Air Traffic Management and ADS-B

Michael Sahlberg, April 2013
What I’ll talk about

- Saab’s role in world-wide air traffic management
- Our product suite
- And, of course, a detailed look at Saab’s ADS-B, including
  - Saab 1090 Extended Squitter ADS-B Ground Surveillance System
  - Deployments for Nav Canada and Avinor
WORLD-CLASS TECHNOLOGY
More than 75 years

1941
First B17 delivered

1948
Tunnan – first flight

1979
First laser simulator BT46

1990
First Gripen delivered

1993
First contract for NLAW

2002
Contract for Neuron

2005
Saab 2000 ERIEYE™ AEW&C

2006
Gripen Demo – first flight

1946
Bofors Järnbruk is founded

1894
Alfred Nobel acquire Bofors

1948
First order for Carl Gustaf

1998
StriC in operation

1950-
Development of fighter radar

1970-
Development of GIRAFFE

1980-
Development of ARTHUR

1990-
Sea Giraffe AMB is launched

1937
Saab is founded

1990
Saab Automobile independent company

2000
Saab acquires Celsius

2005
Saab acquires Grintek

2006
Saab acquires EMW
THE FUTURE OF AIR TRAFFIC MANAGEMENT

DOUBLED CAPACITY

INCREASED SAFETY & SECURITY

REDUCED COSTS

REDUCED ENVIRONMENTAL FOOTPRINT
FOR ALL STAKEHOLDERS
AT AIRPORTS OF ALL SIZES
Saab ATM

- Saab Sensis leads Saab’s global air traffic management
- Employees in United States, Europe and Australia
Saab ATM

- We are the unmatched leaders in global ATM
- We helped pioneer many of the modern ATM systems in use across the world today
- We’re respected for innovation, agility, and our commitment to engineering excellence.
- Improving security, safety and efficiency at more than 250 locations in 40 countries.
Sensis and HITT

- Building on its own air traffic management capabilities, Saab acquired Sensis in 2011 and HITT in 2012.

- Sensis, founded in 1985, specializes in advanced air traffic management and defense radar and security systems. **Sensis pioneered the development and implementation of ADS-B**, fielding the first operational transceivers for both Mode S Extended Squitter (1092 ES) and UAT datalinks.

- HITT brings considerable expertise in air and vessel traffic management systems and has a well-established presence in Europe, India and China; and a growing presence in South America.
Saab ATM

- Products and services in more than 250 locations across the globe
- Servicing 19 of the 20 busiest airports in the world and 10 of the 12 largest Air Navigation Service Providers

- With the inclusion of SENSIS and HITT, SAAB ATM has systems assisting more than twice as many air movements across the globe than any other company.
AIR TRAFFIC MANAGEMENT LEADERS

AIRPORT SURFACE SAFETY
WIDE AREA SURVEILLANCE
AIRLINE AND AIRPORT AUTOMATION
TOWER AUTOMATION
ADVANCED DEVELOPMENT

RWSL & A-SMGCS & MLAT

- Additional runway safety
- Aircraft and vehicle movements
- All weather operations
- Direct-to-pilot warnings
AIR TRAFFIC MANAGEMENT LEADERS

- AIRPORT SURFACE SAFETY
- WIDE AREA SURVEILLANCE
- AIRLINE AND AIRPORT AUTOMATION
- TOWER AUTOMATION
- ADVANCED DEVELOPMENT

MLAT & ADS-B

- Multi-level surveillance
- Precise location of traffic
- Conflict detection and alert
- Lower costs
AIR TRAFFIC MANAGEMENT LEADERS

AIRPORT SURFACE SAFETY

WIDE AREA SURVEILLANCE

AIRLINE AND AIRPORT AUTOMATION

TOWER AUTOMATION

ADVANCED DEVELOPMENT

AEROBAHN

- Enables resource optimization
- Reduce emissions
- Facilitates planning
- Decrease delays and heighten performance
AIR TRAFFIC MANAGEMENT LEADERS

