SESAR vs MET

Bart Nicolai – CAeM ET-ISA Core Expert
Geneva, 23 May 2017
Implementing the Single European Sky

5 pillars

Performance
- Performance scheme
- Performance Review Body
- Functional Airspace Blocks
- Network Manager
- National Supervisory Authorities

Safety
- EASA
- ATM
- Competence
- Crisis coord. cell

Technology
- ATM Master plan
- SESAR Joint Undertaking
- Common projects
- SESAR

Airport
- Airport observatory

Human factor
- Specific sectoral dialogue Committee
- Consultative expert group
- on social dimension of the SES

Source: European Commission
Planned position dependent on wind and influenced by (expected) location of adverse weather.
SESAR phases

The SESAR Phases

Definition phase
Create European ATM Master Plan

Development Phase
Develop new standards, operational procedures and technologies

Deployment Phase
Implement results of development to meet performance targets

2005-08
- 06/2009 Launch
- 07/2009 400 contributors, 20 projects
- 09/2009 Airlines on board
- 03/2010 1,300 contributors, 150 projects
- Today 3,000 contributors, 300 projects, 29 validation exercises

2008-2024
- 2008
- 2014-25
- 2024
- $3.6 \text{ Bln. Euro}$

Source: Eurocontrol (Dennis Hart)
SESAR consortia

Definition phase

R&D phase

Deployment phase

http://www.sesar-consortium.aero/
(no longer active)

http://www.sesardeploymentmanager.eu/

http://www.sesarju.eu/
SESAR 1 – Solutions

Source: SESAR JU
SESAR 1 – Mapping

Source: ATM Masterplan (v2012)
SESAR 1 vs. MET

Operational WP’s
- WP5 - TMA Operations
- WP4 - En Route Operations
- WP7 - Network Operations

Data modeling
System wide management
- WP8
- WP14 - SWIM

WX Information Services

Systems WP’s
- WP9 – Aircraft systems
- WP10 – Ground ATM systems
- WP12 – Airport operations systems
- WP13 – Network management systems

Operational ATM WX Integration

ATM System WX Integration

MET Capability

Source: Eurocontrol (Dennis hart)
SESAR 1 vs. MET

MET partner in SESAR

EUMETNET Consortium contracted by EUROCONTROL on behalf of SESAR Joint Undertaking

Source: Eurocontrol (Dennis hart)
SESAR 1 vs. MET – Raising awareness

User Engagement: Expectation in weather forecast

- Expectation
- GAP
- Service provided

Communicate scientific limitation and MET capability

- Expectation
- GAP
- Service provided

Based on science and technology

Based on current state-of-art and projection
MET vs. ATM timelines

Mapping MET to ATM & ATM to MET

Source: Eurocontrol (Dennis hart)
SESAR 1 vs. MET – Raising awareness
SESAR 1 vs. MET – Future MET concept and Requirements

Deliverables with MET concept & requirements

- MET-DOD (D18/D22/D26)
- MET-OSED (D9/D12/D19/D23) – 3 volumes
- MET-SPR (D10/D13/D20/D24) – 3 volumes
SESAR 1 vs. MET – MET prototypes

<table>
<thead>
<tr>
<th>MET prototype</th>
<th>Related Validation EXE</th>
<th>Related Large Scale Demonstration (LSD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1.1 Radar Composite for 3D convection</td>
<td>VP811</td>
<td>TOPMET, TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>X1.2 Nowcasting of Convection</td>
<td>VP811</td>
<td>TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>X1.3 Super-Ensemble Mesoscale Forecast of Convection</td>
<td>N/A</td>
<td>TOPMET, TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>X1.4 Iong Forecast</td>
<td>VP700, VP811</td>
<td>TOPMET, TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>X1.5 Clear Air Turbulence (CAT) Forecast</td>
<td>VP700, VP811</td>
<td>TOPMET, TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>X1.6 Winter Conditions Forecast at Airports</td>
<td>VP513</td>
<td>TOPLINK</td>
</tr>
<tr>
<td>X1.7 MET support for Network capacity reductions due to weather across Europe</td>
<td>VP700</td>
<td></td>
</tr>
<tr>
<td>X1.8 MET support to 4D trajectories</td>
<td>VP791(V2)</td>
<td></td>
</tr>
<tr>
<td>X2.1 Mode-S EHS New Sensors</td>
<td>VP869 (partially)</td>
<td></td>
</tr>
<tr>
<td>X2.2 E-AM DAR Humidity case studies</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>N/A 4DwxCube - MET-GATE</td>
<td>VP700, VP811</td>
<td>TOPLINK, SWIM Master Class, SWIM Global Demo</td>
</tr>
<tr>
<td>N/A Standard MET data (according ICAO Annex 3)</td>
<td>VP757</td>
<td></td>
</tr>
</tbody>
</table>

