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Automation

Aviation System Block Upgrade

Flow Management

Collaborative Decision Making

ATS Interfacility Data Connection

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Agenda

Aviation System Block Upgrade

- Roadmap and implementation cases

Flow Management & Collaborative Decision Making

- Solutions and implementation cases

ATS Inter-facility Data Communications

- Concept and experience

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Agenda

Aviation System Block Upgrade

- Roadmap and implementation cases

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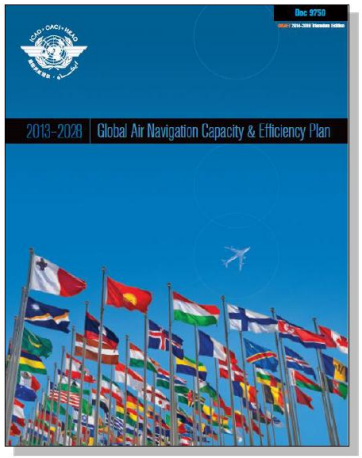
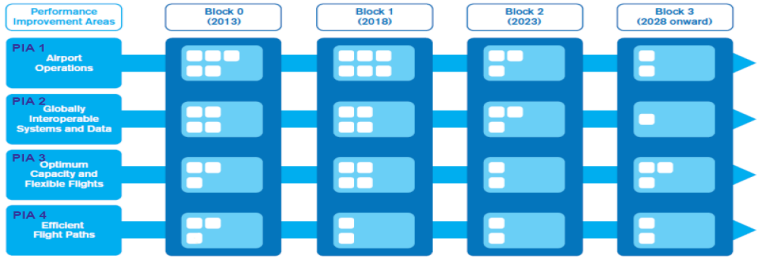
Global Air Navigation Plan

GANP = Global Air Navigation Plan: Doc 9750

- A system engineering planning and implementation approach
- A global framework ensuring safety, harmonization, aviation efficiency and environmental gains at affordable cost
- A vision with short, mid and long term perpectives for key investment planning



Aviation System Block Upgrades



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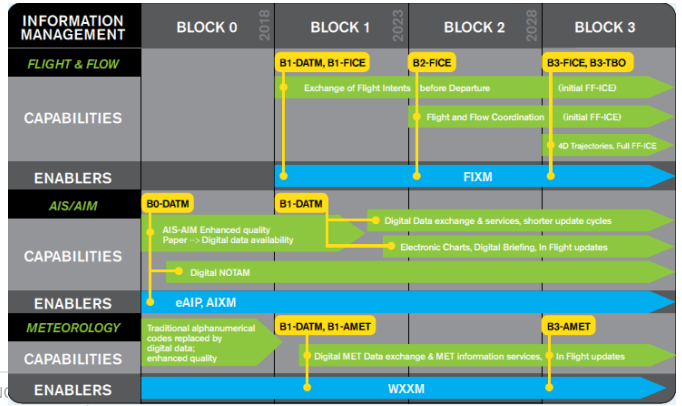
Technology Roadmaps



GANP Doc 9750

Developing the ASBUs

ASBU have been prepared by a group of experts from all aviation stakeholders

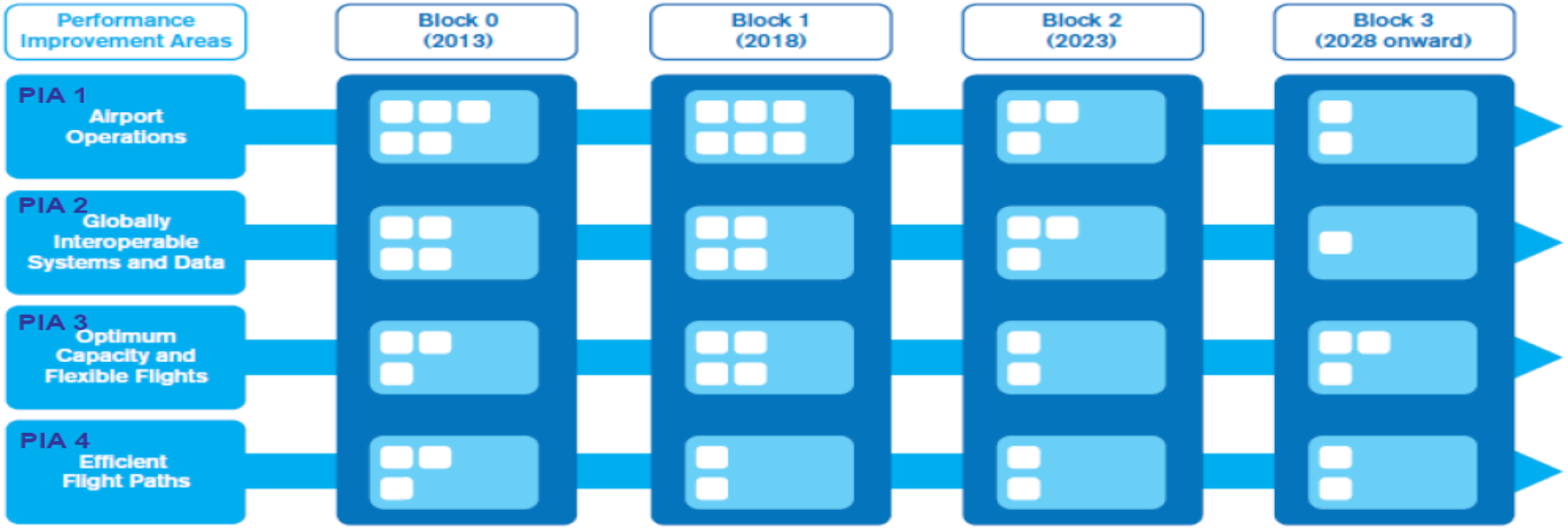
- The key considerations were: global requirements, interoperability, focus on safety and flexible deployment
- The ASBU were consolidated using information from various programs (SESAR, NextGen, Japan, Australia, Brazil …)
- Thales has been the contributing ground system supplier in the ICAO Technical Team

