European Surveillance Modernisation in the global context

ATC Global 2015, Dubai

Christos Rekkas
Head of Surveillance Modernisation Section
05/10/2015
Contents

- Surveillance: Applications + Infrastructure
- Modernisation Progress
- Global Interoperability
- Impact on Operations -> Performance Benefits
- Future Outlook
## Surveillance Application baseline

<table>
<thead>
<tr>
<th>Surveillance Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSR/SSR Surveillance</td>
</tr>
<tr>
<td><strong>Mode S</strong></td>
</tr>
<tr>
<td>Elementary Surveillance (ELS)</td>
</tr>
<tr>
<td>Enhanced Surveillance (EHS)</td>
</tr>
<tr>
<td><strong>ADS-C Surveillance</strong></td>
</tr>
<tr>
<td>Multilateration Surveillance</td>
</tr>
<tr>
<td>In Non-Radar Airspace</td>
</tr>
<tr>
<td>In Radar Airspace</td>
</tr>
<tr>
<td>Airport Surveillance</td>
</tr>
<tr>
<td><strong>ADS-B Ground Surveillance (ADS-B Out)</strong></td>
</tr>
<tr>
<td>In Non-Radar Airspace (ADS-B NRA)</td>
</tr>
<tr>
<td>In Radar Airspace (ADS-B RAD)</td>
</tr>
<tr>
<td>Airport Surveillance (ADS-B APT)</td>
</tr>
<tr>
<td>Aircraft Derived Data (ADS-B ADD)</td>
</tr>
<tr>
<td><strong>ADS-B Airborne Surveillance (ADS-B In)</strong></td>
</tr>
<tr>
<td>Enhanced TSA during flight operations (AIRB)</td>
</tr>
<tr>
<td>In Trail Procedure (ITP)</td>
</tr>
<tr>
<td>Visual separation in Approach (VSA)</td>
</tr>
<tr>
<td>Traffic Situation Awareness with Alerts (TSAA)</td>
</tr>
</tbody>
</table>
**SUR Infrastructure baseline**

**Surveillance Sensors**

- Radars (PSR, MSSR, Mode S)
- ADS-B
- ADS-C
- Multilateration

**Derived Data**

**ASTERIX Interfaces**

- Secured distribution of surveillance information
- ASTERIX: All Purpose STructured EUROCONTROL suRveillance Information eXchange

**Surveillance Data Distribution**

- Performance monitoring

**Surveillance Data Evaluation**

- Elaboration of accurate Air Situation Picture

**Surveillance Data Processing**

**Users**

- Controller display
- Safety nets
- FPL conformance
- and more…

**SUR Users**
Radar implementation

~450 civil secondary radars in Europe
ADS-B & WAM Implementation Overview

**ADS-B IN**
- Voluntary implementation in wider areas
  - New equipage
  - Avionics: EASA AMC20-24 and EASA CS-ACNS

**ADS-B OUT**
- Transition Phase
  - Voluntary implementation in pocket areas
  - Certified existing equipage
  - Avionics: EASA AMC20-24

- Mandate Phase
  - EU Regulation 1207/2011
  - EU Regulation 1028/2014
  - IR based implementation in wider areas
  - Upgraded equipage
  - Avionics: EASA CS-ACNS

