

THE FUTURE OF ALERTS



ADS-B Seminar
Mark Palmer
Thales Melbourne



The Introduction of ADS-B provides scope for enhancing the current alert capabilities of ATM systems.

New alerts can be grouped into the following categories:

- ✦ Inconsistency between ADS-B data and radar data,
- ✦ Inconsistency between ADS-B data and flight plan data,



Possible improvements to existing alert functionality impact:

- ✦ Cleared Level Monitoring,
- ✦ Route Adherence Monitoring,
- ✦ Short Term Conflict Alert
- ✦ Minimum Safe Altitude Warning and
- ✦ Danger Area Infringement Warning.



NEW ALERTS: Inconsistency aircraft received data & aircraft derived data

It is anticipated that the prime area for deriving new alerts in an ADS-B environment is in the **comparison between ADS-B data and Radar data**.

Today many aircraft are detected simultaneously by radar and ADS-C transmissions. Soon aircraft will also be detected by ADS-B transmissions. The variety of sensor types provide multiple sources of data for the same aircraft.

In the future, data from such multiple sources will be fused together, forming one “system track” that represents the physical aircraft. Fusion can take two forms:

- ✦ The fusion of multiple radar data sources, and
- ✦ The fusion of ADS-B data and radar data.

An essential part of the process will be checking the data for inconsistencies during this fusion procedure.



The simplest new alert will highlight inconsistencies between the derived and received position of the aircraft.

- This alert must have the capability to attempt to determine if the sensor or the aircraft position is incorrect.

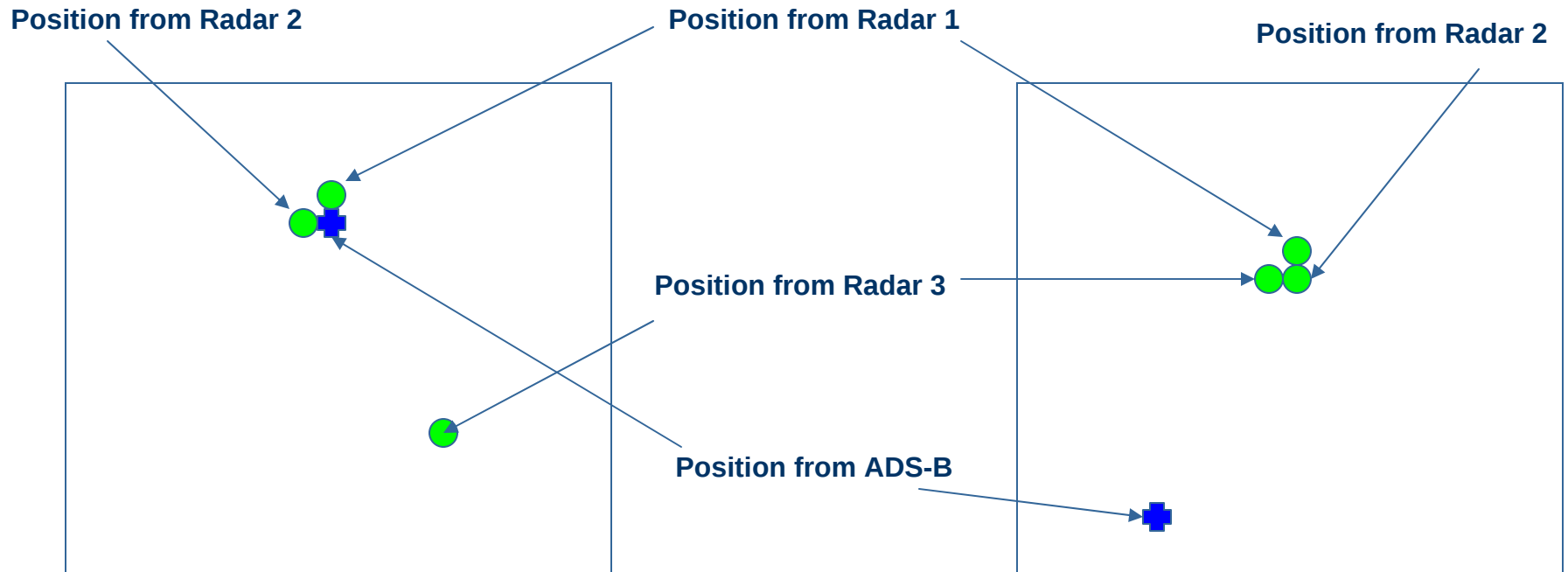
If an inconsistency is detected between all aircraft detected by a specific radar, the alert should be to a supervisor that the radar is faulty, however if we only have an inconsistency for one aircraft, then this should be reported to the responsible controller.

