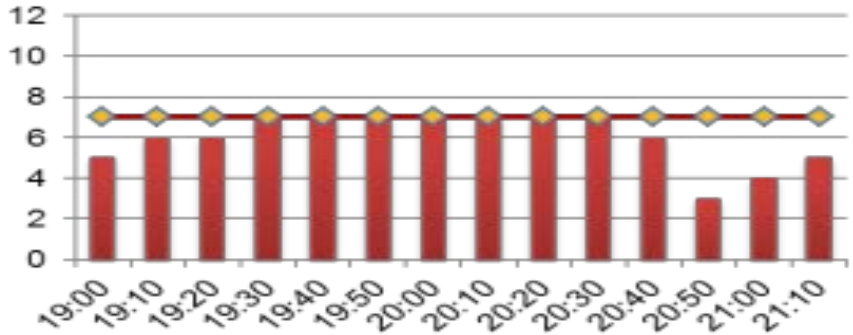
How to Balance Demand/Capacity

Implement Air Traffic Flow Management with Collaborative Decision Making (ATFM/CDM)





Strategic Slot Allocation

Level Capping
Re-Routing

Ground Delay Programs
Airspace Flow Programs
Ground Stop Programs

MINIT
MINT

Speed Control
Vectoring
Airborne Holding

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Key Definitions

- **Airport Slot** - Is mandatory at coordinated airports for each movement (arrival and departure) and is valid for a specific time at a specific weekday and for a specific period applied for. The airport slot is used to plan the airspace, runway and terminal building capacity and/or other capacity constraints for a whole season to minimize airport congestion and potential delays. Worldwide Slot Guidelines

- **Air Traffic Control** (ATC) **slot** - is needed by each regulated/controlled departing or arriving flight on the actual day of operation to manage traffic flows through congested resources (airport/airspace). This slot is only valid for a specific flight and for a specific departure time window.

- An **ATC slot** always has precedence over an **Airport Slot.**

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Strategic Slot allocation

- Airport coordination is a means of managing airport capacity through the application of a set of rules contained in these Worldwide Slot Guidelines (WSG).
- Ensures maximized efficiency at airports
- Airport Levels
  - Level 1 Airport - Capacity is adequate to meet demand
  - Level 2 Airport - Capacity is generally adequate but are times when it is constrained
  - Level 3 Airport - Demand significantly exceeds capacity
- Capacity should be declared every 6 months
- Airport slots are allocated to aircraft operators according to the capacity

