Workshop on the Performance Enhancement of the ANS through the ICAO ASBU framework

Dakar, Senegal, 18-22 September 2017
presented by Emeric Osmont
The Aviation Community
Indra
The Aviation Community

2017–2019 Strategic Objectives

A. Safety
   Enhance global civil aviation safety.

B. Air Navigation Capacity and Efficiency
   Increase capacity and improve efficiency of the global civil aviation system.

C. Security and Facilitation
   Enhance global civil aviation security and facilitation.

D. Economic Development of Air Transport
   Foster the development of a sound and economically-viable civil aviation system.

E. Environmental Protection
   Minimize the adverse environmental effects of civil aviation activities.

Air transport plays a major role in driving sustainable economic and social development. It directly and indirectly supports the employment of 58.1 million people, contributes over $2.4 trillion to global Gross Domestic Product (GDP), and carries over 3.3 billion passengers and $6.4 trillion worth of cargo annually.

The 2016–2030 ICAO Global Air Navigation Plan presents all States with a comprehensive planning tool supporting a harmonized global Air Navigation system. It identifies all potential performance improvements available today, details the next generation of ground and avionics technologies that will be deployed worldwide, and provides the investment certainty needed for States and Industry to make strategic decisions for their individual planning purposes.

Source: GANP FifthEdition 2016
Indra

Global IT, Defense and Transport & Traffic company

€ 2.7 Bn
Sales 2016

Complete offering for all industries

40,000 employees

R&D 6-8% of sales
+200 deals with research centres and universities

Projects in +160 countries

Leading clients in key geographies and industries
Indra

CNS / ATM equipments for all flight phases

- A-SMGCS
- ATC
- SMR
- MLAT
- PSR and MSSR mode S
- WAM
- ADS-B
- DVOR and DME
- VCCS
- SWIM, CDM, AMHS, AIS and AIM
- GBAS
- ILS
- A-SMGCS
- ATC
- SMR
- MLAT

Indra CNS/ATM Equipments for all flight phases.
Indra

Committed to globally harmonized ATM

Research and Innovation:
- Strong involvement in SESAR
- Cooperation SESAR/NEXTGEN
- Functional evolution
- Technical: open systems, interface standards, adv. middleware

Indra contribution in:
- EUROCAE/RTCA working groups
- Eurocontrol/EU Programmes
- ICAO/ASBU
Indra

In all continents

Over 4,000 installations

In over 160 countries

COUNTRIES WITH INDRA’S ATM/CNS SYSTEMS

Date: 25 Jan 2017
ASBU...WHERE ARE WE?
Indra and ASBU...where are we?

Indra complete **CNS ATM & Airports solutions** covers is included in most of ASBU modules.

Indra ATM System already **meets Block 0** and is ready to **meet Block 1 no later than 2018**; whilst Block 2 and Block 3 are in the **roadmap** for future implementations.

Performance Based navigation (**PBN**), Continuous Descent Operations (**CDO**), Continuous Climb Operations (**CCO**) and Air Traffic Flow Management (**ATFM**), including runway sequencing capabilities are part of the **core of our products** and in line with **ICAO GANP 2017-2019 Priorities**.

Indra is a leading contributor to **SESAR**, iTEC and other global initiatives, where ASBU is followed.

“**Minimum path to global interoperability and safety**”:

**B0-ACAS** This Module is identified as N/A for an ATM System.

**B0-APTA** (Optimization of Approach Procedures including vertical guidance). This Module is covered by the current solution of Indra ATM System.

**B0-DATM** (Service Improvement through Digital Aeronautical Information Management) This Module is covered by the current solution of Indra ATM System.

**B0-FICE** (Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration) This Module is covered by the current solution of Indra ATM System.

