Agenda

- Key goals of future European ATM system
- 4D Trajectory Management
  - Spacing, ASAS and 4D TBO
- Enablers
  - DATACOM
  - PBN IR
Key Goals of Future European ATM System

- Handle more traffic
- Cut ATM costs
- Improve safety
- Reduce environmental impact

Binding Targets set by SES Performance Scheme
SESAR Key Ops Features

THE SYSTEM WIDE INFORMATION MANAGEMENT

AUTOMATION
How to unlock the benefits
Operating Concept Evolution

- Initial Data Link En-Route
- Full 4D Trajectories & Airport Services
- Full 4D

- Basic AOC
- Enhanced AOC & MAPS, MET
- Full Air-Ground SWIM TBD

ATS Services
Info Services

ICNS2013 – Operational Trends and Enablers
What is i-4D?

- Share and synchronise airborne and ground trajectory.
- “Flying to Time constraints” to optimize sequences as defined by ATC.
i4D: The Validation Steps in SESAR

2010  2011  2012  2013  2014

Flight Trial

i4D Step C

Non- & Coupled simulations

Ground systems 3rd generation
Airborne systems 2nd generation

i4D Step B

Non-Coupled simulations

Ground systems 2nd generation
(Step A outputs)

i4D Step A

Non- & Coupled simulations

Initial developments
air + ground

Flight Trial

Slide source: SJU 8
What about Full 4D?

Full 4D concept needs to mature

Full 4D will build upon i4D, considering the stakeholder requirements
ASAS and 4D TBO

Separation: Transfer of Responsibility to Pilots

Are we there?
i4D + CTA (Controlled Time of Arrival) - Simple Scenario

- aircraft self-manages speed / descent profile to comply with CTA constraint

Potential instability sources are, among others:

- Meteorological conditions (wind different from forecast)
- Upstream tactical ATC actions
- Any delay in negotiation of CTA constraint, that may cause CTA previously transmitted window to be outdated

CTA FIX
LOCATED 30 NM BEFORE RWY THRESHOLD

Slide source: SJU
CTA: example of what it can deliver

Five aircraft that would have reached the CTA fix simultaneously if no time constraint had been assigned (and would have had to hold)...

Will now reach the CTA fix in a sequence of one aircraft every 2 minutes / 6 miles, without any action on the part of TMA controllers.
Basic ASPA-FIM-S&M Manoeuvres

**REMAIN**
Both aircraft follow same route

**MERGE**
Aircraft fly converging routes

**RADAR VECTOR THEN MERGE**
Closed loop tactical ATC radar vector

**FOLLOW ROUTE THEN MERGE**
First aircraft gets direct routing, second will get direct routing

Spacing applications: ATCos responsible for separation
CTA and ASAS timeline

CTA FIX

TRAFFIC PRE-SEQUENCED BY CTA

SEQUENCE ATTAINED

MERGING AND PRECISE SEQUENCING ASSISTED BY ASAS TECHNIQUES

SEQUENCING MAINTAINED BY ASAS “REMAIN” TECHNIQUE

Slide source: SJU ICNS2013 – Operational Trends and Enablers
Airborne Separation (ASEP)

Separation applications:
ATCos no longer responsible for separation

Scenario is uncertain – THEREFORE

ICAO 12th ANConf: agreement to leave separation applications for a later stage

Current focus in SESAR activities:
Validation of ASPA-FIM-S&M integration in i4D environment with four initial manoeuvres
FIM (Flight-Deck Based Interval Management): EUROPE – US coordination

- **Benefits:**
  - ATCo workload decrease (less speed instructions / vectoring)
  - Higher throughput & more efficient aircraft operations

- **Approach:**
  - ATCo to assign Spacing Goal to Flight Crew
  - Precise guidance within flight deck to enable Flight Crew to actively achieve & maintain spacing relative to Target Aircraft
  - ATCo retains responsibility for separation

- **Standardization: EUROCAE WG51, RTCA SC-186, EUROCONTROL and FAA:**
  - Aiming at a retrofitable avionics solution
  - Not relying on: (advanced) avionics integration / automation, on CPDLC & advanced ground tools
FIM MOPS/SPR planning

- Initial “delta” OSED
  - 2Q 2012: (2a) Mature “delta” OSED
  - 3Q 2012: (2b) Interoperability & Functional Allocation
  - 4Q 2012: (3a) Preliminary “delta” OSA/OPA
  - 1Q 2013: Refine “delta” OSED
  - 2Q 2013: (3b) Detailed “delta” OSA/OPA
  - 3Q 2013: (3c) ASA System Requirements & Test Procedures
  - 4Q 2013: (3d) Detailed MASPS Provisions
  - 1Q 2014: (4a) Finalise “delta” SPR
  - 2Q 2014: (4b) Finalise MOPS
  - 2Q 2014: (4c) FRAC/OC on SPR, MOPS (& MASPS, if req’d)
ENABLERS
Future COM Infrastructure

Legacy Systems

Airport surface: C band

General terrestrial: L Band

Satellite: Oceanic + Continental

Multilink Concept
Traffic situation in Europe

IFR traffic in Europe
1960-2011 historical figures
2012-2018 forecast

Long-Term Trend Before 2009
Forecast Traffic

Actual Traffic
Long-Term Average Growth
Annual Growth

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Number of available big ACC sector frequencies in 2006
ACC 100NM FL450 2006
Number of available big ACC sector frequencies in 2012
ACC 100NM FL450 2012
COMMUNICATIONS: Required Actions

- Maximise usage of VDL Mode 2.
- Expedite developments of future COM systems (terrestrial and satellite based).
- Investigate potential gaps and consider existing available and standardised systems as required.
- Explore flexible avionics equipment.
- Mature the multilink concept.
- Address aircraft connectivity in SWIM.
- Define role of Voice Communications in a future full TBO environment.
Performance Based Navigation (PBN) IR

Goal: Optimised use of airspace using **RNP**

**Key features:**
- **GNSS** as primary NAV sensor
- Ground infrastructure (DME-DME) as back up
- RNP Approach Specification → approaches with vertical guidance (VNAV)
  - Barometric VNAV
  - Localizer Precision with Vertical Guidance (LPV) using SBAS
- Defined **turn performance** in TMA and en route
- SIDs and STARs with coded altitude constraints → Continuous Descent Operation
PBN – Turn Performance

**RADIUS TO FIX (RF)**
- Used on procedures (SID STAR, Approach)
- Defined curved path between start and end waypoint

**FIXED RADIUS TRANSITION (FRT)**
- Potential use on Airways
- Defines the transition abeam an airway fix from one course to the next course
Evolution of Infrastructure

CURRENT INFRA-STRUCTURE → RATIONALISATION → INTEGRATION → TRANSITION CONSIDERATIONS → TARGET INFRA-STRUCTURE → NEW SYSTEMS
**Conclusions**

- Incremental steps in building the future concept
- Need to continue development efforts, while maximising potential of existing infrastructure and investments
- Need to consider CNS synergies and develop synchronized roadmaps
  - Avionics VS Ground
  - Applications VS Technologies
- Transition needs to be facilitated
- Need to work together: US, Europe, Other Regions, and ICAO
Q?

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