This is one of the first steps in Demand and Capacity balancing

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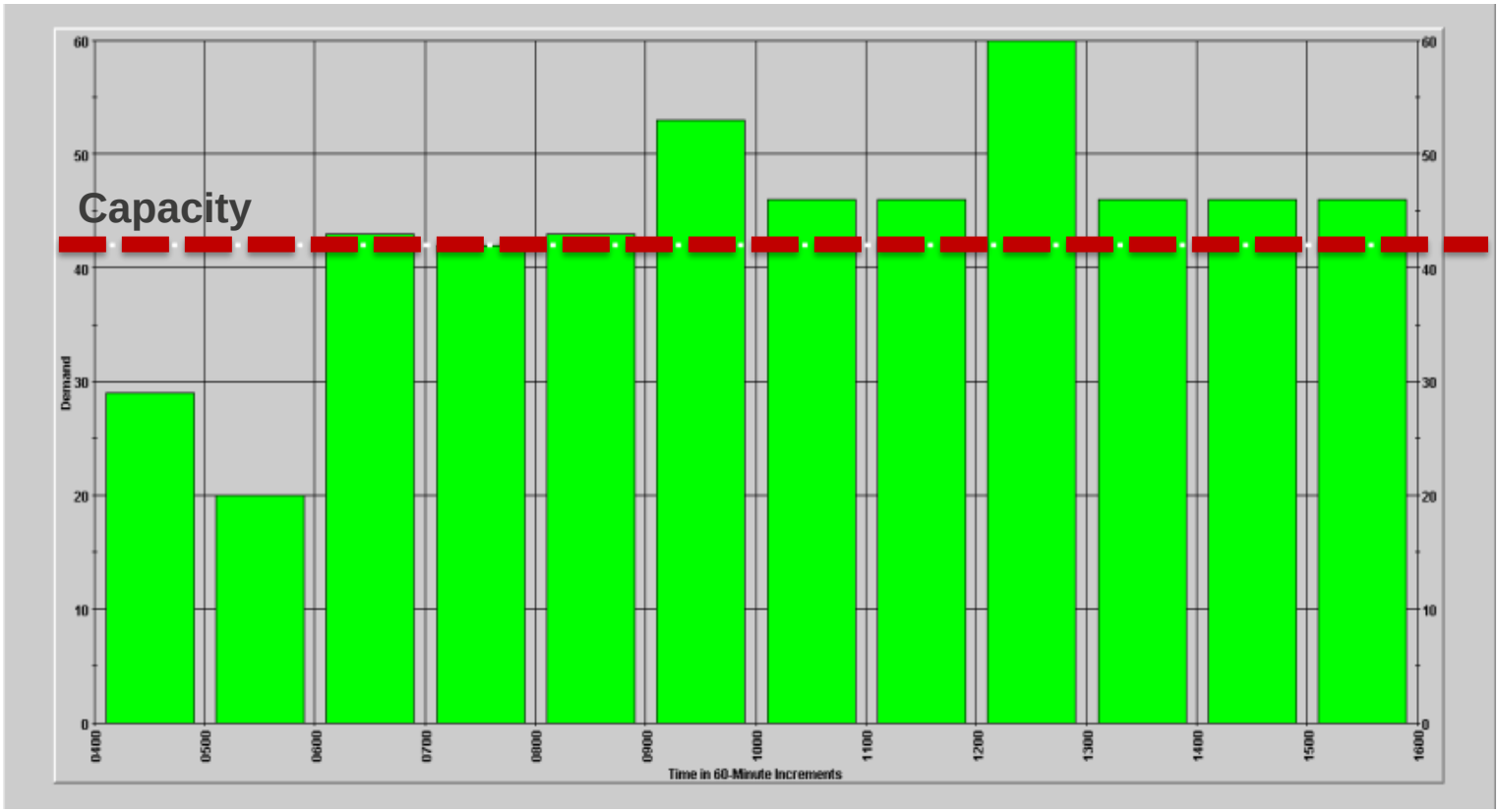
Air Traffic Control Slots