**B0-ASUR** (ADS-B out and MLAT). This Module is covered by the current solution of Indra ATM System.

Three **Block 1 Modules (B1-FICE, B1-DATM, B1-SWIM)** are expected to be deployed worldwide in the coming years within the concept of “minimum path to global interoperability and safety”. Harmonization and interoperability constraints should make them essential, becoming the foundations of the future ATM system. **All these three Modules are covered by the current solution of Indra ATM System.**
Indra ATM (ACC APP TWR) system alignment with ASBUs

Performance Improvement Areas

Airports Operations

Globally Interoperable Systems and Data

Optimum Capacity and Flexible Flights

Efficient Flight Path

Block 0 (2013-2018)

Block 1 (2019-2024)

Block 2 (2025-2030)

Block 3 (2031-onwards)

- ✔ Already Implemented
- ☐ In roadmap
- ■ Not applicable

Indra ATM (ACC APP TWR) system alignment with ASBUs
Indra ATM (ACC APP TWR) system alignment with ASBUs

Block 0 in perspective

Performance Improvement Areas

Airports Operation
Globally Interoperable Systems and Data
Optimum Capacity and Flexible Flights
Efficient Flight Path

Information Network

2017 INDRA Implemented ASBU Block 0 Modules: 15/15 (100%)
Indra ATM (ACC APP TWR) system alignment with ASBUs

Block 1 in perspective

Performance Improvement Areas
- Airports Operation
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path

2017 INDRA Implemented ASBU Block 1 Modules: **10/14 (71%)**
2019 INDRA Implemented ASBU Block 1 Modules: **14/14 (100%)**
Indra ATM (ACC APP TWR) system alignment with ASBUs

Block 2 in perspective

Performance Improvement Areas
- Airports Operation
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path

2017 INDRA Implemented ASBU Block 2 Modules: 4/8 (50%)
2025 INDRA Implemented ASBU Block 2 Modules: 8/8 (100%)
Indra ATM (ACC APP TWR) system alignment with ASBUss

Block 3 in perspective

Performance Improvement Areas

- Airports Operation
- Globally Interoperable Systems and Data
- Optimum Capacity and Flexible Flights
- Efficient Flight Path

Information Network

B3-AMET 2025
B3-NOPS 2020
B3-TBO 2024
B3-RPAS 2025

2017 INDRA Implemented ASBU Block 3 Modules: 0/6 (0%)
2031 INDRA Implemented ASBU Block 3 Modules: 6/6 (100%)
Indra ATM (ACC APP TWR) system alignment with ASBUs

Performance Improvement Areas (PIA)

PIA 1: Airport Operations
- Airport Accessibility (APTA)
- Wake Turbulence Separation (WAKE)
- Runway Sequencing (RSEQ)
- Surface Operations (SURF)
- Airport Collaborative Decision Making (ACDM)
- Remote Air Traffic services (RATS)

PIA 2: Globally Interoperable Systems and Data
- Flight and Flow Information FF/ICE (FICE)
- Digital Air Traffic Management (DATM)
- System Wide Information Management (SWIM)
- Advanced Meteorological Information (AMET)

PIA 3: Optimum Capacity and Flexible Flights
- Free-Route Operations (FRTO)
- Network Operations (NOPS)
- Alternative Surveillance (ASUR)
- Airborne Separation (ASEP)
- Optimum Flight Levels (OPFL)
- Airborne Collision Avoidance Systems (ACAS)
- Safety Nets (SNET)

PIA 4: Efficient Flight Path
- Continuous Descent Operations (CDO)
- Trajectory-Based Operations (TBO)
- Continuous Climb Operations (CCO)
- Remotely Piloted Aircraft Systems (RPAS)

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<td>B1-APTA</td>
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<td>B0-ACDM</td>
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<td>B0-CDO</td>
<td>B1-CDO</td>
<td>B2-CDO</td>
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<td>B0-TBO</td>
<td>B1-TBO</td>
<td>B2-TBO</td>
<td>B3-TBO</td>
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<td>B0-CPO</td>
<td>B1-RPAS</td>
<td>B2-RPAS</td>
<td>B3-RPAS</td>
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Applicable ASBU Modules to ATM System
Implemented ASBU Modules at January 2017

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<tr>
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<th>15</th>
<th>14</th>
<th>8</th>
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<tr>
<td>Percentage</td>
<td>100%</td>
<td>71%</td>
<td>50%</td>
<td>0%</td>
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# Indra Avitech (AMHS AIS AIM) alignment with ASBUs