Source: Eurocontrol (Dennis hart)

SESAR 1 vs. MET – Exploratory research - ensembles

Example Probabilistic Trajectory Prediction SESAR WP11.1 / WP-E

Enables improved knowledge based decision making, e.g.:
- Trajectory uncertainty (thus cost) is visible
- Cost index could use these (flight time) uncertainties
- Balancing flight time adherence vs total cost

Sources: SESAR WP.E.02.40 Draft D2.2
SESAR 2020 – set up

Source: SESAR JU
**SESAR 2020 vs. MET (ER)**

**Meteorology**
Aviation is fundamentally affected by weather, and advances in the understanding and prediction of local and global meteorological effects will increase the efficiency and safety in the system. Enhanced meteorological information and capabilities made available system-wide have great potential as long as ATM is able to integrate the information fully into its decision making process.

**Specific challenge:** Research into enhanced meteorological capabilities and their integration into the ATM planning processes has great potential for improving ATM efficiency, e.g. through robust planning less vulnerable to unforeseen changes in weather; or through improved air-ground trajectory synchronisation. This requires understanding of the potential of different types of weather-related information in ATM operations taking into account the inherent uncertainty of meteorological information.

**Scope:** Research may investigate the vulnerability of the ATM system to local weather phenomena, with existing knowledge taken into account. Research may also investigate the levels of which weather uncertainty impacts 4D trajectories. Research to understand the impact of global and/or long-term phenomena such as climate change, global warming, changes in the frequency and severity of extreme weather or ash-cloud formation on ATM operations may also be considered.

**Expected impact:** This research will contribute significantly to enhancing ATM efficiency by integrating meteorological information. It will also lead to a better understanding of the resilience of the ATM system to local and global weather phenomena.


Source: SESAR JU & European Commission
| **PJ.18-04: Management and sharing of data used in trajectory (AIM/METEO)** | Solution PJ.18-04 will bring a coherent and consistent approach to how AIM and MET information required to support a gate-to-gate trajectory and the individual elements thereof will be managed from production to issuance. PJ.18-04 will collect and analyse the MET and AIM information requirements from the various other Solutions (including other Solutions defined by PJ.18) and define the required MET or AIM capability to meet these requirements as efficiently as possible. This includes a step to identify if there is a demonstrable benefit in providing the required MET or AIM information consistent and consolidated with other MET and AIM information or that a specific capability should be developed. The defined capabilities will be developed, prototyped and verified and the MET or AIM information will be made available as a SWIM service to the Solutions. |
| **PJ.03a-09: Extended provision of Terminal information using datalink** | This solution aims at providing the pilots current meteorological and operational flight information derived from ATIS and NOTAMs/SNOWTAMs, specifically relevant to the departure, approach and landing flight phases via datalink. D-OTIS can be seen as an evolution of the current ATIS services by including NOTAM information automatically, and making it accessible on demand for flight crew. In current ATIS, special operational information affecting the airport is often added manually in a few free text lines or broadcasted by voice. This information can also be provided electronically to the flight crew but only during pre-flight phases (via PIBs). |

Source: SESAR JU & European Commission
PJ.04-04: Pro-active management of MET impacts on the AOP

This SESAR solution addresses two key issues to support pro-active management, the translation of MET information in impacts and the quantification of their likelihood (predictability). Therefore the focus of the MET contribution will be on the integration of tailored MET information in the ATM and airport management processes, including information on MET forecast uncertainty. The first level of integration is already deployed at some CDM airports and consists in probabilistic MET information on a separate display. The next step in PJ04 will be to integrate MET information in impact assessment models to derive an ensemble prediction of the impacts and support DCB with probabilistic impact assessment. The last step in SESAR2020 will be to integrate MET impact assessment in decision support tools to derive optimal solutions in adverse weather conditions. The MET information covers from observation to 7 days forecast of nominal and significant weather, seamless in space and time, and with progressively finer time steps from 6 h for the 7 days horizon to 5 minutes for the forthcoming 2 hours. MET uncertainty will be quantitatively assessed using ensemble weather predictions that provide a probabilistic vision of the future.
Common Projects

“What, where, who & when”

**Identify & enforce** deployment of ATM functionalities that:

- Contribute to achieving the ATM Master plan **essential operational changes**
- Are **mature** enough for implementation
- Require a **synchronised** deployment

Source: European Commission
SESAR Deployment vs. MET
5.1.4. Meteorological information exchange

Operational stakeholders shall implement services which support the exchange of the following meteorological information using the yellow SWIM TI Profile:

- Meteorological prediction of the weather at the airport concerned, at a small interval in the future:
  - wind speed and direction
  - the air temperature
  - the altimeter pressure setting
  - the runway visual range (RVR)
  - Provide Volcanic Ash Mass Concentration
  - Specific MET info feature service
  - Winds aloft information service

- Meteorological information supporting Aerodrome ATC & Airport Landside process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact; the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days.