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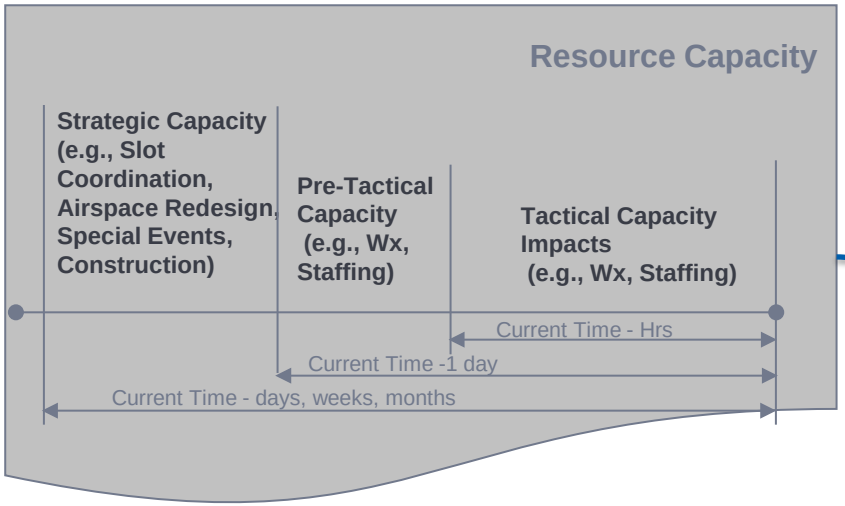
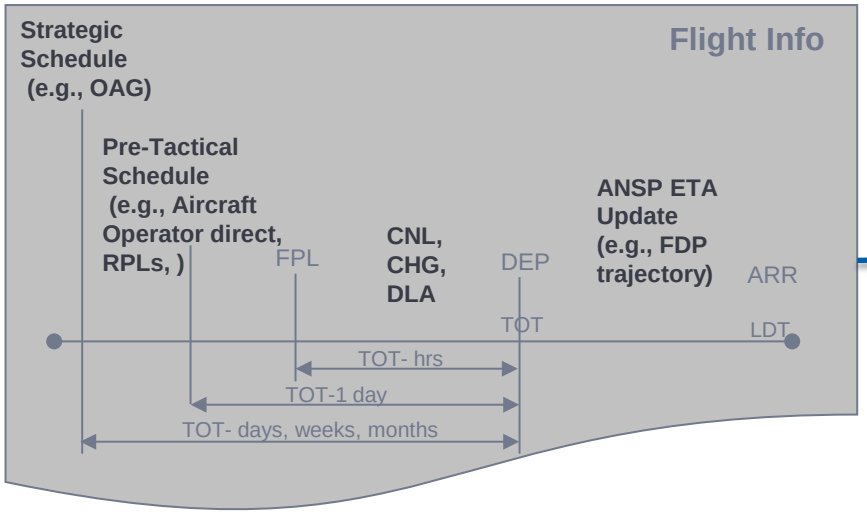
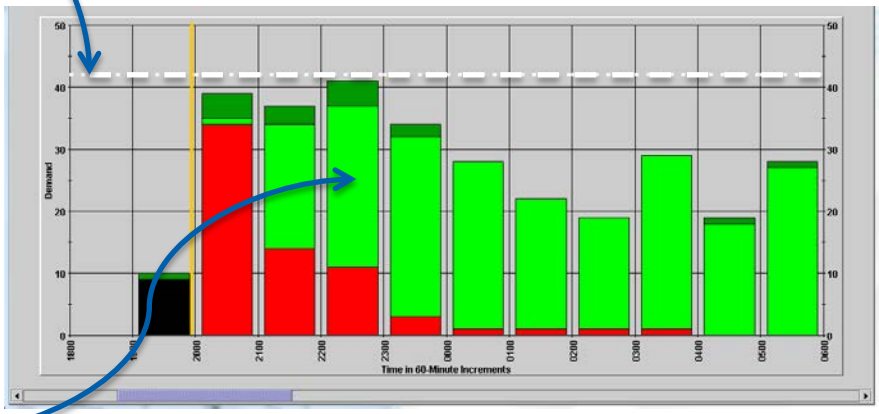
Specify Capacity / Predict Demand

Specify Capacity



Predict Demand





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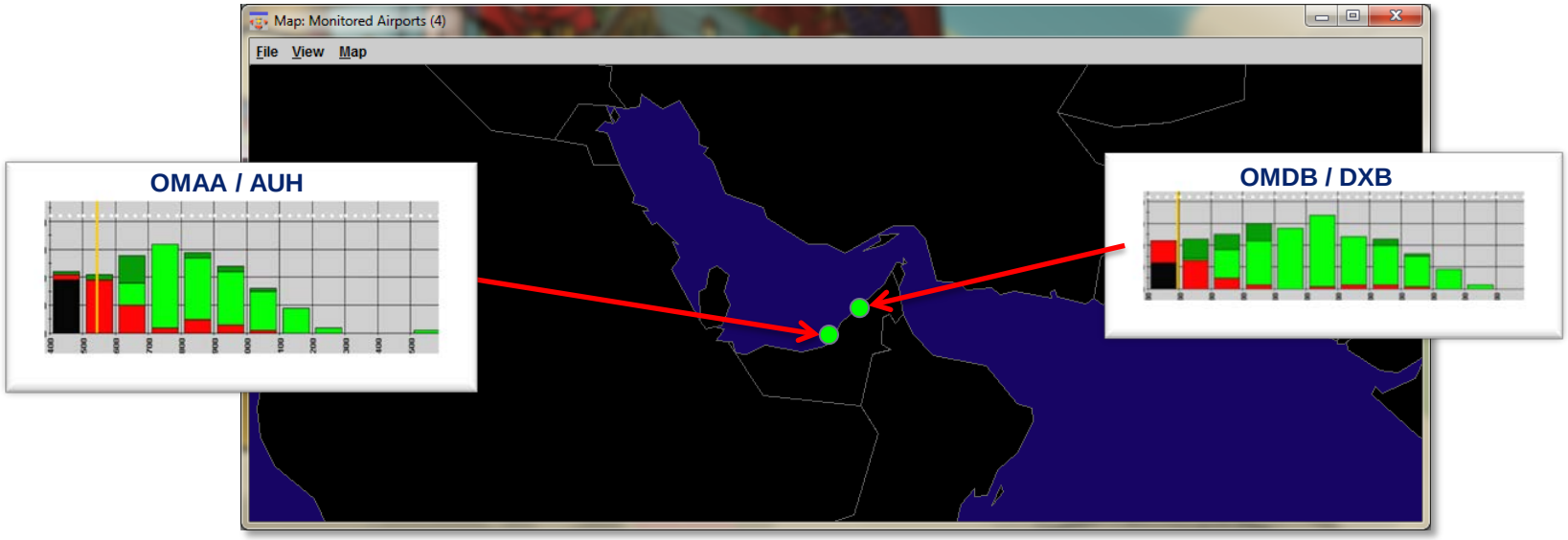
Monitoring Resource Capacity and Demand



