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Agenda

- Next gen. Air traffic surveillance (ADS-B)
- Potential Security threats in ADS-B
- Hazard / Consequences of security threats in ADS-B
- Mitigations techniques
  1. Comparison between ADS-B and other Surveillance sensors (WAM)
  2. **Data Fusion with consistency check**
  3. Velocity/ position prediction
  4. AoA and sector antenna
  5. Received Power strength vs range correlation
  6. TDoA vs Range Correlation
  7. **Artificial intelligent and machine learning**
Role of Surveillance

7.3 billion passengers are expected by 2034: require accurate surveillance

Role of Surveillance

- Ability to accurately determine, track and update the position of aircraft

- Separation standard
- How efficiently air space can be utilized

- An indication of any unexpected aircraft movements
Surveillance

- Primary Surveillance Radar (PSR)
- Secondary Surveillance Radar (SSR)
- Multilateration (MLAT)
- Automatic Dependent Surveillance – Broadcast (ADS-B)
Next gen. Air traffic surveillance (ADS-B)

- Low cost receivers
- Extremely Accurate
- High update rate
- Can Reduce min separation
- More Information
  - Identity of the aircraft
  - Can provide heading, speed
<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
<th>Accuracy</th>
<th>Update rate</th>
<th>Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADS-B</td>
<td>Very Low</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

Eavesdropping
Jamming
Spoofing
Potential Security threats in ADS-B
Potential Security threats in ADS-B

- Jamming
- Spoofing (adding fake targets, modification of real messages)
Hazard/ Consequences of security threats in ADS-B

<table>
<thead>
<tr>
<th>Hazard</th>
<th>Worst case consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jamming</td>
<td>Partial/full loss of traffic picture</td>
</tr>
<tr>
<td>Spoofing</td>
<td>“fake” tracks. Increases Air Traffic Controller (ATCO) workload</td>
</tr>
</tbody>
</table>
1. Comparison between ADS-B and other Surveillance sensors (WAM)

- ADS-B message report
- WAM message report

Accept

Disadvantages

- WAM message report

Reject
2. Data Fusion with Consistency check

Source: Enhancing accuracy and security of ADSB via MLAT assisted-flight information system, in: 2017 12th International Conference on Computer Engineering and Systems (ICCES)
3. Velocity/position prediction

Predicted location

Accept

Reject

Prior locations

ADS-B message report

ADS-B message report
3. Velocity/position prediction

Frog Boiling attack
4. AoA, Sector Antenna
4. AoA, sector antenna

**Accept**

ADS-B message report

**Reject**

ADS-B message report

**Disadvantages**
5. Received Power strength vs range correlation

Position estimated from received power

Reject

Accept

Disadvantages

ADS-B message report

Rx 1

Rx 2

Rx 3

Rx 4
6. TDoA vs Range Correlation

- ADS-B message report
- Position estimated from TDoA

- Reject
- Accept

Rx 1
Rx 2
Rx 3
Rx 4
6. TDoA vs Range Correlation

Disadvantages

Synchronization

Multi-path environment

Low Accuracy
7. Artificial intelligent and machine learning

Offline training phase

Fingerprint Map

Longitude

Latitude
7. Artificial intelligent and machine learning

Online localization phase

Determine the best location matches Incoming fingerprint
7. Artificial intelligent and machine learning

Advantages

- Determining location of aircraft regardless ADS-B message report
- Works well in less Synchronization
- Works well in Multi-path environment
- High localization Accuracy
Conclusion

- Coverage
- Accuracy
- Reliability
- Availability
- Quality of service
- Trust

Communication
Navigation
Surveillance

How to measure it
How to enhance it