Capacity Planning and Assessment
Network Operations Planning

Air Traffic Services System Capacity Seminar/Workshop
Nairobi, Kenya, 8 – 10 June 2016

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EUROCONTROL Operations Planning
Introduction - EUROCONTROL
EUROCONTROL

MISSION
Founded in 1960, today EUROCONTROL is a civil-military organisation committed to building, together with its partners, a Single European Sky that will deliver the air traffic management (ATM) performance required for the twenty-first century and beyond.

UNIQUELY QUALIFIED
EUROCONTROL is uniquely qualified to help make the Single European Sky a reality:
- its 41 Member States provide a truly pan-European perspective;
- its expertise is unrivalled and covers both the operational and technical elements;
- can advise on both the civil and the military aspects of ATM;
- has real experience at bringing States with different needs together for a common goal;

MEMBERSHIP
EUROCONTROL is an intergovernmental organisation with 41 Member States. The European Community signed an Accession Protocol in 2002. Member States include all of the EU States.

EUROCONTROL signed Comprehensive Agreements with the Kingdom of Morocco and the State of Israel on 29 April and 2 June 2016 respectively.

European Organisations

Albania
Armenia
Bosnia and Herzegovina
Georgia
Moldova
Monaco
Montenegro
Serbia
The FYROM
Turkey
Ukraine
Austria
Belgium
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Latvia
Lithuania
Luxembourg
Malta
Netherlands
*Norway
Poland
Portugal
Romania
Slovakia
Slovenia
Spain
Sweden
*Switzerland
UK

Azerbaijan
Iceland
San Marino

* - States with the special agreements with EU. In the context of ATM they are treated like members.
Main Functions

- Directorate Network Management
- Directorate Air Traffic Management
- Directorate Central Route Charges Office
- Maastricht Upper Area Control Centre
- Directorate Pan-European Single Sky
## Areas of Expertise – EUROCONTROL/NETWORK MANAGER

| CNS – Communication, Navigation, Surveillance | • Surveillance tools  
| • CNS Standards and Specifications  
| • RVSM Monitoring  
| • Transponder Codes and Radio Frequencies Coordination |

| Airspace Design | • Evaluation, analysis and design of traffic flows and airspace structures, including civil/military  
| • Macroscopic, Fast/Real Time Data, Tools and Simulations |

| Capacity: analysis and planning | • Network and local capacity optimisation  
| • Macroscopic, Fast/Real Time Data, Tools and Simulations |

| Airspace Management (Civil/Military Coordination) | • Various levels of planning for civil/military coordination and Flexible Use of Airspace, including network procedures  
| • LARA – Civil/Military Airspace Management Planning Tool |

| Safety | • Network Safety Risks Identification, including network management risks  
| • Continuous operational safety improvements  
| • Support to the implementation of safety management systems and procedures  
| • Safety Culture |

| Airport capacity enhancement and optimisation | • Capacity, efficiency and environment studies  
| • A-CDM: Familiarisation and implementation |

| Training and human resources development | Our training covers:  
| • Various Air Traffic Management courses (ATM),  
| • Network Operations  
| • Communication, Navigation, Surveillance |
Involvement is ensured through:

- Participation in EUROCONTROL Expert Groups on all ATM/CNS areas
  - Operational or technical
  - Coordination and support of projects

- Direct support work on individual implementation projects:
  - Airspace design
  - Capacity evaluations
  - ATM procedures
  - Operational performance evaluations
  - Civil/military (FUA) implementation support
  - Technical projects, including specifications
  - Fast and Real Time Simulations

- Execution of tasks on behalf and together with ICAO
  - Transponder Codes and Frequency coordination
  - RVSM monitoring
  - Airspace design
  - Operational and technical aspects on the interfaces between the ICAO EUR Region and other Regions
“ATC Chain” and Network Operations

Flight Data

Regional ATFM

Airlines  ATC  ATC  ATC  Airports

FPL – Flight Plan Processing

Central data repositories

EAD  ASM
Network Manager operations cover:

• Central management of airspace data (AIS, AIP, NOTAM and military requirements)

• A single flight plan based on an integrated process: a single entry point for submission, reception, verification and distribution (IFPS).