**Block 0  2013 - 2018**

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<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Airport Operations</strong></td>
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<tr>
<td>BO-APTA</td>
<td>Optimization of Approach Procedures Including vertical guidance</td>
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<tr>
<td>BO-SURF</td>
<td>Safety and Efficiency of Surface Operations (AR-SMGCS Level 1-2)</td>
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<tr>
<td>BO-ACDM</td>
<td>Improved Airport Operations through Airport-CDM</td>
</tr>
<tr>
<td><strong>Globally Interoperable Systems and Data</strong></td>
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</tr>
<tr>
<td>BO-FICE</td>
<td>Increased Interoperability, Efficiency and Capacity through Ground-Ground-Integration</td>
</tr>
<tr>
<td>BO-EAIA</td>
<td>Service Improvement through Digital Aeronautical Information Management</td>
</tr>
<tr>
<td>BO-AMET</td>
<td>Meteorological information supporting enhanced operational efficiency and safety</td>
</tr>
<tr>
<td><strong>Efficient Flight Paths</strong></td>
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<tr>
<td>BO-CDO</td>
<td>Improved Flexibility and efficiency in Descent Profiles (CDNs)</td>
</tr>
<tr>
<td>BO-CCO</td>
<td>Improved Flexibility and efficiency in Departure Profiles - Continuous Climb Operations (CCOs)</td>
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**Block 1  2019 - 2024**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Airport Operations</strong></td>
<td></td>
</tr>
<tr>
<td>B1-APTA</td>
<td>Optimized Airport Accessibility</td>
</tr>
<tr>
<td>B1-SURF</td>
<td>Enhanced Safety and Efficiency of Surface Operations - SURF, SURF 2 and Enhanced Vision Systems (EVS)</td>
</tr>
<tr>
<td>B1-ACDM</td>
<td>Optimized Airport Operations through Airport-CDM</td>
</tr>
<tr>
<td>B1-RATS</td>
<td>Remotely Operated Aerodrome Control</td>
</tr>
<tr>
<td><strong>Globally Interoperable Systems and Data</strong></td>
<td></td>
</tr>
<tr>
<td>B1-FICE</td>
<td>Increased Interoperability, Efficiency and Capacity through FF-ICE, Step 1 application before departure</td>
</tr>
<tr>
<td>B1-EAIA</td>
<td>Service Improvement through Integration of All Digital ATM Information</td>
</tr>
<tr>
<td>B1-SWIM</td>
<td>Performance Improvement through the application of System Wide Information Management (SWIM)</td>
</tr>
<tr>
<td>B1-KNET</td>
<td>Enhanced Operational Decisions through Integrated Meteorological Information (Planning and Near-Term Service)</td>
</tr>
<tr>
<td><strong>Efficient Flight Paths</strong></td>
<td></td>
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<tr>
<td>B1-CDO</td>
<td>Improved Flexibility and Efficiency in Descent Profiles (CDNs) using UNAV</td>
</tr>
<tr>
<td>B1-RPAS</td>
<td>Initial Integration of Remotely Piloted Aircraft (RPA) Systems into non-segregated airspace</td>
</tr>
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**ASECNA OPERATING THE FIRST PAN AFRICAN AMHS LINK USING INDRA'S TECHNOLOGY**

![Map of Africa and Madagascar](image)

Agence pour la Sécurité de la Navigation Aérienne en Afrique et à Madagascar
Indra CNS ATM roadmap in line with ASBU

**AMAN DMAN, 2017-19**
GANP priority

**GBAS,**
thread APTA

**ADS-B**
**WAM**
**MLAT,**
three

**ASMGCS,**
three
**SURF**

**iACM ATFM, 2017-19**
GANP priority
ASBU and regional programs: SESAR
Single European Sky

The costs of **fragmentation** of European airspace have been estimated at **€4 bn pa**.

To save costs and meet growing capacity demand, **ATM systems** must become **interoperable** and **methods of operation** across Europe must become **aligned**.

In addition, a **unified European airspace structure** would allow for more efficient flights across the European sky.