**WAM**
- WAM / ADS-B Ground system Deployment
## ADS-B & WAM Implementation

### Legend
- ADS-B current equipage
- ADS-B updated avionics
- WAM with ADS-B capabilities
- ADS-B and WAM Opportunities

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Albania</td>
<td></td>
<td>Albania</td>
<td>Deployed</td>
</tr>
<tr>
<td>2</td>
<td>Armenia</td>
<td></td>
<td>Armenia</td>
<td>Deployed</td>
</tr>
<tr>
<td>3</td>
<td>Austria</td>
<td></td>
<td>Austria</td>
<td>Deployed</td>
</tr>
<tr>
<td>4</td>
<td>Azerbaijan</td>
<td></td>
<td>Azerbaijan</td>
<td>Deployed</td>
</tr>
<tr>
<td>5</td>
<td>Bulgaria</td>
<td></td>
<td>Bulgaria</td>
<td>Deployed</td>
</tr>
<tr>
<td>6</td>
<td>Czech Republic</td>
<td></td>
<td>Czech Republic</td>
<td>Deployed</td>
</tr>
<tr>
<td>7</td>
<td>Cyprus</td>
<td></td>
<td>Cyprus</td>
<td>Deployed</td>
</tr>
<tr>
<td>8</td>
<td>Denmark</td>
<td></td>
<td>Denmark</td>
<td>Deployed</td>
</tr>
<tr>
<td>9</td>
<td>Estonia</td>
<td></td>
<td>Estonia</td>
<td>Deployed</td>
</tr>
<tr>
<td>10</td>
<td>Finland</td>
<td></td>
<td>Finland</td>
<td>Deployed</td>
</tr>
<tr>
<td>11</td>
<td>France</td>
<td></td>
<td>France</td>
<td>Deployed</td>
</tr>
<tr>
<td>12</td>
<td>Germany</td>
<td></td>
<td>Germany</td>
<td>Deployed</td>
</tr>
<tr>
<td>13</td>
<td>Georgia</td>
<td></td>
<td>Georgia</td>
<td>Deployed</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td></td>
<td>Greece</td>
<td>Deployed</td>
</tr>
<tr>
<td>15</td>
<td>Iceland</td>
<td></td>
<td>Iceland</td>
<td>Deployed</td>
</tr>
<tr>
<td>16</td>
<td>Ireland</td>
<td></td>
<td>Ireland</td>
<td>Deployed</td>
</tr>
<tr>
<td>17</td>
<td>Italy</td>
<td></td>
<td>Italy</td>
<td>Deployed</td>
</tr>
<tr>
<td>18</td>
<td>Latvia</td>
<td></td>
<td>Latvia</td>
<td>Deployed</td>
</tr>
<tr>
<td>19</td>
<td>Malta</td>
<td></td>
<td>Malta</td>
<td>Deployed</td>
</tr>
<tr>
<td>20</td>
<td>Netherlands</td>
<td></td>
<td>Netherlands</td>
<td>Deployed</td>
</tr>
<tr>
<td>21</td>
<td>Norway</td>
<td></td>
<td>Norway</td>
<td>Deployed</td>
</tr>
<tr>
<td>22</td>
<td>Poland</td>
<td></td>
<td>Poland</td>
<td>Deployed</td>
</tr>
<tr>
<td>23</td>
<td>Portugal</td>
<td></td>
<td>Portugal</td>
<td>Deployed</td>
</tr>
<tr>
<td>24</td>
<td>Romania</td>
<td></td>
<td>Romania</td>
<td>Deployed</td>
</tr>
<tr>
<td>25</td>
<td>Slovak republic</td>
<td></td>
<td>Slovak republic</td>
<td>Deployed</td>
</tr>
<tr>
<td>26</td>
<td>Spain</td>
<td></td>
<td>Spain</td>
<td>Deployed</td>
</tr>
<tr>
<td>27</td>
<td>Sweden</td>
<td></td>
<td>Sweden</td>
<td>Deployed</td>
</tr>
<tr>
<td>28</td>
<td>Turkey</td>
<td></td>
<td>Turkey</td>
<td>Deployed</td>
</tr>
<tr>
<td>29</td>
<td>UK</td>
<td></td>
<td>UK</td>
<td>Deployed</td>
</tr>
<tr>
<td>30</td>
<td>Ukraine</td>
<td></td>
<td>Ukraine</td>
<td>Deployed</td>
</tr>
<tr>
<td>+</td>
<td>All other continents</td>
<td></td>
<td></td>
<td>Deployed</td>
</tr>
</tbody>
</table>

- D = Deployed
- O = Operational
ADS-B & WAM ground stations

Note: Only deployed or firmly committed are included
Space based ADS-B

- Global coverage of ADS-B Out
- Several studies
- Aireon starting satellite deployment
  - 66 LEO satellites (Iridium NEXT)
  - Full constellation 2017
  - Initial operations 2018
- Main interest for low density airspace
- ATM Impact – key issues
  - Performance
  - Interoperability
  - Business Case
  - Global coordination
SUR Data Fusion