Stakeholder Roles

- Consistently monitor demand and assess how the changing conditions might affect capacity
- Demand graphs allow air traffic managers to identify future capacity/demand imbalances and determine if an ATFM Measure is required

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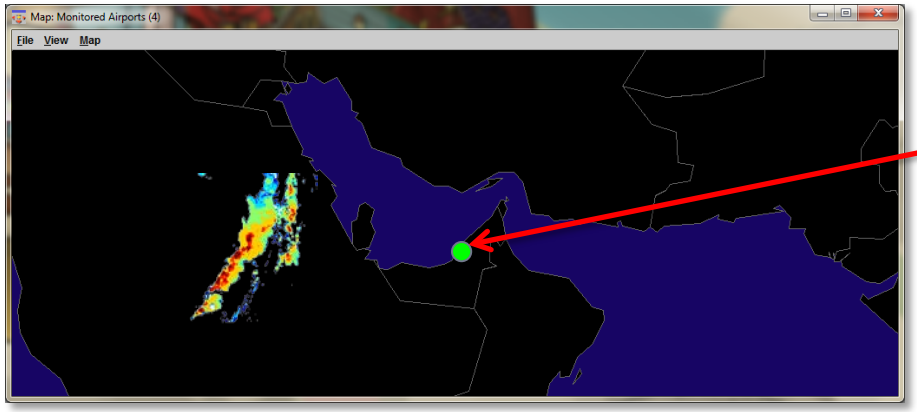
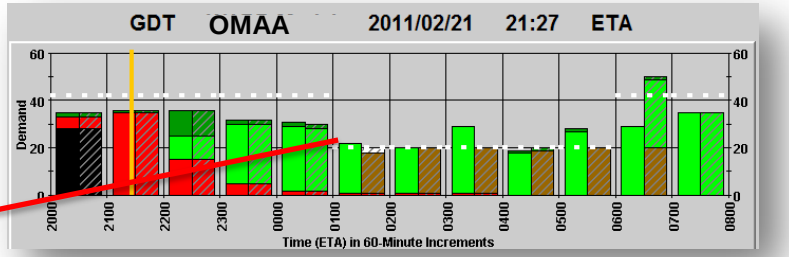
Evaluating and Initiating ATFM Measures

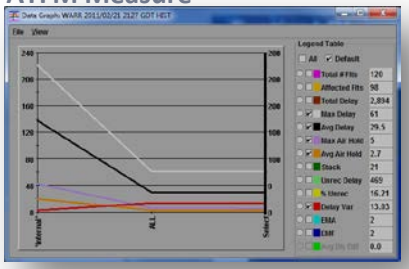
Various capacity-reducing events can require an ATFM measure that will balance the demand with available capacity. Stakeholders can be involved in deciding the appropriate ATFM Measure with the least operational impact.