The European Union **Single European Sky** Programme aims to enable this.

**Single European Sky high level goals**

- **A 27% increase** in Europe’s airspace capacity
- **A 40% reduction** in accident risk per flight hour - corresponding to the safety need associated with the anticipated traffic growth
- **A 2.8% reduction** per flight in environmental impact;
- **A 6% reduction** in cost per flight.

**Source:** EUROCONTROL & FAA Study March 2012, Figures 2010

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<thead>
<tr>
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<th>US</th>
<th>EU</th>
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<tbody>
<tr>
<td><strong>Airspace</strong> (millions of km²)</td>
<td>10.4</td>
<td>11.5</td>
</tr>
<tr>
<td><strong>Flights</strong> (IFR, in millions)</td>
<td>15.9</td>
<td>9.5</td>
</tr>
<tr>
<td><strong>Service Providers</strong> (en route)</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td><strong>Area Control Centres</strong></td>
<td>20</td>
<td>63</td>
</tr>
<tr>
<td><strong>Air traffic controllers</strong></td>
<td>14.6</td>
<td>16.7</td>
</tr>
<tr>
<td><strong>Flights per controller</strong></td>
<td>1089</td>
<td>569</td>
</tr>
<tr>
<td>Share of <strong>departure delays &gt; 15 min. due to en route constraints</strong></td>
<td>0.1%</td>
<td>5.7%</td>
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</table>

**Source:** SESAR European Master Plan 2012
SESAR: Single European Sky ATM Research

SESAR is the European R&D programme which enables the realisation of the Single European Sky.

SESAR will drive improvements to the procedures and technologies being used by all stakeholders in order to increase capacity and safety, and reduce environmental impact and flight costs.

Benefits

• Increase airspace capacity using trajectory-based operations.

• Increase safety with enhanced conflict, detection and resolution tools.

• A reduction in aircraft emissions and fuel costs by optimising aircraft trajectories.

• Optimisation of staff resources and an increase in productivity.

• Improved interoperability between systems and reduced operational costs.
Indra within SESAR1

Indra has been a **key member** of SESAR since the definition phase as an integral European Ground Industry Manufacturer.

Indra participates in a third of all SESAR projects, playing a **leading role** in 28.

Indra contributed **€140M investment** to the Development Phase in SESAR 1.

Indra contributed actively to the definition of the **European ATM Master Plan**, which defines SESAR’s targets and objectives.

**ATM concepts** and **architectural** frameworks developed within SESAR are **incorporated** into Indra iTEC and other products.
Indra within SESAR 2020

Indra is willing to continue as a **key member** in SESAR 2020 Programme as an integral European Ground Industry Manufacturer.

Indra has bid to participate in 26 of the 28 SESAR 2020 Industrial Research and Very Large-scale Demonstrations projects, playing a **leading role** in 2 of them.

Indra is aiming to contribute over **€60M** to the SESAR 2020 Programme, being 60% of this budget allocated to the ATC domain

Key ANPSs being partners of Indra for S2020 Solutions validations in the ATC domain are DFS, ECTRL-MUAC, ENAIRE, NATS, ON, PANSA
Indra’s main contribution to the SESAR Solutions

In the areas of **Advanced air traffic services, Optimised ATM network services** and **Enabling aviation infrastructure**

- Interoperability Ground-Ground
- 4D trajectory Management System
- Complexity Management Tools
- Queue Management Tools
- Airport Planning
- CWP/HMI
- Tower/Remote Tower
Indra’s main contribution to the SESAR Solutions -iTEC based

Automated assistance to controller for seamless coordination, transfer and dialogue through improved trajectory data sharing

**Arrival Management (AMAN) and Point Merge**

**System Wide Information Management (SWIM)**

Medium term conflict detection (MTCD) and conformance monitor tools

Advanced Short ATFCM Measures (STAM)

Extended Arrival Management (AMAN) horizon

Arrival management into multiple airports

Optimised route network using advanced RNP

Variable profile military reserved areas and enhanced (further automated) civil-military collaboration