• Central Air Traffic Flow and Capacity Management (ATFCM)

• Real time flight data: real time situation shared and accessible for all partners: reception, centralisation and distribution of all available information
Our Challenges
Our Challenge
Every day Traffic Situation

Europe Domestic: 27086 flights 83.4%
To/From East: 1572 flights 6.4%
To/From West: 1334 flights 4.6%
To/From South: 1048 flights 3.3%
Others: 477 flights 1.5%

One Day European Traffic
Analysis: AIRSPACE OVERLOAD

Fri 1/7/2006 Traffic

Sectors Overloads
- very high
- high
- medium
- slight
- at capacity
- below capacity

Capacity weaknesses
Analysis: NETWORK BOTTLENECK

Most congested Areas

Conflicts Densities mixed with Traffic Densities

Complexity assessment
From Ops Planning to Post-Ops

-5 years

Capacity Assessment and Planning

-3 months

Strategic

Pre-tactical

Tactical

Post-Ops

Day 0

ATFCM

ACC Baseline – capacity indicator
Optimise sectorisation
Sector configurations
Sector opening schemes
Staff planning
New ATC system or upgrade
Route structure development

Axis meetings
Simulation
Planning
Coordination
Special events planning
Re-routings

Play book
Scenarios
ADP

Regulation
Slot Allocation
Analysis
Reports

STAM
Sector occupancy

09/06/2016
Assessing traffic demand

- Centralised flight planning
- Traffic forecast
Flight Planning in Europe with NM IFPS

One FPL for all NM area
- Full acknowledgement process
- Dynamic re-processing
- Highly automated (>95%)
Flight Planning Process

- **AO**: Direct Filing
- **MAN**: Two units
- **REJ**: Direct Filing
- **ACK**: Distribution

- **BRE**: MAN: Manual Processing Required
- **ACC 1**: REJ: Reject - refile
- **ACC 2**: ACK: Acknowledge
- **ACC N**: ADEP
- **ADES**: ACC 2
IFPS Initial Flight Plan Processing System

- Centralising the management of flight plans at REGIONAL level
- Collaborative with civil and military airspace users
- Delivered with the highest degree of security and service continuity, including disaster recovery
- A single flight profile AGREED with airlines & shared between ALL ATM actors
- Direct filing from aircraft operator to IFPS
- **Accurate, predictable, consistent picture of DEMAND across a region**
- Routing assistance: Opportunities for more efficient routes
- KEY STEP for building a regional ATFM capability, optimising capacity and flight efficiency
- Implementing System Wide Information Management (SWIM) standards to support interoperability in order to give wide access to our services, via business to business and client applications, without geographical constraints
IFPS Initial Flight Plan Processing System

• Additional Functions

  • Safety/security watch: alerting function

  • Callsign Similarity Service (CSS): support to airlines & ANSPs for preventing call sign confusions

  • Demand Data Repository (DDR): traffic MODELLING system to anticipate future demand
IFPS BENEFITS

• Highly automated > 96% of flight plans automatically processed.

• Single consistent flight plan for all ATM stakeholders.

• Concrete gains in flight efficiency (flight plan route as close as possible to the shortest direct route).

• Simplified flight plan handling for all actors, with access via business to business and client interfaces, in addition to legacy systems.
Traffic Forecast
EUROCONTROL (STATFOR) 7 Year forecast

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<td>10,293</td>
<td>10,639</td>
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<td>11,503</td>
<td>11,997</td>
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<td>11,091</td>
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<td>10,023</td>
<td>10,107</td>
<td>10,140</td>
<td>10,231</td>
<td>10,335</td>
<td>10,373</td>
<td>10,440</td>
<td>0.7%</td>
<td>0.9%</td>
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<td>Annual Growth (compared to previous year unless otherwise mentioned)</td>
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<td>3.8%</td>
<td>3.4%</td>
<td>4.3%</td>
<td>3.7%</td>
<td>4.3%</td>
<td>3.5%</td>
<td>3.6%</td>
<td>3.8%</td>
<td>3.3%</td>
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<tr>
<td>B</td>
<td>-2.2%</td>
<td>-1.1%</td>
<td>1.7%</td>
<td>1.5%</td>
<td>2.4%</td>
<td>2.1%</td>
<td>2.1%</td>
<td>2.3%</td>
<td>2.5%</td>
<td>1.9%</td>
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<td>1.1%</td>
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<td>0.4%</td>
<td>0.6%</td>
<td>0.7%</td>
<td>0.9%</td>
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7-year IFR movements forecast: 2016-2022
7-year IFR movements forecast: 2016-2022
Assessing Sector Capacity
The CAPAN Methodology
ATC Capacity Influencing Factors