Received data such as speed, heading or altitude can also be checked.

- One of the most useful new alerts could be the checking of reported versus measured speed of an aircraft.

An error in the aircraft speed sensor could go undetected during normal Enroute flying, however during landing when the pilot needs a higher level of accuracy in the speed measurement, an error could have dramatic outcomes.

Multiple Radar Environment

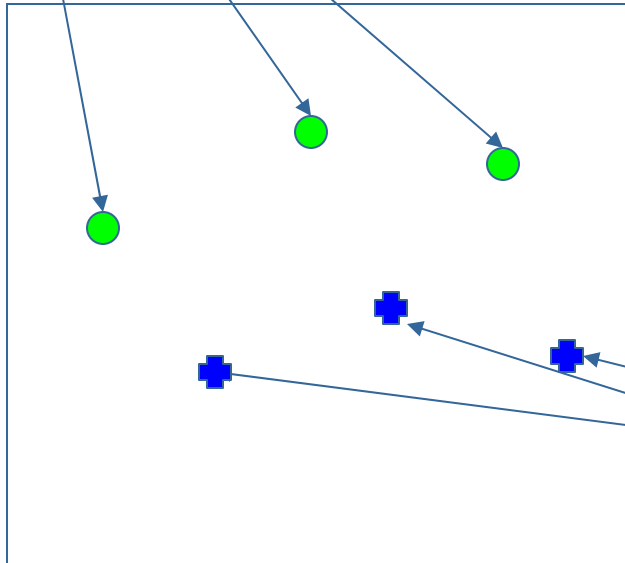


Potential Problem with Radar 3

Potential Problem with Aircraft Data

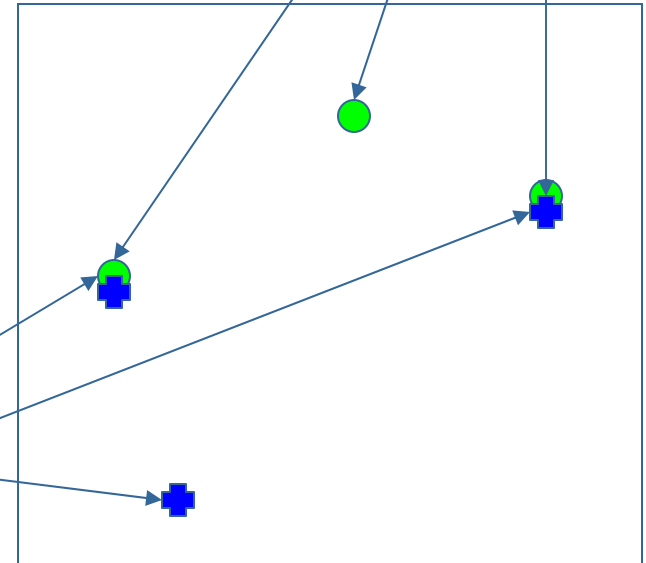
Single Radar Environment

Positions from Radar



Potential Problem with Radar

Positions from Radar



Potential Problem with Aircraft Data



The other source for deriving new alerts is in the comparison of ADS-B data and flight plan data registered in the ATM system.

✚ ARCW (Aircraft Route Conformance Warning) checks already the received ADS-C route data (which is entered in the Flight Management System of the aircraft) against the flight plan data entered in the ATM system, and can identify a possible problem well before it occurs.