Automated support for traffic complexity detection and resolution
SESAR Solutions are mapped to ICAO ASBU
SESAR Solutions are mapped to ICAO ASBU:

ICAO Module $\leftrightarrow$ SESAR Operational change
Indra supports ICAO Aviation System Block Upgrades (ASBU) global interoperability through SESAR Programme

Global Cooperation & Interoperability

- Standards built on SESAR and NextGen developments will support harmonised Implementation and Regulation
- Global consensus to ensure world-wide interoperability.
- Programme level coordination enhanced by interoperability and wider industry buy-in.
- Development of a common avionics roadmap is a priority for SESAR
ASBU and regional programs: iTEC
iTEC Suite: the most advanced, safe and reliable ATM system available today

**iTEC**: Interoperability Through European Collaboration

**International Collaboration**

iTEC is an ATM system collaboratively developed by ENAIRE, NATS and DFS as founding members, with LVNL as part of DFS System Group and Indra as technological partner and supplier.
iTEC Suite: the most advanced, safe and reliable ATM system available today

**iTEC**: Interoperability Through European Collaboration

An expanding collaboration

Reduction in operational expenditure and implementation risks

Improvements in safety, training and transition

Interoperability

- **Current partners**: Spain, Germany, Netherlands, UK
- **Potential partners**: Norway, Poland, Lithuania
iTEC Suite: the most advanced, safe and reliable ATM system available today

iTEC Suite

Supporting future ATM operations

iTEC Suite is an advanced 4D trajectory-based ATM system that enables conflict detection, flight path monitoring and stripless operations, fully aligned with SESAR principles...

...and ICAO Aviation System Blocks Upgrades (ASBUs) definition and evolution strategy.
iTEC Suite: the most advanced, safe and reliable ATM system available today

iTEC Suite

Guaranteeing iTEC Suite evolution

→ Having a roadmap aligned with the SESAR functionality roadmap and Pilot Common Project (PCP) ATM functionalities (AFs).
→ Driven by the requirements of four very demanding ANSP, whilst sharing the development costs of such evolution.
→ Meets the conditions to call for INEA funds for the deployment of the iTEC Suite.

iTEC Roadmap

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<tr>
<td>iTEC V1: 4D Trajectory Based Operations</td>
<td>iTEC V2.1 &amp; V2.5: Full support to Upper and Lower Airspace. Provision of advanced separation management tools for Planning and Tactical Control</td>
<td>iTEC V3: Full support to I0P, SWIM and I4D</td>
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<td>● AF1. Extended AMAN</td>
<td>● AF1. Enhanced TMA using RNP</td>
<td>● AF3. NOP Itf</td>
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<td>● AF2. A-CDM</td>
<td>● AF2. Integrated AMAN/DMAN</td>
<td>● AF4. Collaborative NOP</td>
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<td>● AF2. A-SMGCS</td>
<td>● AF2. TBS</td>
<td>● AF4. ADS-C EPP trajectory</td>
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<tr>
<td>● AF2. Airport Safety Nets</td>
<td>● AF3. Tactical Trajectory and Risk Modules</td>
<td>● AF5. SWIM full (FIXM, AIXM, WXXM)</td>
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<td>● AF3. Dynamic Sect. and Advanced FUA</td>
<td>● AF3. LARA Itf</td>
<td>● AF6. I4D</td>
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<td>● AF3. FRA and DCT</td>
<td>● AF3. Dynamic FRA</td>
<td>● AF6. 10P (ATC-ATC and ATC-NM)</td>
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<td>● AF3. MTCO and CMON</td>
<td>● AF3. Contingency sectors</td>
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<td>● AF3. Civil/Military coordination</td>
<td>● AF4. Complexity Manager</td>
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<td>● AF5. FMTL. AMHS, METAR/GRIB2</td>
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<td>● AF6. ADS-C tracks</td>
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iTEC Suite: the most advanced, safe and reliable ATM system available today

iTEC Suite

Centers

3,000,000 km² of airspace covered

4 million flights p.a. controlled by the end of 2015

To be deployed in 12 centers located throughout Europe before 2020
iTEC Suite: the most advanced, safe and reliable ATM system available today

iTEC Suite

Centers - Operational facts (since December 2010)