Radar/ADS/WAM functionality available in modern data fusion systems

More than 20 years of ARTAS evolution
- Surveillance technology upgrades (e.g. for new types of sensors)
- Performance (capacity) doubled
- Platform cost divided by 70
- More than 2,000,000 hours of field service experience

ARTAS: ATM Surveillance Tracker and Server
EU Regulation

SPI IR (1207/2011 and 1028/2014)

- All aircraft flying IFR/GAT
  - Mode S ELS
- Aircraft flying IFR/GAT >5700 kg or >250kts TAS
  - ADS-B Out (v2) & Mode S EHS

Mandate dates

- ELS
  - Forward fit: Jan 2015
  - Retrofit: Dec 2017
- EHS and ADS-B
  - Forward Fit: June 2016
  - Retrofit: June 2020
- Provisions for State a/c

SPI IR amendment is ongoing (incl. GA)
Performance Monitoring

Performance Monitoring of
✓ Avionics (e.g. Transponder, Altimeter)
✓ Ground systems (sensors, data fusion)
✓ Data link

Monitoring Methods & Tools
SASS-C
RF Monitoring tools
RVSM Height Monitoring Unit
ADS-B Monitoring

Avionics monitoring activities
✓ Flight test & analysis support
✓ Aircraft equipage rates
✓ Anomalies investigation

![Graph showing ADS-B Equipage - all versions]

- **13300 ADS-B aircraft in the Database**
- **20+ billion ADS-B reports**

**ADS-B equipped a/c over Paris:**
- Total ADS-B Out a/c: ~12 600
  - v0 (ED102/DO260): ~9 600
  - v1 (DO260A): ~1 100
  - v2 (ED102A/DO260B): ~1 900
Airborne Surveillance
ATSAW operational since 2012

- 20 000+ ATSAW flights so far (~14 000 within trial period)
- Deployment of ATSAW on revenue aircraft
- Large stakeholder participation
  - Project: 6 Airlines and 2 ANSPs
  - Several other airlines have also equipped
Global harmonisation

More than a decade of intensive international co-operation
Australia, Canada, Europe, USA, ICAO etc.
ANSPs/Airspace Users/Industry/Regulators

Common Standards for all applications and systems

Aligned Certification material

Exchange of functional performance assessment results

Great contribution to global interoperability and efficiency
# Global Standards

<table>
<thead>
<tr>
<th>Year</th>
<th>ADS-B Out &amp; WAM</th>
<th>ADS-B In</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td></td>
<td>SPR VSA SPR ED-160 (314)</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>MOPS SURF SPR ED-165 (322)</td>
</tr>
<tr>
<td>2011</td>
<td></td>
<td>MOPS FIM SPR ED-195 (328)</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Cert**
- EASA AMC20-24
- FAA AC20-165A
- FAA AC20-172A
- EASA CS-ACNS
- EASA CRI
- TSO-C195a (ED194/317A)
- TSO-C195b (ED194A/DO317B)
- FAA AC20-172B
- FIM SPR ED-195A (328A)
- A-IM, PTM, SURF IA (tbd)
- FIM MOPS ED-236

**Publications**
- ADS-B RAD ED-161 (318)
- ADS-B APT ED-163 (321)
- WAM system spec ED-142
- 1090 Link MOPS ED-102A/DO-260B
- 1090 ADS-B GS spec ED-129
- ETO C166b A1 (ED102A) & C112d (ED73E/ED102A)
- EASA CS-ACNS
- FAA AC20-165A
- FAA AC20-172A
- EASA CS-ACNS

**Publication date:**

**Expected date:**
Safety and Security

Preliminary Safety Cases (PSC), by EUROCONTROL

Generic SUR Security Risk Assessment (ongoing)
EUROCONTROL in co-ordination with ICAO, NATO, SESAR
European Aviation Safety Agency (EASA) CS-ACNS

Compliance means for EU Regulation 1207/2011
Avionics upgrade required: Mode S ELS/EHS & ADS-B v2
Supports surveillance in high density airspace (e.g. continental Europe)

EASA AMC 20-24

Legacy ADS-B Out installations are generally compliant to AMC20-24
Supports surveillance in low density airspace (e.g. periphery of Europe, Australia, Canada, SE Asia etc.)