An Aviation System Block Upgrade is made of a series of modules

- Including what is required to achieve performance objectives.
- Described in terms of operational needs, CNS/ATM enablers, procedures

ASBU: An essential foundation to achieve performance improvement

ASBU structure: PIA, Blocks, Threads and Modules



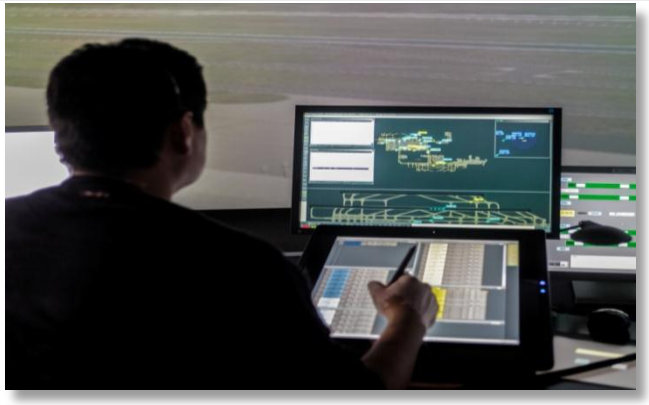
- Dates identified when ICAO material supporting the ASBU are fully available & system upgrades may be put in operations
- Modules only need to be implemented if and when they satisfy an operational need and bring benefit in a given State or an ICAO region

ASBU: the way to full interoperability and global harmonization

Thales solutions supporting Surface Operations Thread: PIA1

B0-SURF: Safety and Efficiency of Surface Operations /A-SMGCS Level 1 & 2

- Comprehensive situational awareness by integrating ADS-B, Multilateration & Radars
- Runway incursion alerts improving safety at Abu Dhabi, Frankfurt, Bangkok



B1-SURF: Enhanced Safety and Efficiency of Surface Operations

- Enhanced surface conflict prediction and detection, routing & guidance providing capacity & efficiency benefits
- SESAR D-TAXI validations at Paris CDG Airport with TopSky - Tower

TopSky-Tower implements full B0 capabilities and already most of B1 Functions

Example of ASBU module implementation: Bangkok Airports

- **Suvarnabhumi was one of the first airport equipped with a Level 2+ system and initial routing/guidance capabilities**
- **It's being renovated to Level 4 capabilities implementing SURF (surface man.) & RSEQ (sequencing) modules from Block 0 and 1**
  - High Accuracy Multi sensor data tracking and fusion algorithms with Safety Nets
  - New ergonomic Controller Working Station
  - Routing and guidance capability
  - Electronic Flight Strip
  - Integrated with Departure/Arrival Manager
  - Enabling A-CDM operations

One of the most advanced systems

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Thales solutions supporting Runway Sequencing Thread: PIA1

B0-RSEQ: Improved Runway Traffic Flow through sequencing (AMAN/DMAN)

- TopSky - ATM Solutions fully integrated with AMAN and DMAN (MAESTRO)
- Deployed at Paris Airports, Cape Town, Sydney, Copenhagen …

B1-RSEQ: Improved Airport Operations through Departure, Surface and Arrival Management

- Departure and surface management integration validated in SESAR
- Measured benefits at CDG with MAESTRO: capacity, taxi and holding times (triple parallel Approaches)

Maestro sequencing tools are essential to optimize the runway use

Thales solutions for Globally Interoperable Systems & Data: PIA2

B0-FICE: Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration

- Full AIDC and OLDI have been deployed worldwide by Thales : LORADS 3, NESACC…
- Automatic and seamless coordination with adjacent sectors and FIRs reduce errors and controllers workload

B1-FICE: Increased Interoperability, Efficiency and Capacity through FF-ICE/1 Application before Departure

- Implement ground-ground trajectory exchanges between ATC Centres
- SESAR Flight Object exercises including development of FIXM standard

TopSky-ATC block 0 capabilities are operational & field proven, Block 1 capabilities being validated in full scale demonstrations

Thales solutions for Efficient Flight Path : PIA4

B0-TBO: Improved Safety and Efficiency through the Initial Application of En-route Datalink

- TopSky - ATC supports ADS-C and CPDLC for FANS-1/A+ and/or ATN baseline 1
- Thales supports the deployment and validation of FAA Data Communications Integrated Services Program (DCIS)

B1-TBO: Improved Traffic Synchronization and Initial Trajectory-Based Operation

- Thales plays an Essential role in SESAR EPP development, simulation and flight tests
- A/G Trajectory exchange allow fuel burn optimization by limiting vectoring and anticipation of traffic situation by ATC

Our implementation of TBO thread brings flight efficiency, increased predictability and improved safety

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Flow Management & Collaborative Decision Making