AIRPORT SURFACE SAFETY

WIDE AREA SURVEILLANCE

AIRLINE AND AIRPORT AUTOMATION

TOWER AUTOMATION

ADVANCED DEVELOPMENT

r-TWR & INTAS & i-TWR

- E-strips and other advanced systems
- Improved workflow
- Sustaining profitable airports
- Efficient and safe
AIR TRAFFIC MANAGEMENT LEADERS

- Decision support tools
- Trajectory based flight management
- Advanced analysis and problem-solving
- Research to Reality

AIRPORT SURFACE SAFETY
WIDE AREA SURVEILLANCE
AIRLINE AND AIRPORT AUTOMATION
TOWER AUTOMATION
ADVANCED DEVELOPMENT
Saab 1090 Extended Squitter (ES) ADS-B Ground Surveillance System (GSS)
Ground Surveillance System (GSS) Architecture

GSS consists of ground stations, Remote Control & Monitoring, optional ADS-B Central Processing and optional MLAT Processing
RU6 – MLAT and 1090 ES ADS-B Ground Station

★ ADS-B capable:
  • Processes DO-260/A/B Mode S ES messages
  • Reports ASTERIX CAT021/CAT023 messages
  • Complies with ED-129

★ MLAT capable:
  • Receives and decodes Mode S, Mode S ES and Mode A/C messages
  • Transmits Mode S/A/C interrogations

★ High resolution time stamping

★ GPS antenna and receiver

★ Indoor/Outdoor:
  • Weatherproof enclosure, -40C to 55C
  • 19” rack mountable

★ Low power consumption
**ADS-B Central Processor (ADS-B Server)**

- Consolidates CAT21 reports for one target from different ground stations into one output for automation
- Can support validation of ADS-B data through a variety of techniques (TDOA, comparison to radar, etc.)
- Can support multiple flavors of ASTERIX CAT21, as well as legacy radar formats such as CAT34/48
- Provides ADS-B outputs to multiple clients
- Evaluates equipment status to determine system status
- Web based control and monitoring interface (like eLCMS for the GS)
- Flexible, scalable service oriented architecture
- Fully redundant
- Supports up to 500 simultaneous targets and up to 128 GS
Ground Station Antennas

Variety of antennas for short range, medium range and long range applications:

- 3 dB AS177
- 9 dB dB-5100A
- 12 dB dB-540
### 1090 ES Ground Station Specs (1/2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message Processing</td>
<td>Complies with <em>EUROCAE ED-129</em> and <em>DO-260B</em></td>
</tr>
<tr>
<td>Report Formats</td>
<td>Target Reports: Cat021 Ed 1.4</td>
</tr>
<tr>
<td></td>
<td>Status Reports: Cat023 Ed 1.2</td>
</tr>
<tr>
<td>ASTERIX CAT021 Data Items Inclusion</td>
<td>Per ED-129. Non-mandatory data items are configurable.</td>
</tr>
<tr>
<td>Reporting Modes</td>
<td>Periodic, Data Driven, Throttled</td>
</tr>
<tr>
<td>Target Filters</td>
<td>Filters by 24 bit ICAO address, NUCp, NIC</td>
</tr>
<tr>
<td>Capacity/Latency</td>
<td>3000 ES messages/sec, 500 ASTERIX reports/sec &lt; 500 ms latency</td>
</tr>
</tbody>
</table>
## 1090 ES Ground Station Specs (2/2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control &amp; Monitoring</td>
<td>SNMP v2, embedded web based interface</td>
</tr>
<tr>
<td>Interfaces</td>
<td>IP based, local and remote network interfaces</td>
</tr>
<tr>
<td>Modes &amp; States</td>
<td>Operational/Maintenance Mode</td>
</tr>
<tr>
<td></td>
<td>Primary/Secondary State (for redundancy support)</td>
</tr>
<tr>
<td>MLAT Support</td>
<td>Compatible with Saab Sensis Multistatic Dependent Surveillance (MDS) surface and wide area multilateration system</td>
</tr>
<tr>
<td>Software Assurance</td>
<td>ED-129, Assurance Level (AL) 4</td>
</tr>
</tbody>
</table>
Local Control & Monitoring System (LCMS)