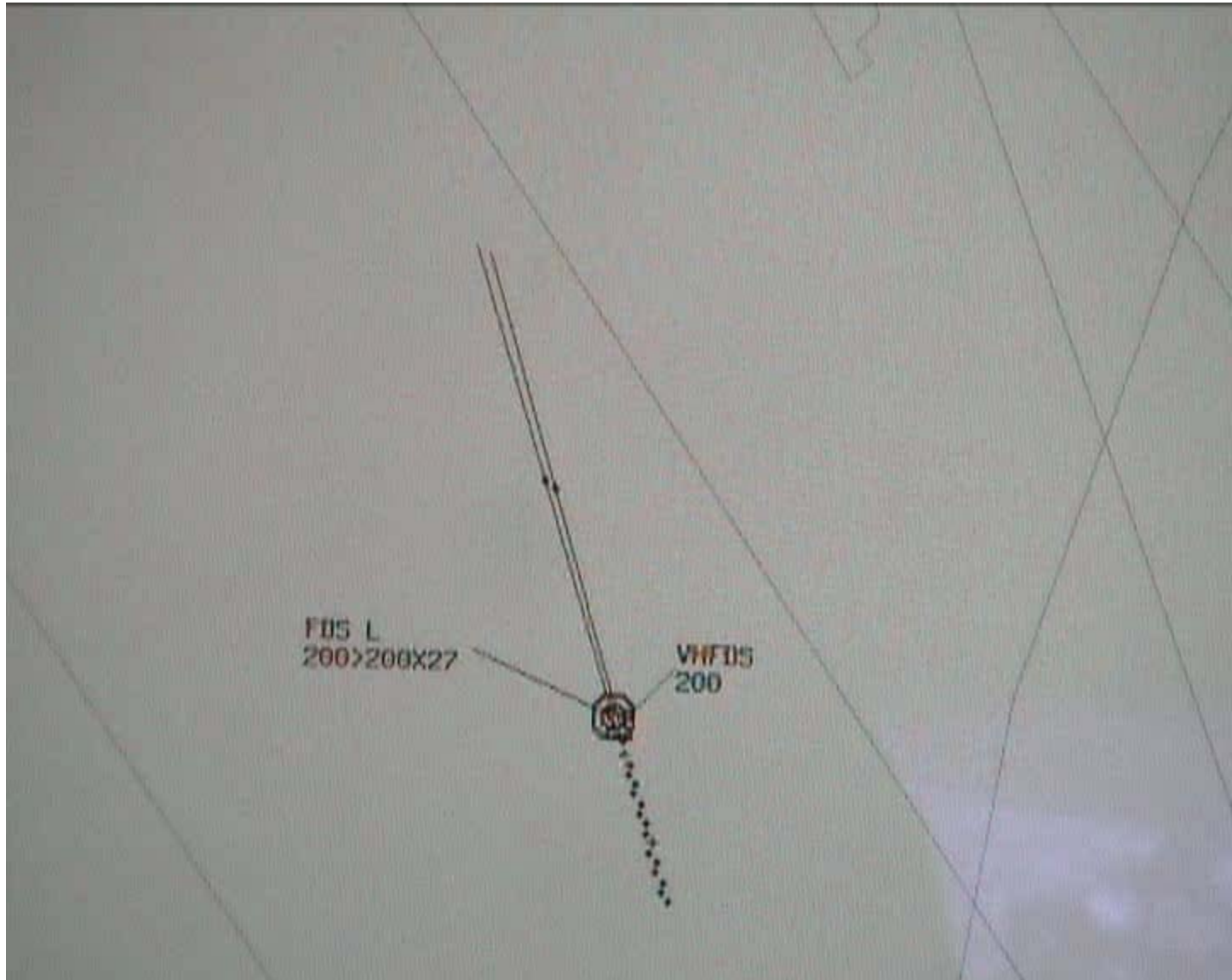
✚ This can be readily expanded to include ADS-B data by comparing received ADS-B trajectory intent information against the flight plan data to determine if there are any inconsistencies.