- Solutions and implementation cases

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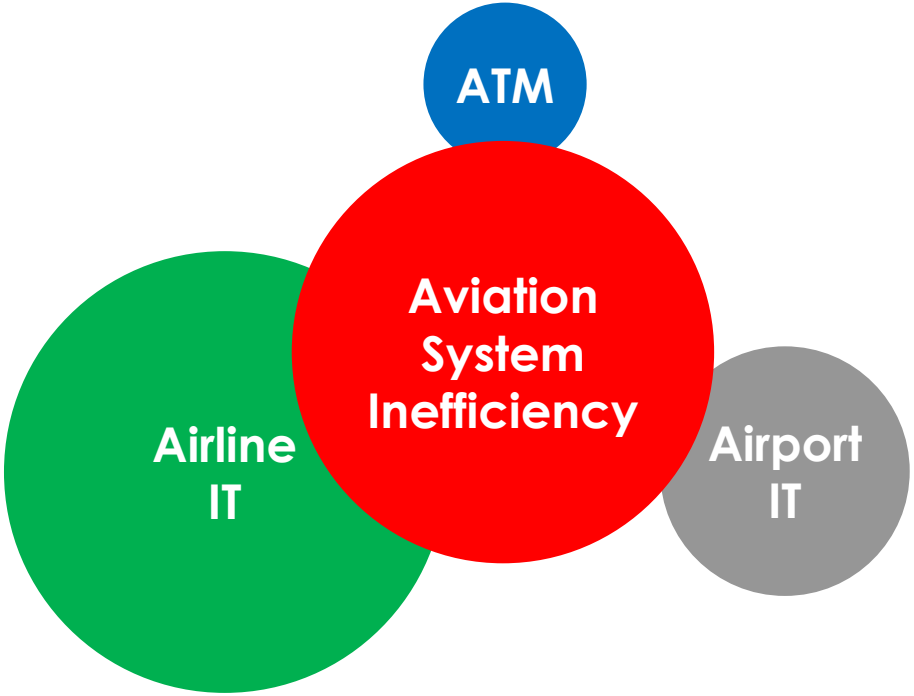
Why do we need Flow Management & CDM ?



- Large investments in IT infrastructure by all stakeholders
- Good optimisation of each stakeholder's own operations
- Very little optimisation across the stakeholder boundaries
- Still > $9B in aviation system inefficiency per annum

Small gains in aviation operations efficiency = large value / benefits

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Many Factors Influence Airspace capacity

Traffic complexity

Vertical movements ?

Amount of ATC intervention required

Opposite direction with vertical movement?

Traffic homogeneity

On vectors ?

Separation standards

Procedural or surveillance based ?

PBN

Weather

Airspace capacity

Airspace design

Sectorization

Procedures

Environmental constraints

Restricted airspace

ATM system capability

CNS/ATM system availability

COM

DPLC voice ?

Relayed?

CPDLC?

PBN ?

Surveillance ?

Human factors

Workload

Sector size

ATCOs per sector

Number / distribution of conflict points

Conflict management

Decision support

Tools

Intra-ATM communication tools

Trajectory display

ATM factors

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Many Factors Influence Airport capacity

Environment

Emission reduction?

Noise abatement

Curfew

Airspace complexity

Airport slots ?

Runway allocation scheme ?

Separation

Arrival interval

Departure interval

Weather

Headwind

IMC ?

Airport capacity

High speed exit

Multiple taxiways

Aerodrome design

Single active runway ?

Mixed mode ?

Multiple active runways

Dependent runways ?

Runway condition

Runways

Average ground speed on final

Runway occupancy time

Fleet mix

Demand

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Flow Management on the globe

A common ICAO regulation and ASBU roadmap

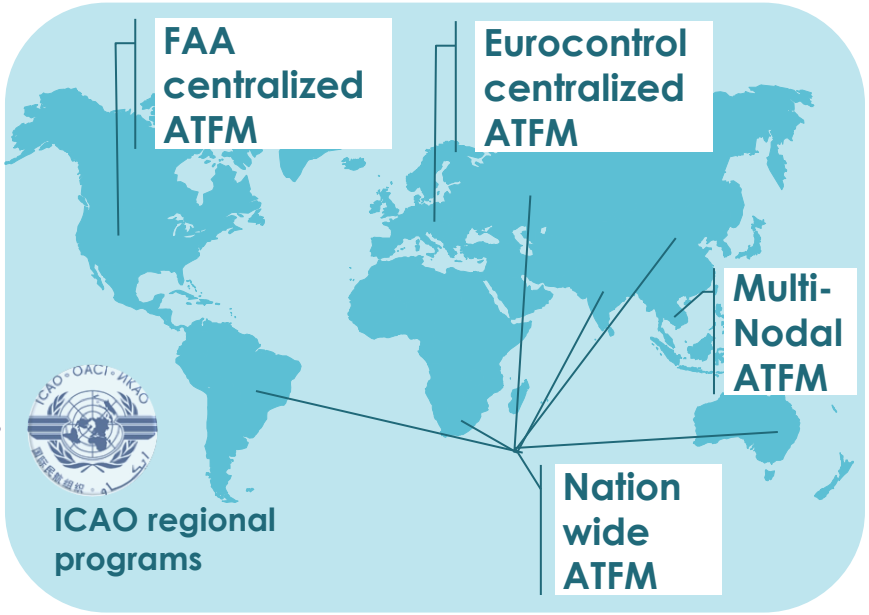
- Doc 9971 *Manual on Collaborative Air Traffic Flow Management* issued in 2012
- To extend collaboration with airlines, airports, military and neighboring ATC centers

… Various implementation in the world…

- To cope with regional constraints
- To be tailored for each situation

… To face big challenges!