Assessing the conditions with enough anticipation





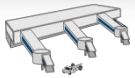
Evaluating the Impact of the ATFM Measure



Stakeholder Roles

- Assess changing conditions and determine any capacity adjustments
- Evaluate alternative ATFM Measures that efficiently balance demand with capacity

- Work with ANSP to understand the changing conditions
- Evaluate alternatives along with ANSP and advise minimal impact ATFM Measures



- Work with ANSP to determine extent of capacity impact

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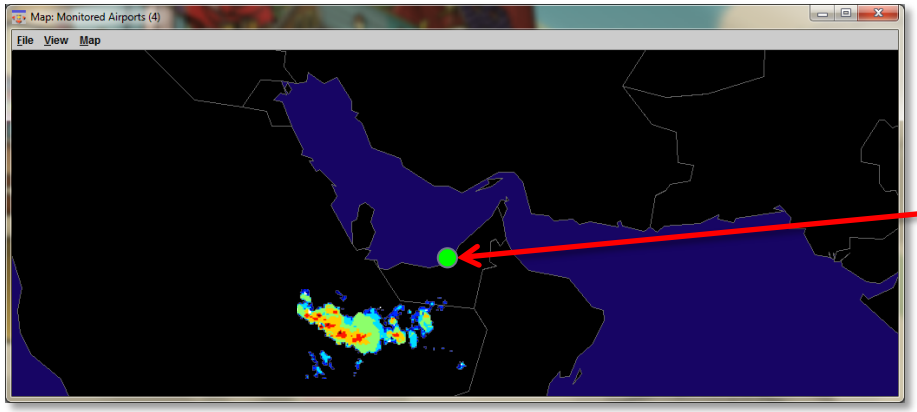
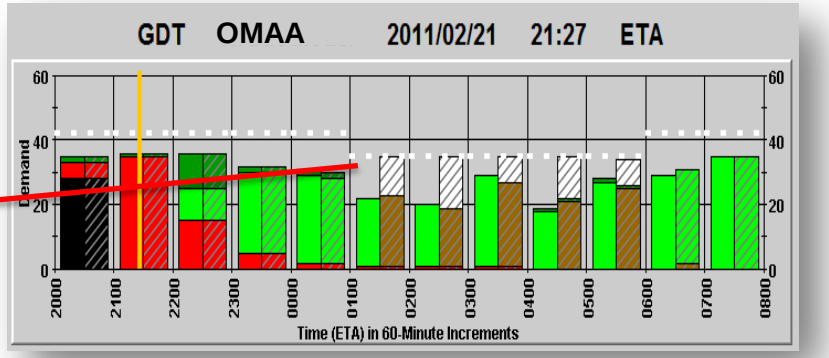
Modifying ATFM Measures

ATFM Measures can be modified as conditions change

- Full capability to revise an ATFM Measure if the operational conditions change
- Automated and manual compressions take advantage of unused capacity



If the weather impact does not materialize, the program is revised to reflect available capacity



Stakeholder Roles

- **ANSP makes any program revisions necessary in order to accommodate changing conditions.**
- **ANSP can fill the unused capacity by issuing a program compression**