However, new surveillance technologies permit new types of alerts. For example, the ADS-B emitter category can be checked against the stored flight plan data.

✚ The controller believes he is in communication with a light aircraft when in fact it is a heavy aircraft. This could result in the controller giving the aircraft incorrect instructions.

ADS-B Data offers improvements to Radar data

- Improved Data Rate of 1 per second
- Direct Velocity Vector Information
 - *Radar Velocity vector can be up to 7seconds behind the actual aircraft vector*
- Opportunity to use ADS-B information for Parallel Runway Monitoring
- Rate of Turn Information
- Rate of Climb/Decent Information
- Future Intent Information

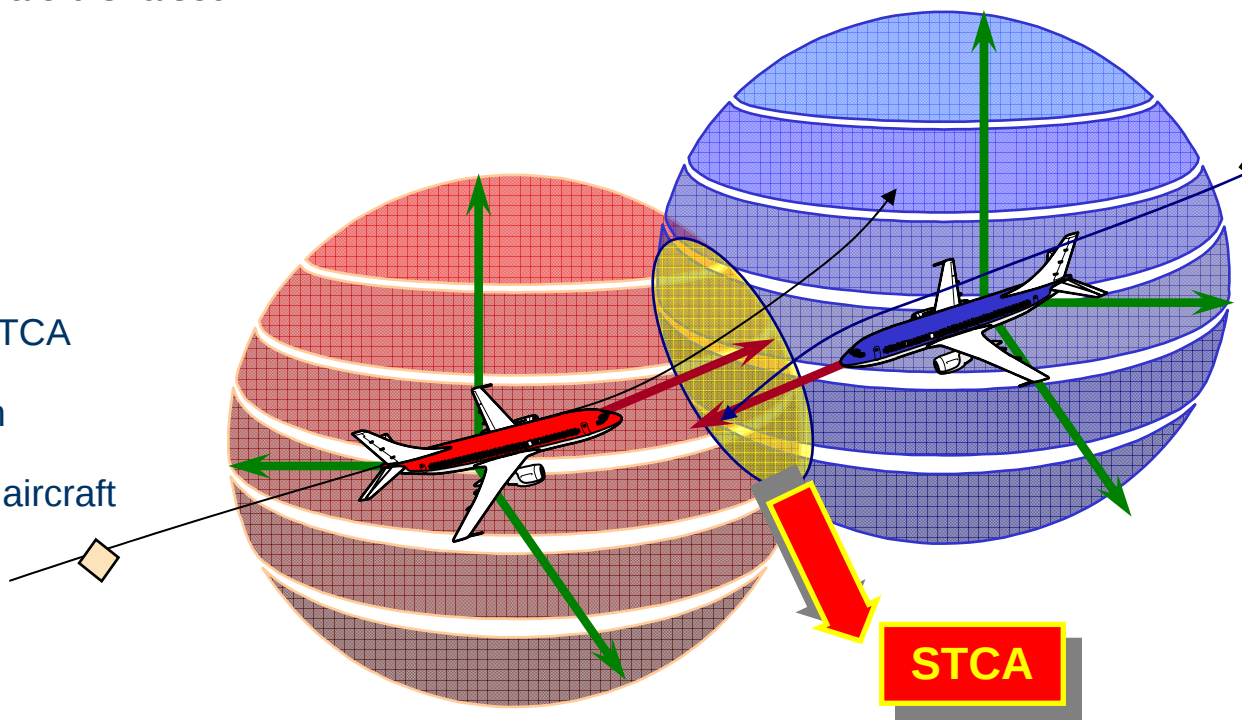


Short Term Conflict Alert

The short-term conflict alert performs a linear extrapolation of the current position of aircraft based on their current speed and heading in order to predict their future positions. If the aircraft are going to violate a separation standard for their current or future situation an alert is raised.