- Safety
- Growing demand versus Dynamic capacity
- Flight efficiency versus flexibility
- Safety



Deliver sustainable Efficiency

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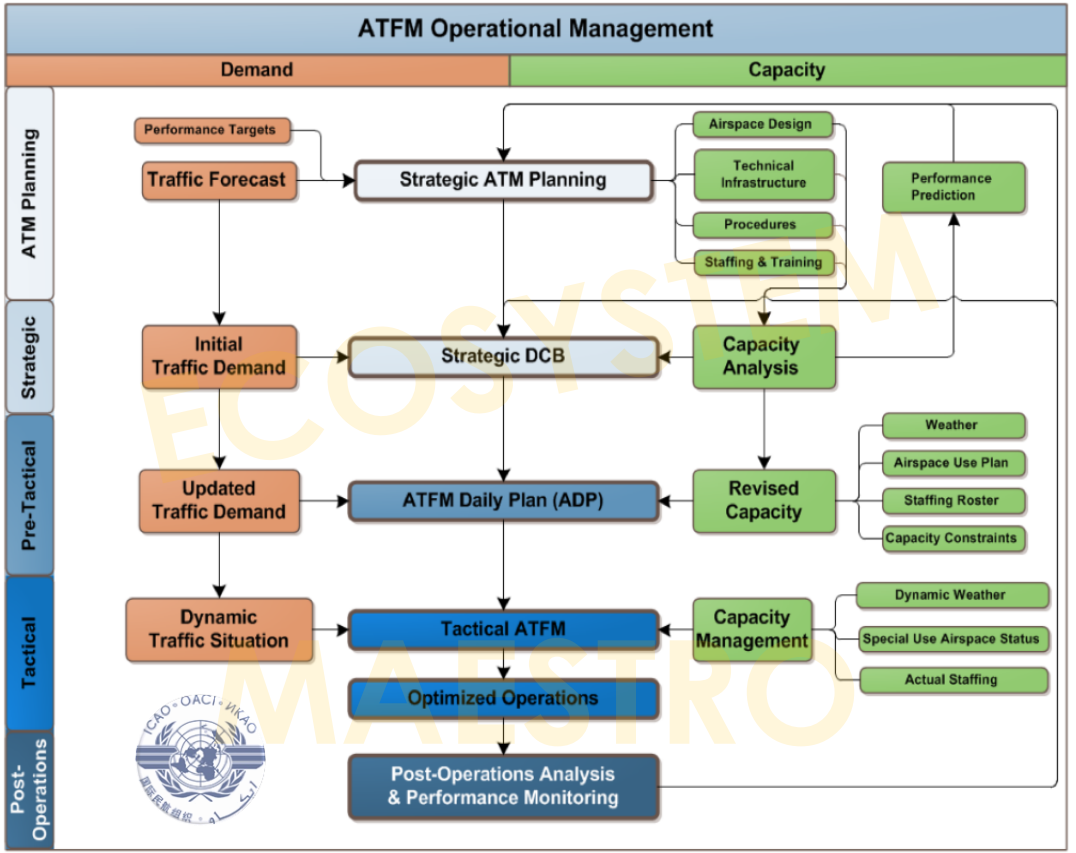
Flow Management Principles

- Assess Traffic Demand
- Assess Capacity
- Detect shortages
- Support coordinated ATM measures
- Measure/Record efficiency



Flow Management challenges

Reliable data

- Accurate Demand and capacity
- Continuous improvement loop
- Situation Awareness

Accurate profile
Benefits to end users
Data exchange

Detect the right problem(s)

Efficient actions on traffic

- Several ATFM measures are possible
- Penalize as few as possible

Efficient initiative
Targeted initiative

Implement the right measure(s)

Fairness

- Transparent with end users
- Long Haul versus Short Haul
- Agreed Performance Indicators

CDM
Airspace Users priorities

Deliver the right service level

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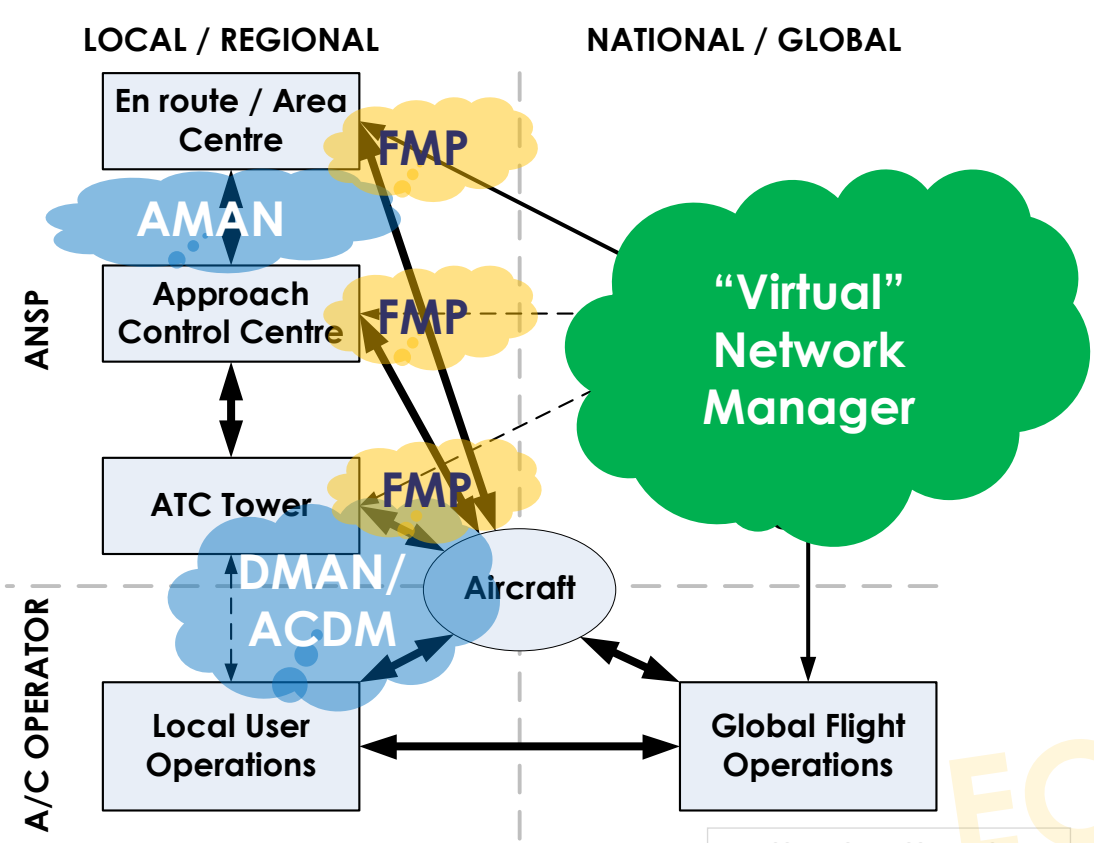
Aviation stakeholder relationships and interactions