- Saab ADS-B Ground station incorporates embedded web server (eLCMS) for control & monitoring
- User connects to eLCMS with standard web browser, no special software is required
- User can view LRU status, view statistics, configure GS and upload new software versions
Remote Control & Monitoring System (RCMS)

- Control & monitoring of multiple ground stations
  - GS LRU status and statistics
  - GS commands and configuration parameters
  - Code and file upload

- Data recording: ASTERIX CAT21/23 and raw Mode S messages (if enabled at the GS)

- Air Situation Display

- Security and access control
ADS-B Integrity Monitoring

- Saab VeeLo NG can be used as an ADS-B Site Monitor
- Provides end-to-end RF Test Target and GPS integrity monitoring
- Generates DO-260A compliant ADS-B position with HPL
- Adaptable Mode S address
- GS monitors reception of ADS-B site monitor message and verify correct position
- GS generates CAT21 target report flagged as site monitor, with FOM derived from HPL

<table>
<thead>
<tr>
<th>Saab Sensis Veelo</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions (HxWxD)</td>
<td>235 x 146 x 205 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>0.77 kg</td>
</tr>
<tr>
<td>Power Supply</td>
<td>9 to 32 Volts DC, ~1.5 watts</td>
</tr>
<tr>
<td>Transmit Power</td>
<td>20 W (peak)</td>
</tr>
<tr>
<td>Temperature</td>
<td>-30 to 55 °C</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>5 to 95%</td>
</tr>
<tr>
<td>Wind</td>
<td>Up to 160 kph</td>
</tr>
</tbody>
</table>
ADS-B Implementation Considerations

_interfaces to Automation_

• Eurocontrol ASTERIX standards for ADS-B reports
• Typical: Category 21 for target reports, Category 23 for ground station status
• Specialized formats possible for legacy automation (e.g. CD2, CAT34/48)
• Needs to be supported by the ATC Processing and Display system: data fusion, handling of accuracy/integrity indicators, handling of identification (Flight ID vs. Mode A), display symbology, etc.

_standards Compliance_

• ADS-B Mandate in 2016 for Europe and 2020 for United States
• **Ground Station:** EUROCAE ED-126 (RTCA DO-303)/ED-129
• **Software:** EUROCAE ED-109/ED-153
• **Avionics:** RTCA DO-260/A/B, EUROCAE ED-102A

Ensure that continuous compliance to revised specifications is supported by surveillance supplier
ADS-B Safety Considerations

- **ADS-B accuracy and equipage**
  - Risk: non-equipped targets or inaccurate or low quality ADS-B positions
  - Mitigation: airspace segregation for ADS-B equipped targets, implementation of ADS-B “White List”, filtering of low integrity ADS-B reports

- **GPS Integrity**
  - Risk: Poor ADS-B accuracy due to constellation or no ADS-B due to GPS outage
  - Mitigation: incorporate GPS integrity monitors at each ground station location. Discard ADS-B reports in case of low GPS integrity

- **Duplicate ICAO 24-bit Mode S address**
  - Risk: Safety critical situation if transponder identifications are duplicated
  - Mitigation: detect, track and identify duplicated addresses
Deployment Example:

- ADS-B for NAV CANADA
- 12 redundant ground stations deployed around Hudson Bay, North Eastern Canada and Greenland
ADS-B for NAV CANADA

Problem:

- Hudson Bay covers an area of over 250,000 sq. nmi
- Little surveillance coverage over the Bay
- Aircraft traversing the area require procedural separation (80 nmi – 10 minutes)
- Longer flights, increased fuel consumption, traffic limitations

Solution:

- ADS-B surveillance of airspace over Bay
- Reduced separation to 5 nmi and preferred altitude for qualified aircraft
- Enhanced safety
ADS-B for NAV CANADA