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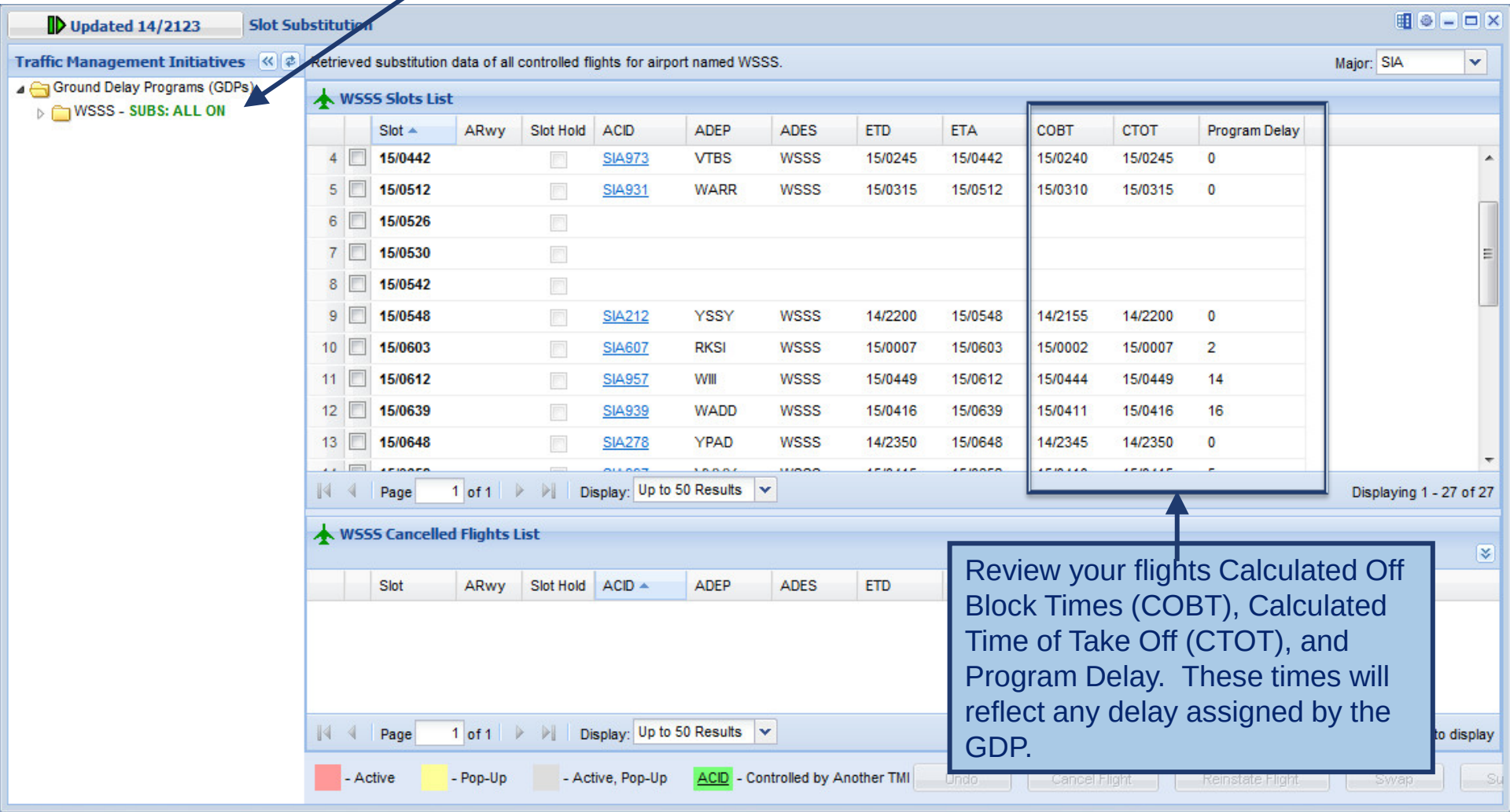
Viewing delay and Calculated Times

Selecting a GDP displays its slot list and cancelled flights in the right panes



Review your flights Calculated Off Block Times (COBT), Calculated Time of Take Off (CTOT), and Program Delay. These times will reflect any delay assigned by the GDP.

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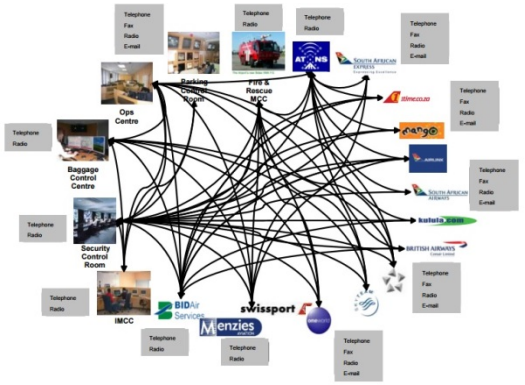
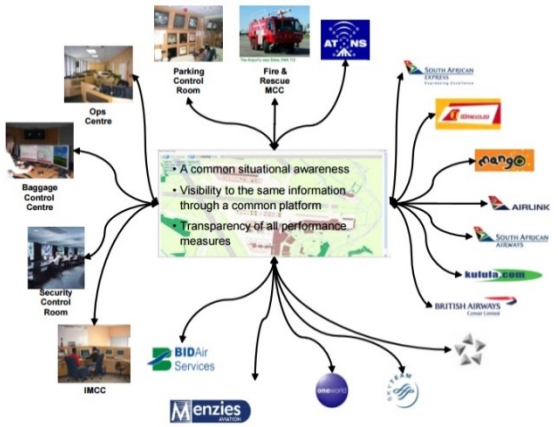
ATFM Benefits - Qualitative

- Enhanced Safety
- Improved CDM
- De-Peaking of airspace or airports
- Increased Situational Awareness
- Reduction in Carbon emissions
- Reduced ATC staffing levels
- Reduced pilot flight and duty times
- Reduced aircraft maintenance
- Increased capacity
- Better on time performance
- Better usage of resources