Ref.: ICAO DOC.9971
Several approaches to workload modelling

- Workload self-assessment
- Task time models
- Traffic/sector complexity models

Different workload vs. capacity relationships

→ Workload thresholds

Different assessment process

- Numerical Estimates
- Fast-time Simulations
- Real Time Simulations

Several valid methodologies available
CAPAN

Simulation Methodology

Sector Capacity

Controller Workload
Fast Time Simulation in ATM

- Events at Sector
- Actions
- Tasks
- Workload
RCAPAN
70%
Regression Analysis
Assessing Optimum Opening Schemes and Future Bottlenecks
Optimize configuration opening schemes

- Using the same controller-hours differently results in less sector overloads
Optimize configuration opening schemes

- Using additional controller-hours only solves some of the overload problems
Find future bottlenecks

- Use the latest STATFOR forecasts to see where bottlenecks are likely to appear
Network Capacity Planning
Winter
- Annual Performance Analysis - Network Operations Report – (the NOR)
- Consolidation of Plans - Network Operations Plan (the NOP)

Spring
- Traffic Forecast
- Network Delay Forecast Update NOP

Autumn
- Traffic Forecast update
- Traffic Demand and Distribution
- Capacity Requirements and Delay
- Interactive Capacity Planning meetings with ANSPs
- ANSP Plans

Summer
- Evaluation of Summer performance
- ACC Capacity Baselines
Capacity Planning and Monitoring

Sector capacity, configuration and opening scheme data

Traffic & Delay statistics

ACC Capacity Baselines

Current Situation Analysis

Network Operations (end of year) Report

Past Performance

Economic Forecast
User Demand
Airport Capacity Plans
States' Transport Policies

Traffic Forecast

Future Traffic Demand and Distribution per ACC

Assessment of Future ACC Capacity Requirement Profiles

Policy on Delay / Capacity targets

Demand Evolution dataset
NEVAC Assessment

Capacity Planning Meetings

Implementation Actions

Future ATS Route Network (output from Route Network Development Sub-Group - RNDSG)
Expected Hourly Airport Capacities

LSSIP: Local Capacity Plans
Network Operations Plan Seasonal

European Strategic ATM Network Operations Performance Plan
Approved Capacity Planning Methodology
Consolidated performance-based planning process

2015

ANNUAL NETWORK OPERATIONS REPORT 2015

2016

European Network Operations Plan
2016-2019/20

Edition May 2016

2016 - 2020

Operational Performance monitoring

Short/Medium-Term Planning
### Capacity Profiles

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<tbody>
<tr>
<td>EPWW</td>
<td>142</td>
<td>145</td>
<td>150</td>
<td>145</td>
<td>2537</td>
<td>2187</td>
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### 2.1.1 Summer 2015 performance

<table>
<thead>
<tr>
<th>Traffic Evolution</th>
<th>2015 Capacity Baseline</th>
<th>En-route Delay (min./flight) - Summer</th>
<th>Capacity gap</th>
</tr>
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<tbody>
<tr>
<td>-1.6 %</td>
<td>142 (+5%)</td>
<td>0.34</td>
<td>Yes</td>
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</table>

The average en-route delay per flight decreased from 1.14 minutes per flight in Summer 2014 to 0.27 minutes per flight in Summer 2015. 84% of delays were for the reason ATC Capacity, 6% for Weather and 4% for ATC Staffing.