ADS-B GS are installed in challenging environment

ADS-B GS provide a >250 nm range
ADS-B for NAV CANADA

- Hudson Bay currently operational for 5 nm separation of qualified aircraft since January 2009
- 30 Airlines with Over 800 ADS-B Eligible Aircraft are currently operating in Hudson Bay Airspace
- 50-60% ADS-B equipage
- NAV CANADA estimates that ADS-B will save 195M CAD and will reduce carbon emissions by 436,000 metric tonnes by 2016
- Saab Sensis/NAV CANADA awarded the “Jane’s Environment Award” at the 2010 ATC Global Exhibition and Conference

ADS-B Deployment will proceed in multiple phases throughout Canada. Goal is to provide full coverage of Canadian airspace through a combination of ADS-B, WAM and radar.
Deployment Example:

- ADS-B for Avinor Ekofisk/Balder
- North Sea west of Norway
Program Description

Customer: Avinor

Purpose:
- Deploy an ADS-B surveillance system to provide all weather surveillance of helicopters over oil platforms in the North Sea
- Upgrade Ekofisk ADS area from Class G uncontrolled to Class D controlled airspace
- Provide accurate location data for search and rescue operations

Challenges
- Harsh North Sea environment
- 160,000 helicopter movements annually
- Low-altitude coverage requirements
- Confined equipment spaces
- Limited site accessibility
Solution and Benefits

Solution: ADS-B GSS with 11 GS, 2 ADS-B Servers and 2 CMS Servers

Benefits

• Highly accurate surveillance enhances safety of flights by providing greater situational awareness as well as critical data for search and rescue
• Upgraded to support ATC services with a minimum separation of five nautical miles
• use the same hardware as existing MLAT systems, = lower logistics costs
Avinor ADS-B Coverage at 1500 Ft AMSL
Actual Ground Station Performance

Actual ADS-B GS range exceeds 250 NM!
**ADS-B Deployment Challenges**

- **Availability of infrastructure**
  - Cost of available bandwidth
  - Reliability of comms & power
  - Space constraints
  - Remote locations
  - Maintenance difficulties

- **Site Acquisition**
  - Often commercial sites required
  - Cost, time to get access

- **Environment and weather**

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*Site selection is critical for successful ADS-B deployment*
Saab ADS-B Experience

- Saab has deployed over 1000 MLAT and ADS-B Ground Stations throughout the world
- Saab (Sensis) has been an ADS-B technology leader by participating in ADS-B trials and early deployments
- Saab is an active participant of key RTCA, Eurocontrol and EUROCAE ADS-B working groups and is helping shape the ADS-B standards
Summary

- Saab has a long and rich experience with ADS-B technologies.
- Saab MLAT and ADS-B equipment has been deployed for ATC applications throughout the world, in a variety of operational and physical environments.
- Saab equipment is very reliable and has performed flawlessly in all environments.
- The Saab ADS-B Ground System complies with the latest ADS-B standards, ED-129 and DO-260B.
- The Saab Ground Station can provide both ADS-B and MLAT services simultaneously.
- Saab is committed to the ADS-B technology and will continue to update its product line as the standards evolve.
THANK YOU

Saab ADS-B technology: proven, rugged and reliable.
Lower initial cost and lifecycle cost.
Deployed in challenging environments.
Back up slides follow
What is ADS-B Surveillance?

- On board aircraft equipment determines GPS position and velocity based on GPS
- Aircraft transmits position, velocity, identity, altitude, status, intent
- Ground stations receive and decode ADS-B messages and send ADS-B position reports to ATC automation
- Multiple ADS–B data links
  - 1090 MHz Extended Squitter (ES)
  - Universal Access Transceiver (UAT), implemented in the US
Benefits of ADS-B

### Flexible and Scalable
- Small size, low power consumption GS enable deployment in many physical environments
- Adaptable to terrain-limited coverage
- Coverage is extended with addition of ground stations

### High Performance
- ADS-B provides better accuracy, higher integrity and higher update rate than traditional radar
- Enables reduction in separation standards
- Enables many air-to-ground and air-to-air applications

### Low Cost
- Lower acquisition cost and life cycle costs than radar

*ADS-B has many qualities that SSR cannot match*