In USA: Certification baseline FAA AC 20-165A supports the US mandate
Performance Improvements overview

Full “Network-wide” Surveillance coverage
- Ground Surveillance with “no gaps” from gate-to-gate
- Airborne Surveillance now possible, i.e. traffic picture available on board
- Surveillance data directly from on-board systems

Higher Quality – e.g. accuracy
Safety
Capacity
Cost-efficiency
Flight efficiency
- Potential for better flight profiles
- Fuel savings

Environmental Sustainability (CO2 reduction)
Spectrum efficiency (efficient use of 1090 MHz datalink)
Global Interoperability
Performance Monitoring - multi-sensor
Solid foundation for future applications (developed by SESAR, NEXTGEN etc.)
Impact on operations and benefits
Non radar airspace (Low density)

Europe: Oceanic airspace / Mediterranean / Secondary TMAs etc. Australia, Canada, S.E. Asia etc.

No SUR coverage before (procedural)

- Reduced Separation minima
- Shorter routings, optimal flight levels, reduced holdings, fuel savings, CO2 emission reduction etc.
- Safety, Capacity, Flight Efficiency, environmental sustainability

Legacy ADS-B or WAM can be used
Impact on operations and benefits
Radar airspace (Medium and high density)

Continental parts of Europe
Radar separation before

✓ Radar decommissioning at the end of their operational life
  (ADS-B/WAM -> double SUR layer)

✓ Infrastructure rationalisation

✓ Cost and Spectrum efficiency -> Infrastructure Cost reduction

WAM can be used now
ADS-B upgraded functionality required (e.g. EU Regulation)
Performance Based Surveillance Documents and products

Generic SUR Safety and Performance Requirements
- Draft by EUROCONTROL
- Standardisation by EUROCAE starts in Oct 2015
Surveillance Vision and Objectives

Performance Based Surveillance progressively integrating new technologies and supporting evolving operational applications (ground and airborne), with Global Gate-to-Gate Seamless Coverage, Cost & Spectrum Efficiency and Global Interoperability

Airborne SUR applications

Future proof avionics: SPI IR + Voluntary

Low Density Airspace

Medium & High Density Airspace

Ground SUR applications

Multisensor Data fusion

INCS where req’d

WAM or Mode S

ADS-B

Continuous Performance Monitoring

SPI IR: SUR Performance and Interoperability Implementing Rule (EU Reg. 1207/2011 and amendments)
INCS: Independent Non-Cooperative Surveillance (e.g. Multistatic PSR)
Drivers for Future Surveillance Evolution

**Operational needs**
- Global Coverage (reduced separation)
- Increasing number of a/c (e.g. RPAS) & users
- New applications (ASAS, Met, Intent)
- Rationalisation (cost & spectrum)

**Innovations**
- Integration (within CNS & with ACAS)
- Performance-based Surveillance
- Space based ADS-B (IOC 2018)
- High capacity 1090 datalink (+300%)
- New ADDs e.g. Met, intent
- Independent non-cooperative Surveillance
- Low-cost avionics for GA & RPAS

**Future SUR**
- Performance Improvements
  - Full Coverage
  - Quality
  - Safety
  - Capacity
  - Cost-effectiveness
  - Flight efficiency
  - Fuel savings
  - Spectrum efficiency
  - CO2 reduction
  - Interoperability
  - Monitoring
  - Future growth

ASAS: Airborne Separation Assistance Systems
IOC: Initial Operational Capability
ADD: Aircraft Derived Data
RPAS: Remotely Piloted Aircraft Systems
SESAR Programme
SUR perspective

SESAR Joint Undertaking (SJU)
   Emphasis on R&D
   Input to deployment

SESAR 1 (->2016)
   WP9: Avionics
   WP15: Ground CNS
   Other WPs on SUR applications

SESAR 2020 (2016->2024)
   Preparation ongoing
   Several projects with SUR interest (Infrastructure and applications)
Summary

Surveillance Modernisation progressing fast

~25 ANSPs deploy 800+ ADS-B / WAM stations

Modernised high performance interoperable Surveillance system

Airborne equipage growing
EU Regulation being amended

Partnership with the stakeholders is key
For more information

www.eurocontrol.int/sms