- **Multi-Nodal ATFM means Virtual Network Manager**
  - Many-to-Many Relationship
  - No centralize view/control
- **AMAN / DMAN / ACDM**
  - Links short and medium haul airports directly
  - Individual flight planning
  - Precise planning and control
  - Runway resource mgmt
- **Flow Mgmt Position (FMP)**
  - Efficiency tool to manage all constraints efficiently

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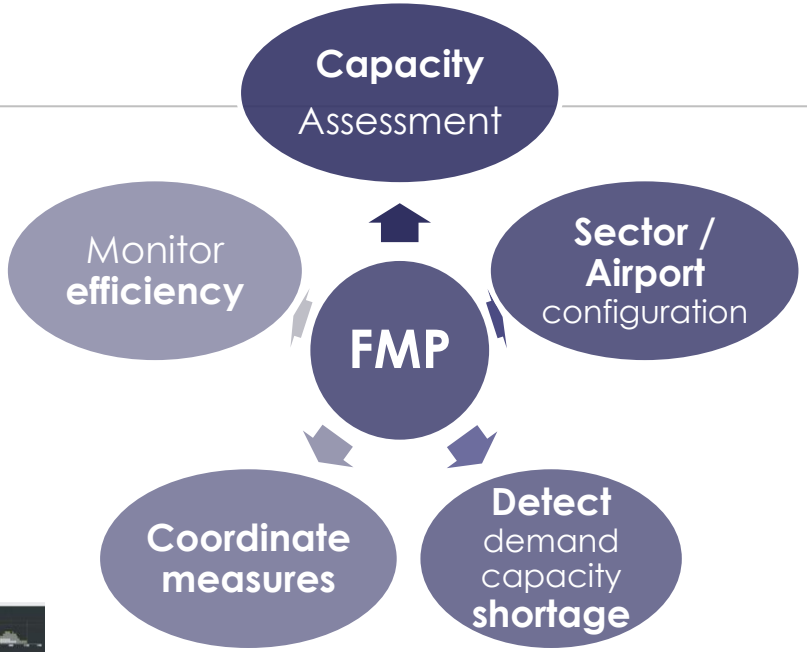
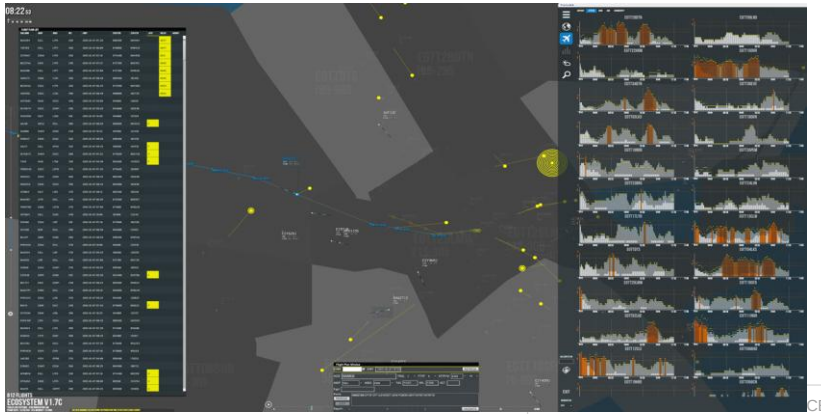
Flow Management Position

Main features:

- Non-safety critical ATC application
- Deployed in ATC facilities
- Connectivity to Network Manager, MET source, stakeholders & other data sources
- Continuous update
- Integrated display
- Multiple decision aids