■ ADS-B Data will provide

- Improved rate of update
- Quicker STCA Detection
- Reduced Tolerance's required for STCA
- Improved velocity vector information
- Less False STCA's in maneuvering aircraft
- Rate of Turn information



Together this will provide a improved STCA in Enroute and a quality STCA in Approach

Emergency Alerts

Current Emergency Alerts

- General Emergency (7700),
- Radio Failure (7600)
- Hijack (7500),

New ADS-B Alerts

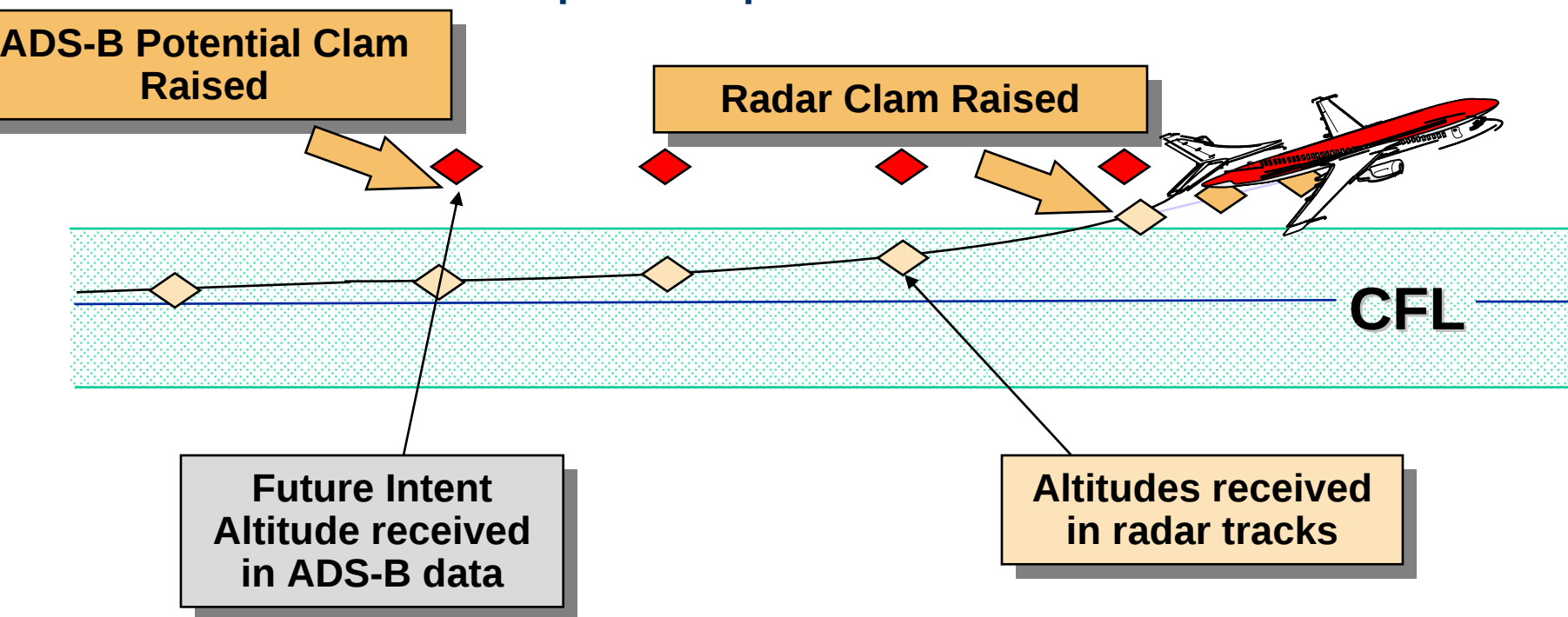
- Lifeguard / Medical Emergency
- Minimum Fuel.

Cleared Level Adherence Monitoring

ADS-B data received from an aircraft can include

- Intermediate State Selected Altitude
- Final State Selected Altitude data.