#### Capacity Plan

- Improved ATFCM techniques, including STAM
- Additional controllers: YEAR – 125 ATCDs available
- Improved sector configurations and management (additional measure to the 2015 plan)
- Introduction of Traffic Manager position (additional measure to the 2015 plan)
- Minimizing ATC Staffing cause of delays (additional measure to the 2015 plan)
- Maximum configuration: 9 sectors

#### Summer 2015 performance assessment

The ACC capacity baseline was measured with ACCESS/Reverse CASA at 142, 5% higher than in 2014. During the measured period, the average peak 1 hour demand was 149 and the average peak 3 hour demand was 140.
## Strategic drivers

### Capacity Plan

<table>
<thead>
<tr>
<th></th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td><strong>Free Route Airspace</strong></td>
<td>Stepped implementation of FRA</td>
<td>Full implementation of FRA in Baltic FAB</td>
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<tr>
<td><strong>Airspace Management</strong></td>
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<tr>
<td><strong>Advanced FUA</strong></td>
<td>Initial ASM Tool to support Advanced FUA</td>
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<tr>
<td><strong>Airport &amp; TMA Network Integration</strong></td>
<td>Implementation of A-CDM at Warsaw Chopin airport</td>
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<tr>
<td><strong>Cooperative Traffic Management</strong></td>
<td>Advanced ATFCM techniques, including STAM</td>
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<tr>
<td><strong>Airspace</strong></td>
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<tr>
<td><strong>Procedures</strong></td>
<td>Introduce 5 NM longitudinal separation</td>
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<tr>
<td><strong>Staffing</strong></td>
<td>7 additional controllers</td>
<td>Additional controllers</td>
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<tr>
<td><strong>Technical</strong></td>
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<tr>
<td><strong>Capacity</strong></td>
<td>Re-evaluation of sector capacities In new vertical split airspace</td>
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<tr>
<td><strong>Significant Events</strong></td>
<td>World Youth Days in Krakow (July 2016)</td>
<td></td>
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<tr>
<td><strong>Max sectors</strong></td>
<td>9/10</td>
<td>9/10</td>
<td>10/11</td>
<td>10/11</td>
<td>10/11</td>
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<tr>
<td><strong>Capacity increase p.a.</strong></td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
<td>5%</td>
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<tr>
<td><strong>Reference profile</strong></td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
<td>3%</td>
<td>N/A</td>
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<tr>
<td><strong>Profile – Current routes</strong></td>
<td>4%</td>
<td>3%</td>
<td>4%</td>
<td>3%</td>
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<tr>
<td><strong>Additional information</strong></td>
<td>Transition to vertical sectorisation in the first phase in 2016 will be focused on safe transition and familiarisation with the new operational environment. Therefore overall performance however planned to be enhanced, might not be necessarily a primary target.</td>
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Airspace Network Design
Collaborative Rolling Airspace Design Planning
Preparing the European Route Network Improvement Plan
Collaborative Airspace Design Planning, Integrating a coherent European Route Network Improvement Plan

Network Performance Targets

FAB Proposals
National/local proposals
Sub-Regional proposals
Other stakeholders proposals
Adjacent areas proposals
Airspace users proposals
Network proposals

RNDSG Role
Consolidated European network
• Common ops concept
• Common design principles
• Share best practice
• Network consolidation
• Network inter-connectivity
• Project synchronisation
• Complete network view
• Support to development
• Stakeholders coordination
• Stakeholders commitment
• Input to ICAO

Consultation/working arrangements
Meet Network Performance Targets

Rolling Improvement plan for the European Network (3-5 years)
Planning
Annual deployment plans
Short term

European Network
Advanced Airspace Scheme (AAS): LONG TERM
A living Master Plan, Collection of FABs & Network Plans
Guideline for Medium & Short term Developments

Trade off between flight efficiency and network capacity
Consolidated Airspace Structure Development

FREE ROUTE AIRSPACE
REDUCED SEPARATION NAT TRACKS
NIGHT / WEEKEND ROUTES
FAB INITIATIVES
RVSM
TERMINAL AIRSPACE IMPROVEMENTS
Implement!