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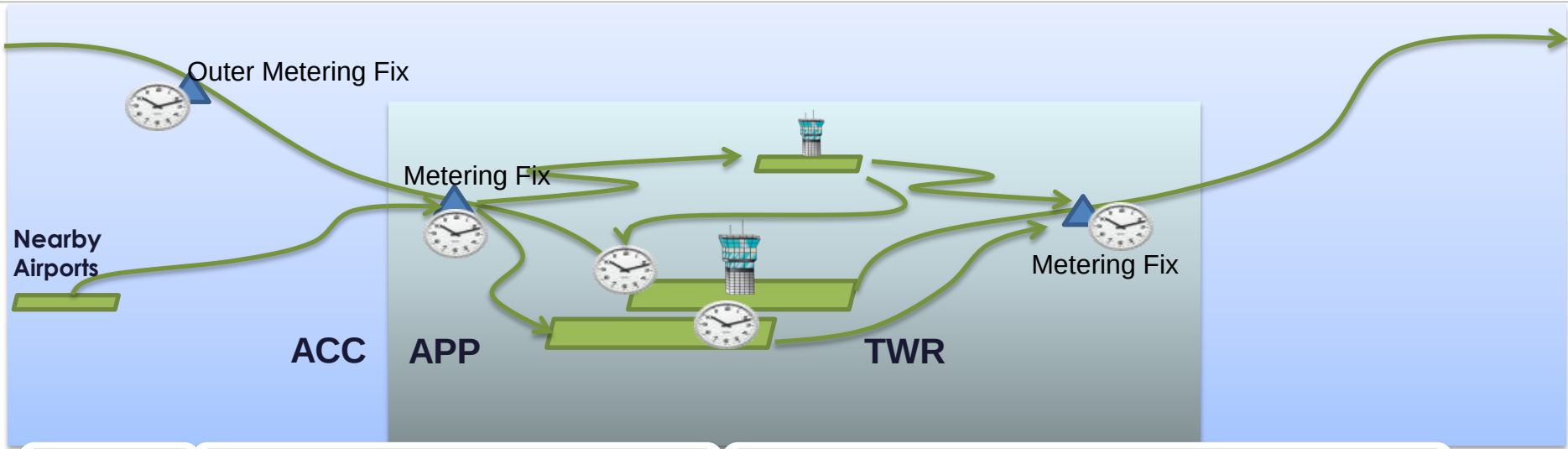
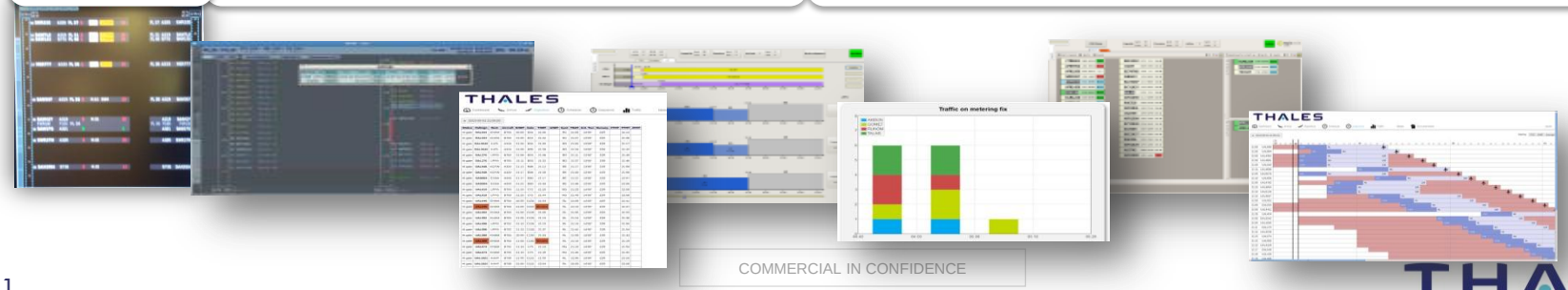
Thales Flow Management capabilities : Tactical Flow Optimisation



XMAN | AMAN | DMAN



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AMAN : The Arrival Manager

Situation without AMAN

- No reliable traffic forecast available, capacity problem detected/managed very late
- Apply the same speed regulation to all aircraft; late instruction for holding
- Poor coordination between ACC, APP, TWR, Use protective capacity
- In high density traffic situation, unplanned events become a crucial issue

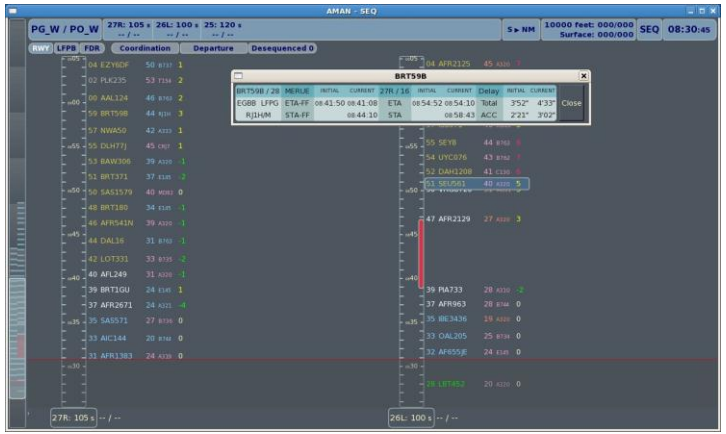
  Wind/Runway orientation, Runway inspection, LVP conditions, Missed Approach

AMAN Principles

- Prevent the use of holding pattern
- Provide a feasible arrival schedule
- Provide delay advisory to be absorbed