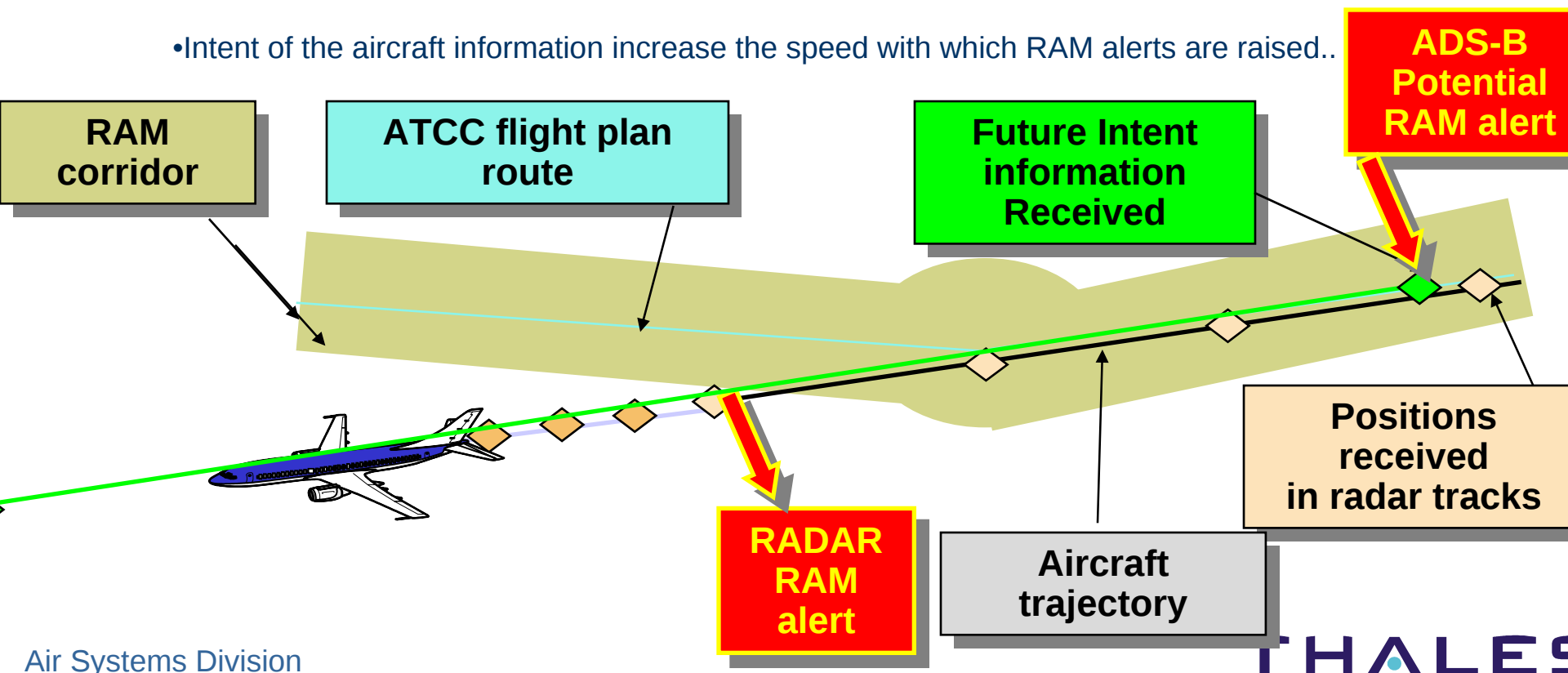
This data immediately gives information about the intent of the pilot and can alert the controller to a potential problem much earlier..