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ATFM Benefits Quantitative

- **USA**
- 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

South Africa

- 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

Cross Border Multi-Nodal ATFM Potential Benefits - APAC

	2014	2019
Domestic and Regional ATFM	US$660-810M	US$1.1B-$1.4B

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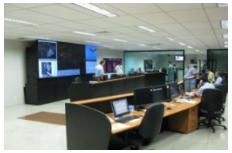
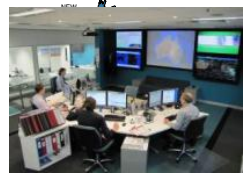
ATFM Implementations





ATFM Level	Characteristics
1	Advanced National/Regional, Integrated-ATFM/CDM Procedures and System Deployed
2	Mature ATFM/CDM Procedures and Initial System Deployed
3	Initial ATFM/CDM Procedures but No System Deployed
4	No ATFM/CDM Procedures or System Deployed

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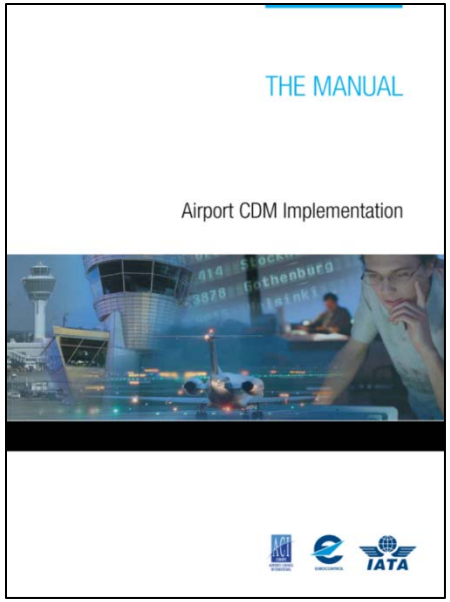
Airport CDM: Concept of Operations

- **Objective:**
  - Improve Air Traffic Management at airports through the collaborative involvement of stakeholders to efficiently utilize available resources
- **Approach:**
  - Increase predictability of take-off times at local airports by:
    - Defining a standardized airside process
      - Control of pushback regulated by airport and aircraft operators, not ATC
    - Supporting ATFM slot compliance
    - Improving the predictability of events
    - Optimizing the utilization of resources
- **Benefits:**
  - Improved departure punctuality
  - Reduced taxi time
  - Improved ATFM slot compliance
  - Situational awareness for stakeholders
  - Decrease in block buffer time