Benefits

- Capacity, Predictability
- Flight efficiency
- Safety



Enabler for Performance Based Operations

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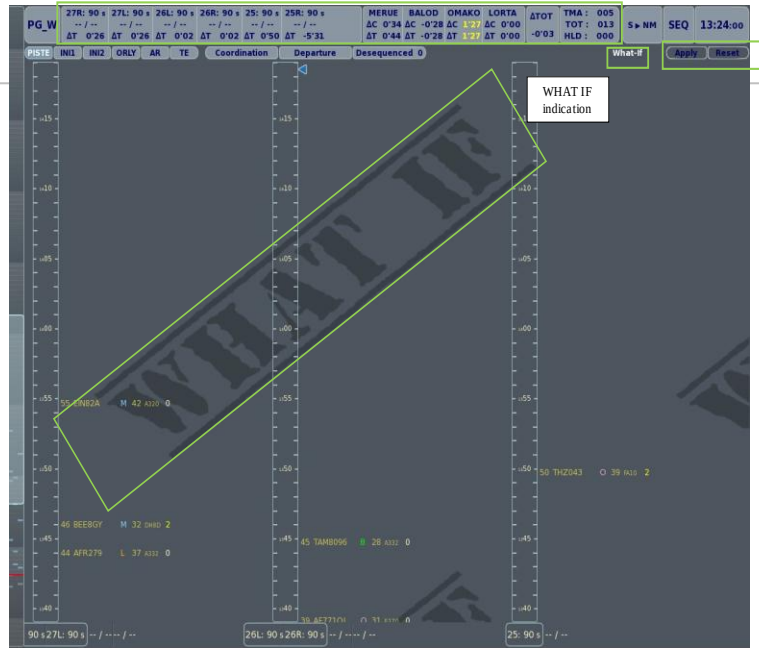
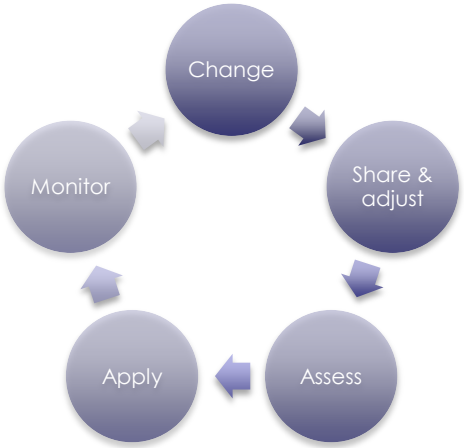
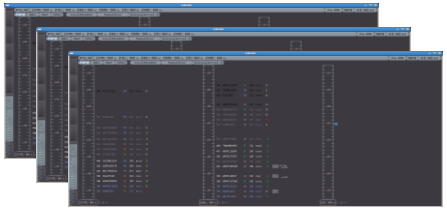
Collaborative What-if sessions

- To prepare major changes without interfering with operational session
- Shared between key actors possibly in various sites
- Using indicators to measure the impacts of the changes







Live data

Apply

Operational positions

Try, assess, make decision

What-if positions

Thales experience in ATFM

Thales has been involved in ATFM for over a decade

- Closely linked to ATM/ANSP
- CAMU for South Africa (including slot management)

Recent Thales ATFM developments and activities

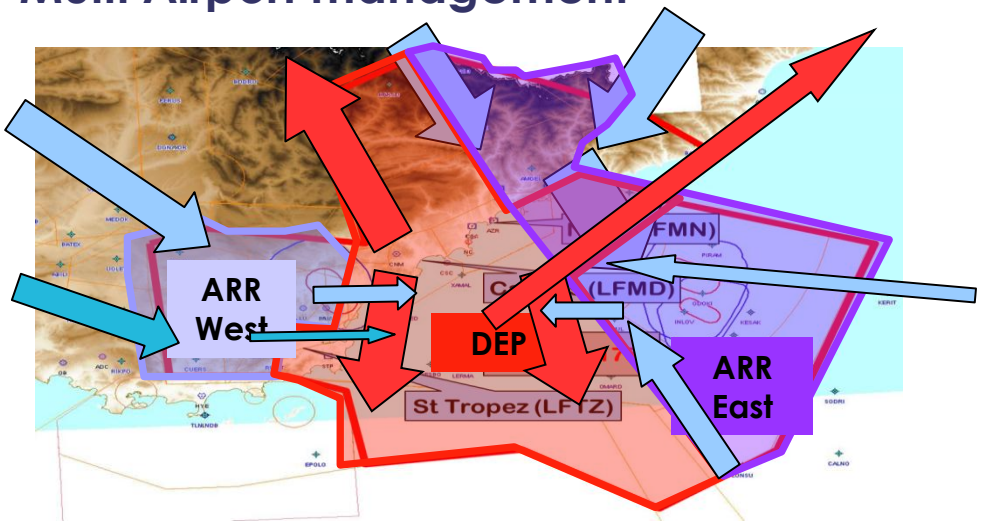
- Enhanced native ATFM features in ATM product (TopSky-ATC)
- MAESTRO AMAN, DMAN and XMAN now in portfolio
- Maturing of SESAR/FABEC projects and internal R&D
- TopSky-ATFM Generation II – Web Services

Application Case : Nice Côte d'Azur airport, France

Constrained airspace

- Mountains & Sea
- Noise abatment procedures
- Arrival/departure interferences

Multi Airport management



- France's 3rd largest airport
- Approx.160,000 movements/year
- Approx. 11million passengers/year
- Serving both domestic and international destinations
- Significant share on general aviation and helicopter traffic serving Monaco, Cannes, and the entire Côte d'Azur

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DMAN : The Departure Manager