- Meteorological information supporting En Route/Approach ATC process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact; the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days.

- Meteorological information supporting Network Information Management process or aids involving the relevant MET information, translation processes to derive constraints for weather and converting this information in an ATM impact; the system capability mainly targets a 'time to decision' horizon between 20 minutes and 7 days.

Service implementations shall be compliant with the applicable version of AIRM, the AIRM Foundation Material and the ISRM Foundation Material.

**System requirements**

- ATM systems shall be able to use the MET information exchange services
Deployment Programme – MET outside 5.4.1

Families 1.1.1/1.1.2
• AMAN applications require high resolution wind information in approach/TMA area

Family 2.1.4
• (initial) AOP requires MET information as input to weather monitoring and adverse weather management activities

Family 2.3.1
• Time Based Separation requires high resolution wind information as input
• Ref. PCP: Actual glide slope wind conditions are required

Family 3.1.4
• To appropriately manage dynamic airspace configuration a good situational awareness of the weather conditions (both actual and pre-tactical) are required

Families 4.1.2/4.2.2
• Advanced STAM & NOP activities both require (network wide) MET information for situational awareness purposes and to trigger the required NM activities

Family 4.4.2
• Complexity management needs to take into account the weather situation to assess whether or not the proposed de-complexing traffic complexity solutions are feasible
Deployment Programme – SWIM aspects

Family 5.1.2
• Making SWIM compliant MET Information Services available: via NewPENS network

Family 5.1.3
• Implementation of common SWIM infrastructure components: MET information services to be published in SWIM registry

Families 5.2.1, 5.2.2 & 5.2.3
• Implement Internet Protocol compliance, SWIM infrastructure components & SWIM PKI & cyber security
# MET Projects (ongoing)

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Project Coordinator</th>
<th>Project Contributors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial WXXM Implementation on Belgocontrol systems</td>
<td>Belgocontrol</td>
<td>N.A</td>
</tr>
<tr>
<td>SESAR PCP Meteorological Information Exchange by MET ANSP KNMI to support non-safety-critical and safety-critical aviation applications for Amsterdam Schiphol</td>
<td>KNMI</td>
<td>N.A</td>
</tr>
<tr>
<td>European Weather Radar Composite of Convection Information Service</td>
<td>EUMETNET EIG</td>
<td>Met Office (UK) DWD Météo-France EUROCONTROL</td>
</tr>
<tr>
<td>European Harmonised Forecasts of Adverse Weather (Icing, Turbulence, Convection and Winter weather)</td>
<td>EUMETNET EIG</td>
<td>Met Office (UK) DWD Météo-France FMI EUROCONTROL</td>
</tr>
<tr>
<td>European MET Information Exchange (MET-GATE)</td>
<td>EUMETNET EIG</td>
<td>Met Office (UK) DWD Météo-France EUROCONTROL</td>
</tr>
<tr>
<td>European Meteorological Aircraft Derived Data Center (EMADDC)</td>
<td>KNMI</td>
<td>Met Office (UK)</td>
</tr>
<tr>
<td>Sub-regional SWIM MET deployment to support NEFRA</td>
<td>FMI</td>
<td>SMHI DMI EEA</td>
</tr>
</tbody>
</table>
# MET use projects (ongoing)

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Project Coordinator</th>
<th>Project Contributors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam Schiphol AMAN 2.0</td>
<td>LVNL</td>
<td>N.A.</td>
</tr>
<tr>
<td>Including: Implementing high resolution meteo data to improve trajectory prediction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AF2_MET-Compliance-Program</td>
<td>Austrocontrol</td>
<td>N.A.</td>
</tr>
<tr>
<td>Including:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Recovering and improving loss of capacity due to bad weather conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Supporting automatic observer functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Improve exchange of meteorological information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial (I)WXXM implementation on CCIS Amsterdam ACC and Schiphol</td>
<td>LVNL</td>
<td>N.A.</td>
</tr>
<tr>
<td>Including:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Implementation of the (I)WXXM model in the meteo gateway of LVNL, CCISv2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Demonstration and verification of the operational deployment of iSWIM for MET information, in collaboration with the dutch MET office KNMI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Receiving and storing MET information coming from the dutch MET office KNMI, compliant with the iSWIM data formats and interfaces.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Simultaneously supporting legacy messaging exchanges</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
THANK YOU!
ANY QUESTIONS?

IF YOU ONLY FOCUS ON THE PROBLEM
YOU MIGHT MISS THE EASY SOLUTION

DO YOU HAVE A PROBLEM?

YES

CAN YOU DO ANYTHING TO SOLVE IT?

YES

THEN WHY DO YOU WORRY?

NO