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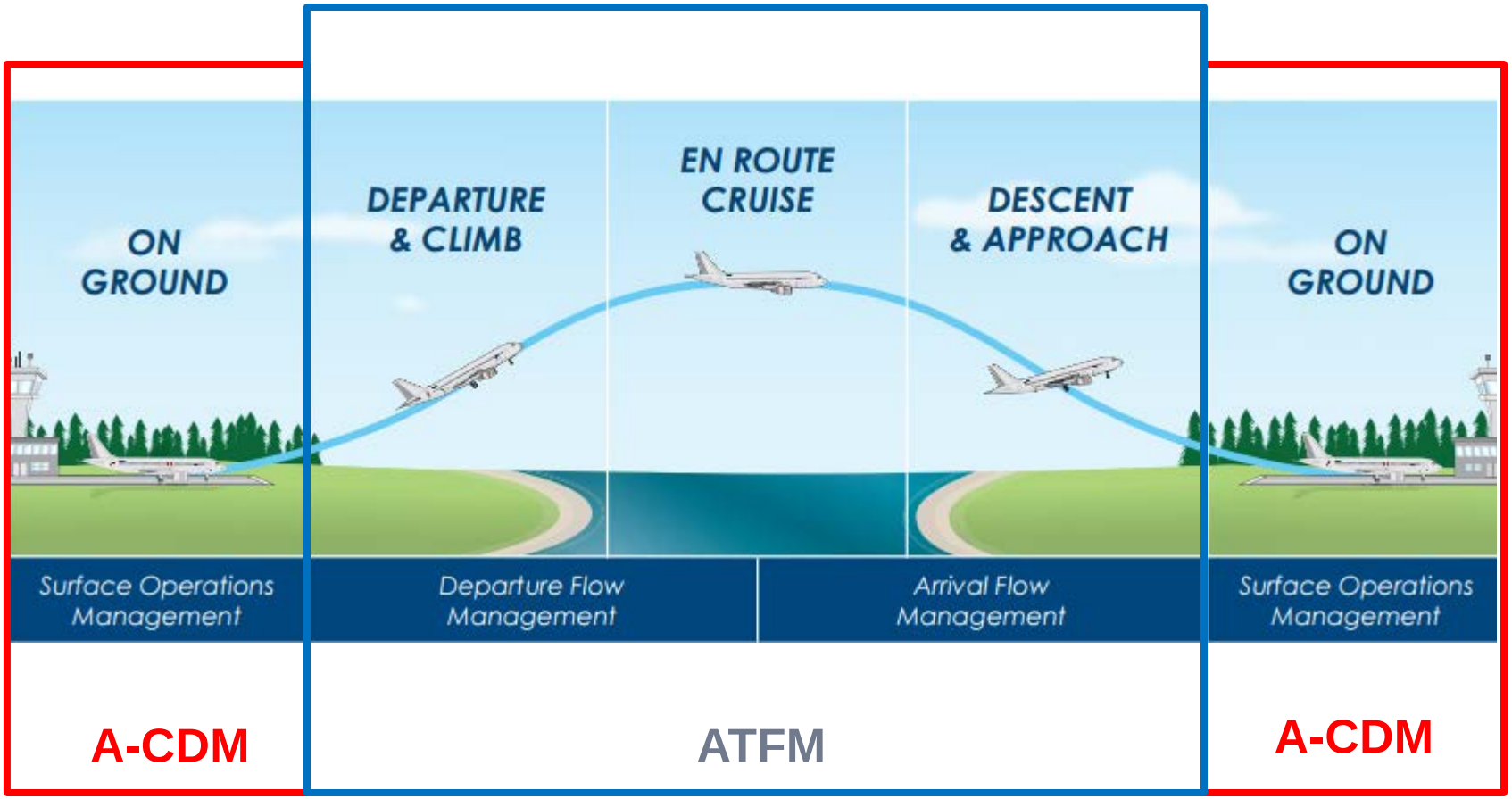
Phases of Flight where A-CDM and ATFM are implemented



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Common Terms for ATFM and A-CDM

Phase of Flight	Scheduled	Flight Plan	Target (Airline)	Target (ANSP)	ATFM Measure	Estimated	Actual
Off-Block Time (OBT)	SOBT	EOBT	TOBT	TSAT	COBT		AOBT
Take-Off Time (TOT)	STOT	PTOT		TTOT	CTOT	ETOT	ATOT
En-Route Elapsed Time (EET)	SEET	EET					
Time Over (TO)					CTO	ETO	
Landing Time (LDT)	SLDT			TLDT	CLDT	ELDT	ALDT
In-Block Time (IBT)	SIBT				CIBT		AIBT

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ATFM and A-CDM

- Both systems must use the same source of data
- All stakeholders must ensure latest information on their operations is known to both systems
- Both systems need to be integrated so as to share information
- Both systems must use the same variable taxi times
- CDM must take place with all stakeholders
- To balance demand against capacity in airspace and at airports ATFM will issue CTOTs
- The COBT becomes the TSAT
- A-CDM contributes to COBT/CTOT compliance which leads to Network optimization
- Information shown to stakeholders must be consistent between both systems

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Are the 2 concepts dependent on each other?

- *ATFM does not require A-CDM to achieve its objectives*
- *A-CDM does not require ATFM to achieve its objectives*
- *Both can be implemented without the other*
- *Ideal if both are implemented*

If ATFM and A-CDM are implemented at an Airport they must be integrated

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Conclusion

- *A-CDM will*
  - *manage traffic on the ground*
  - *manage the turn around process*

- *ATFM will*
  - *balance demand and capacity at airports or airspace*
  - *manage a Network approach to Air Traffic Management*

- *ATFM and CDM together will*
  - *Increase situational awareness*
  - *Include all stakeholders in the CDM process*
  - *Contribute to operational efficiency for all stakeholders*

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Thank You

Presented by
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