Route Adherence Monitoring

ADS-B data will improve the RAM alerting in the following ways

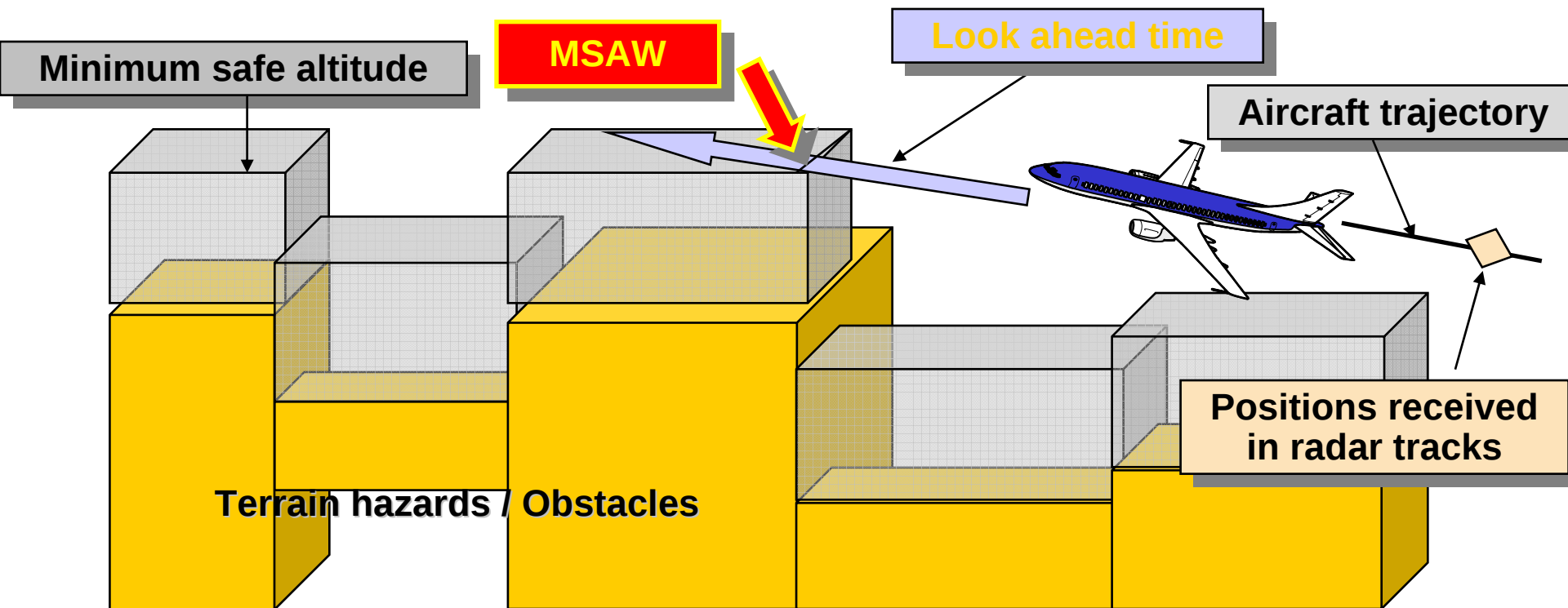
- Improved rate of data, providing earlier RAM indication
- Improved velocity vector, providing more accurate RAM determination
- Rate of turn information improving the RAM determination algorithm
- Intent of the aircraft information increase the speed with which RAM alerts are raised..