Coordinate

Validate

Concept & Criteria
Definition

Annual Review

Plans: short, medium & long term

State / FAB / ANSP representatives

FPL service providers

RNDSG

EUROCONTROL

Military

ICAO
Enroute Design - The Old Way
Enroute Design - The New Way
Modular Sectorisation

Flexible and dynamic sectorisation able to respond to different traffic patterns
FRA Cross Border Example

KIRCHBERG FIR

GIZDA(E)

ANOTHER FIR

STAND(EX)

PENDA(I)

LENNE(E+EX)

GONDO(E)

KIEM

GABOR(E)

SAM VOR(EX)

SPECIAL AREA (SA)

ARES FBZ

Military

50 32 26 N
05 22 31 E (I)

BRAIN(I)

TODOR(I)

ELENA(D)

BORCE(I)

KRICHBERG

GERIS(A)

KIEM FIR

P112

DADELI(EX)

DENIS(EX)

ADELI(EX)

CHRIS(I)

KIEM FIR
FRA Cross Border Example SA Active
Flight Planning when Transiting from FRA

FPL: ... EEEE/N460F370 DCT AAAAA/N460F350 UA1 BBBBB UA1 XXXXX ...
Flight Planning when Transiting to FRA

FPL: ... EEEEE/N460F350 UA1 AAAAA/N460F370 UA1 BBBBBB DCT XXXXX ... 
FPL: AD ... SID ... DDDDD/N460F260 UM01 AAAAA/N460F370 UA1 BBBBBB DCT CCCCCC DCT ...
ERNIP Part 2 – ARN Version 2016-2020
Main developments
Free Route Airspace
ERNIP Part 2 – ARN Version 2016-2020
Main developments
Free Route Airspace
ERNIP Part 2 – ARN Version 2016-2020
Main developments
Free Route Airspace
ERNIP Part 2 – ARN Version 2016-2020
Main developments
Free Route Airspace
Civil Military Cooperation
Improved ASM/ATFCM Coordination Process

Moving closer to the time of operations with better anticipation

Airspace Users
Submit airspace requests

Network Manager with local partners
Collaborative process to identify the solution optimising the Network

Identify actual congestion risks
Select individually suitable solution(s)
Disseminate congestion risks and applicable solutions

Better consideration of the airspace dynamicity
Re-filed FPLs back in the ATM system

ASM & Local Flow Managers
Identify possible solutions

Airspace Users
Informed about the airspace status and replanning operations accordingly
WIN-WIN Approach

- Optimised Network with more route options
- Better use of new route opportunities
- Consideration of re-routing scenarios due to route closure
- More Precise airspace requests / Less Segregated airspace
- Improved information process about released airspace
- Better flexibility in ad-hoc airspace allocation
ATM Procedures
Addressing capacity at Inter-Regional Level
2014 – Daily NM Flights

Traffic within NM Area
26,548 flights

High Increase
• Middle East
• SE Asia
• China

Predictability
• Crisis Planning and Management

SE Asia
415
Gulf
578

590

923

1460

1463

578

140
Predictability
Local, Regional and Global Interoperability and Data Sharing

Surveillance and updates of flight data – Radar, ADSB, ACARS, …

Local, Regional and inter-regional ATFM measures

Traffic Demand: Schedules and Flight Plans

Information: capacities, special events, meteo, disruptions

Network Infrastructure: airports, airspace structures, FIR, ACC, sectors
Integrated Planning Toolset
NEST: Network Strategic Tool
Integrated & interactive support-airspace design & network capacity

- It features:
  1. airspace structure design and development,
  2. capacity planning and post operations analysis
  3. strategic traffic flow organization
  4. scenario preparation for fast and real-time simulations
  5. ad-hoc studies at the local and network level.
NEST Input Data

Default datasets for NEST: consolidated pan-European airspace and route network, traffic demand and distribution as well as STATFOR. All this data can be downloaded from the Demand Data Repository (DDR) web site.

Automated Data Preparation Process
Services and tools

Organising the airspace

Airspace Design

Airspace Management
ASM/ATM/ATFCM
procedures

Capacity
Enhancement

Airspace & Capacity Modelling

Network Strategic Tool
(NEST = SAAM-NEVAC tool)

Demand Data Repository (DDR)

Fast-Time Simulation: CAPAN Methodology
Real Time Simulation: Airspace /ATM Procedures