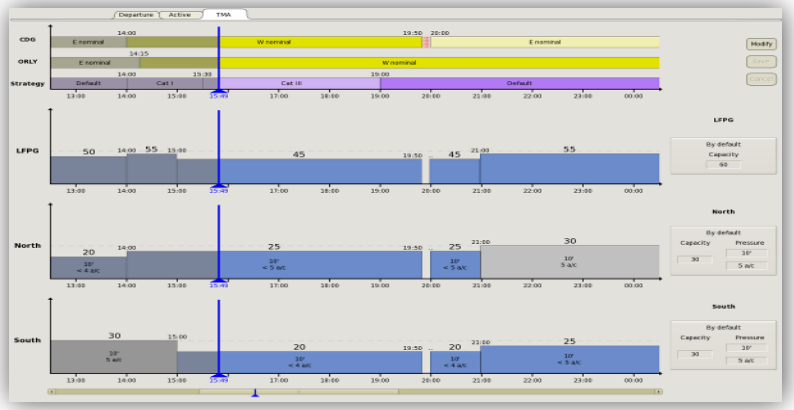
Situation without DMAN

- Long queues at the runway threshold
- Poor coordination between ATC, Airlines, Airport
- Poor departure predictability that impacts Network Operations
- In high density traffic situation, unplanned events become a crucial issue

  Wind/Runway orientation, Runway inspection, LVP conditions, De-icing

DMAN Principles

- Absorb delay at the gate
- Provide a feasible departure schedule
- Support controllers to issue just on time clearances
- Reinforce Tower Supervisor role



Benefits

- Predictability
- Flight efficiency & Environment footprint
- Capacity

Enabler for Airport-CDM Operations

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Application Case : CDM@CDG Measured benefits

Airport operations and ATM efficiencies

- Taxi time (-8%)
- Queuing at holding point (average -17%)
- Fuel consumption (-12 Tons per day)
- Departure Punctuality (up to +9%)
- CFMU Slot adherence (> 85%, +4%)
- Predictibility : Stable flow of traffic
- Use of available airport resources
- Airport capacity : up to 5% gain during peak hours
- Less congestion on ground and at runway threshold
- Better safety feeling

Improved environmental protection

- Decrease gas emission (39 CO2 Tons per day)
- Noise reduction

	2010	2011	Gains
6h/7h	209	178	15%
9h/10h	234	214	9%
12h/13h	262	239	8%
18h/19h	240	151	37%

Holding time
on peak hours (in seconds)
Sample of 18 days (march 2010 -2011)

dgac DSNA

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AMAN/DMAN Maestro Installations

Nearly 20 installations worldwide

AMAN

- 18 major airports
- Copenhagen : +10% runway capacity
- Sydney : 7,1 MAUS$ fuel consumption saved
- Paris : 30% capacity in Extended TMA

DMAN

- Paris-CDG: 2 minutes of taxiout saved

Agenda

ATS Inter-facility Data Communications

- Concept and experience

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History

- Initially in response to a need for Oceanic area information exchange
  - > Need a common language
- Designed to eliminate verbal coordination, initially between OCEANIC and ACC, then ACC/APP and TWR
- Designed to work within the AFTN/AMHS
- 1994 the initial ICD for AIDC was adopted for planning purposes by the APAC Air Nav Planning and Implementation Regional Group (APANPIRG)
- Regional NAM and CARSAM ICDs

AIDC Concept

- **By Definition**
  - "The AIDC application supports information exchanges between ATC application processes within automated ATS systems located at different ATSUs", (ICAO 2007)
- **Not designed to replace ICAO messaging, only provide new facilities.**
- **Requires bilateral agreements between neighbours**
- **Computer to Computer messaging – Some messages are "automated"**
- **Concept – 3 phases**

Thales' systems : Which ANSPs with AIDC experience ?

- Australia (Ops)
- Singapore
- Tahiti
- South Africa
- Maritius
- Vietnam
- China (Ops)
- Philippines
- Taiwan (Ops)
- Abu Dhabi
- Bahrein
- Saudi Arabia
- Egypt
- Sudan
- ASECNA
- Panama
- Chile
- Mexico
- Dominican Republic

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Application case : Australia

- Two FIRs – Melbourne and Brisbane. Separate FDPs
- Multiple remote TMAs
- Sydney - Approx 315,000 movements in 2012 = average 863 per day
- Many transit Sydney TMA to/from Brisbane ACC
  - Sydney Arrivals/ Departures
- MIL ATC coordination

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Lessons learned

- Two FIRs – Melbourne and Brisbane. Separate FDPs
- Voice coordination only used in non-standard cases
- Different standards between systems
- Accuracy of flight data must maintained at all times
- Human factors: Controllers must be aware of the lack of prompting
- Overall reduced coordination errors and workload
- General feed-back is very positive
  - from integrators and operational people
  - from customers (organizations and controllers), Implementation of AIDC has been very beneficial
- But only two significant issues
  - Dynamic standard
  - ICD definition with customer

Summary

AIDC messaging supports ATM automation principles

- Assigns repetitive tasks to the computer – reduction in controller workload
- Reduces coordination errors
- HMI should clearly indicate when the system is degraded
- Allows to revert to manual coordination if required

Requires close cooperation between Air Traffic Service Units

- Letter of Agreement (LOA) essential
- Exact message set needs to be agreed
- Common degraded mode procedures

Transfer between APP/ACC should be as seamless as transfer between Sectors

Keep in mind

Standards and ATC Systems' Vendor version

- per-ICAO-region basis NAM (North America), CARSAM (Central America and South America) and APAC (Asia Pacific)
- Different versions, e.g. APAC V1, 2, and 3. Systems support one or the other …

Start with simple Messages

- Standards define many messages
- Notification messages and move on to negotiation
- Save training and get confidence
- Ease the multi region/version testing (e.g use of NAM and CARSAM)

And involve Vendors for testing

- Supporting system configuration