Minimum Safe Altitude Warning

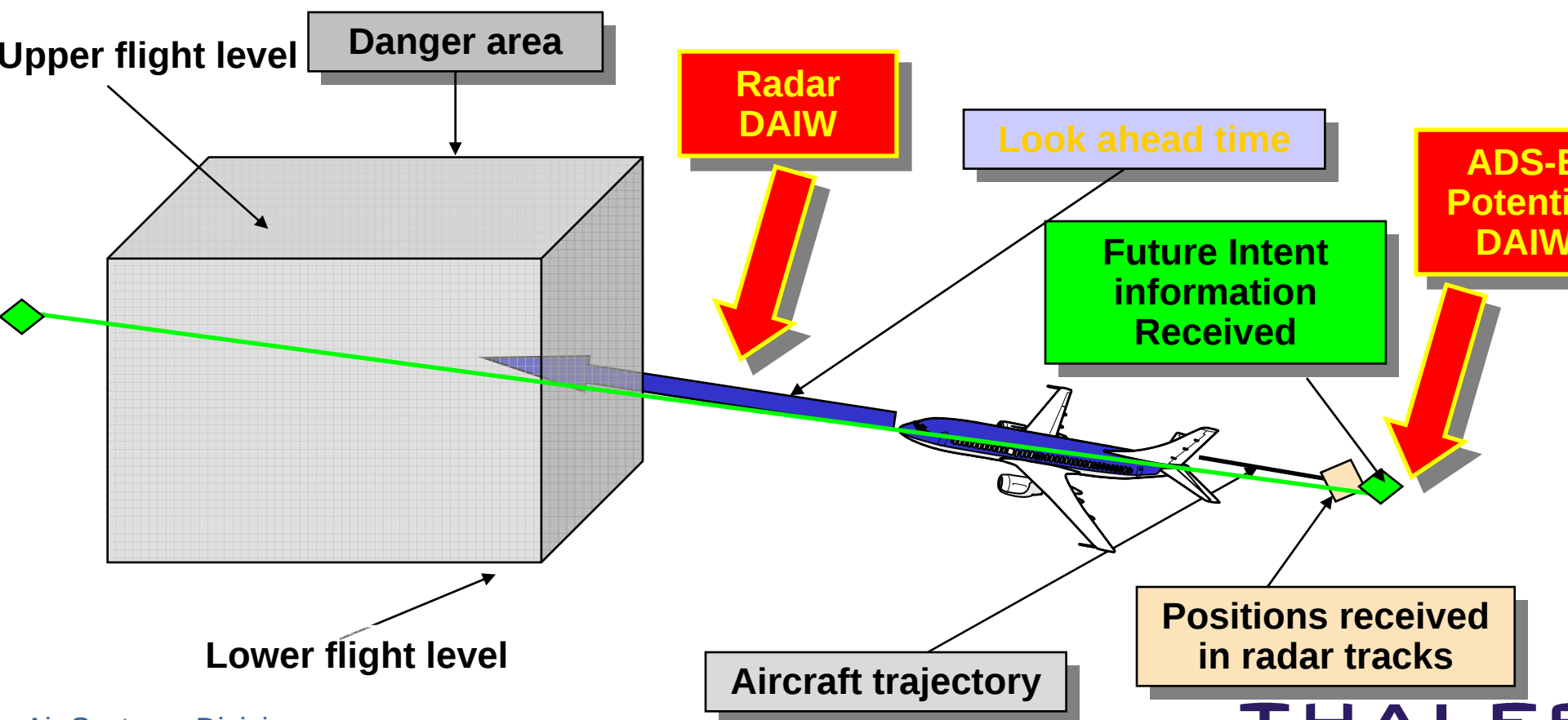
Minimum Safe Altitude Warning can be improved in the same way as the Cleared Level Alert is improved by ADS-B intent information.

And by the use of ADS-B Rate of Climb information.



Danger Area Infringement Warning

Danger Area Infringement Warning can be improved in the same way as the Route Adherence Monitoring alert is improved by ADS-B intent information.



Improvements to alerts and warning functions needs **to be actively considered by the ATC community now**, while suppliers are currently working with Air Navigation Service Providers to design algorithms for the data fusion of ADS and multiple derived data sources.

Improvements to existing alerts and the development of new warnings and alerts must incorporate a range of issues

- **Maintaining** existing capabilities.
- **Ensuring** controllers do not suffer from “over-alerting”
- **Integrity** checks to ensure the accurate fusion of data from multiple sources.

With the improvement of the quality of the alerts, provided by the more accurate and timely data available, the result is a safer ATC environment due to the enhanced controller awareness.

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Contact Details

*Mr Mark Palmer
ATM Applications Specialist
Air Systems Division
Melbourne, Australia
mark.palmer@thalesatm.com*

*Mr Michel Procoudine Gorsky
Business Development Manager
Air Systems Division
Bagneux, France
michel.procoudine@thalesatm.com*

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Thank you