**ACHIEVED BENEFITS**

- **466 direct routes** (46% available 24 hours a day)
- **Average deviation** from shortest route of **1.7%**, significantly lower than the 4.65% EU requirement
- **More than 1.5 million flights** managed each year
- **More than 5200 flights** managed during peaks days
- **11% increase** in capacity during its first year of operation

**EXPECTED BENEFITS**

- **Capacity growth** of **5% to 7%** annually

**YEARLY SAVING**

- **1.5 million** nautical miles
- **9000 tonnes** of fuel
- **30000 tonnes** of CO₂

2017-2019 GANP priority: ATFM and iACM
ATFM tools increase...

Safety

Efficiency and Delays Reduction

Cost-Efectiveness

Environmental Sustainability

Performance Improvement Area 3: Optimum capacity and flexible flights – through global collaborative ATM

Thread: Network operations (NOPS)

Our Priorities

ICAO will focus its efforts over the next three years on the development and implementation of performance-based navigation (PBN), continuous descent operations (CDO), continuous climb operations (CCO) and air traffic flow management (ATFM), including runway sequencing capabilities (AMAN/DMAN).

Source: GANP FifthEdition 2016
Indra’s Airspace Capacity Manager helps ANSPs to strategically adapt demand and capacity enabling ANSPs to optimize operational and environmental performances.
INDRA’S AIRSPACE CAPACITY MANAGER (iACM)

Summary Area

Geographical Area

Working Area

Flight List
INDRA’S AIRSPACE CAPACITY MANAGER (iACM)

The information comes from different sources:
- Historical Data
- Operational FDP
- SUA Schedule

Roles
- Regional
- ACC
- Sector

Controllers workload depending on:
- Traffic
- Planned sectorization
- Complexity of traffic
- Conflicts between flights

Key Performance Indicators (KPIs)
- Workload
- Occupancy
- Entry
- Business
- Environment
INDRA’S AIRSPACE CAPACITY MANAGER (iACM)

Tactical Phase - Sandboxes

- Copies of reality that can be manipulated
- Try actions on Demand and Capacity and inspect results
- Same metrics and KPIs as in real context
- Graphics will simultaneously display real and what-if situation
- Several sandboxes in parallel
INDRA’S AIRSPACE CAPACITY MANAGER (iACM)

Strategic and Planning Phases

iACM supports horizons of years

Long/Mid term ACC operations are managed by an Operations Plan:

- Sequence of sectors configurations
- Major Events
- SUA Schedule (long term)
- Capacity
- Environment Updates
- Potential Problems

Plan update and maintenance is executed by users collaboratively:
- Users collaborate and decide around it
- Accessible by external actors/tools
NATS released a RFT in order to renew its Air Traffic Flow Management Tools. iACM won the tender.
THE NATS CASE: CONTEXT

- 11% of Europe's airspace
- 25% of Europe's traffic

8000 flights/day on average

One of the most complex airspaces in Europe

~3M flights

~2.4M flights

17 18 19 20 21 22 23 24 25 26 27 28 29 30
THE NATS CASE: MAIN CHALLENGES

London TMA handles more than 6 airports

- Suitable for worldwide deployment
- Effective workload calculator tool to reduce minutes of ATC attributable delays
- Exchange the information with other NATS systems and stakeholders
- Provide service for multiple FIRs, ACCs, APPs and TMAs

Different Planning Phases considered

- Strategic Phase
- Pre-Tactical Phase
- Tactical Phase
- Post-Operational Phase
SUCCESS KEY POINTS

Objective: reduce ATM-related CO$_2$ emissions by 10% by 2020. Currently 5% improvement over the baseline

Avoiding 10 sec increase in average delay

Direct delay costs £14m pa direct delay costs

1% fuel emissions → £33m pa

iACM as a key element for NATS operations

Product roadmap following and leading industry trends

Attractive and functional HMI designed by users for users

Capacity increase maintaining low delays per flight

Safety target: reduce the accident risk per flight attributable to NATS by 13% by 2020

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THANK YOU!!