PASSIONATE ABOUT PERFORMANCE

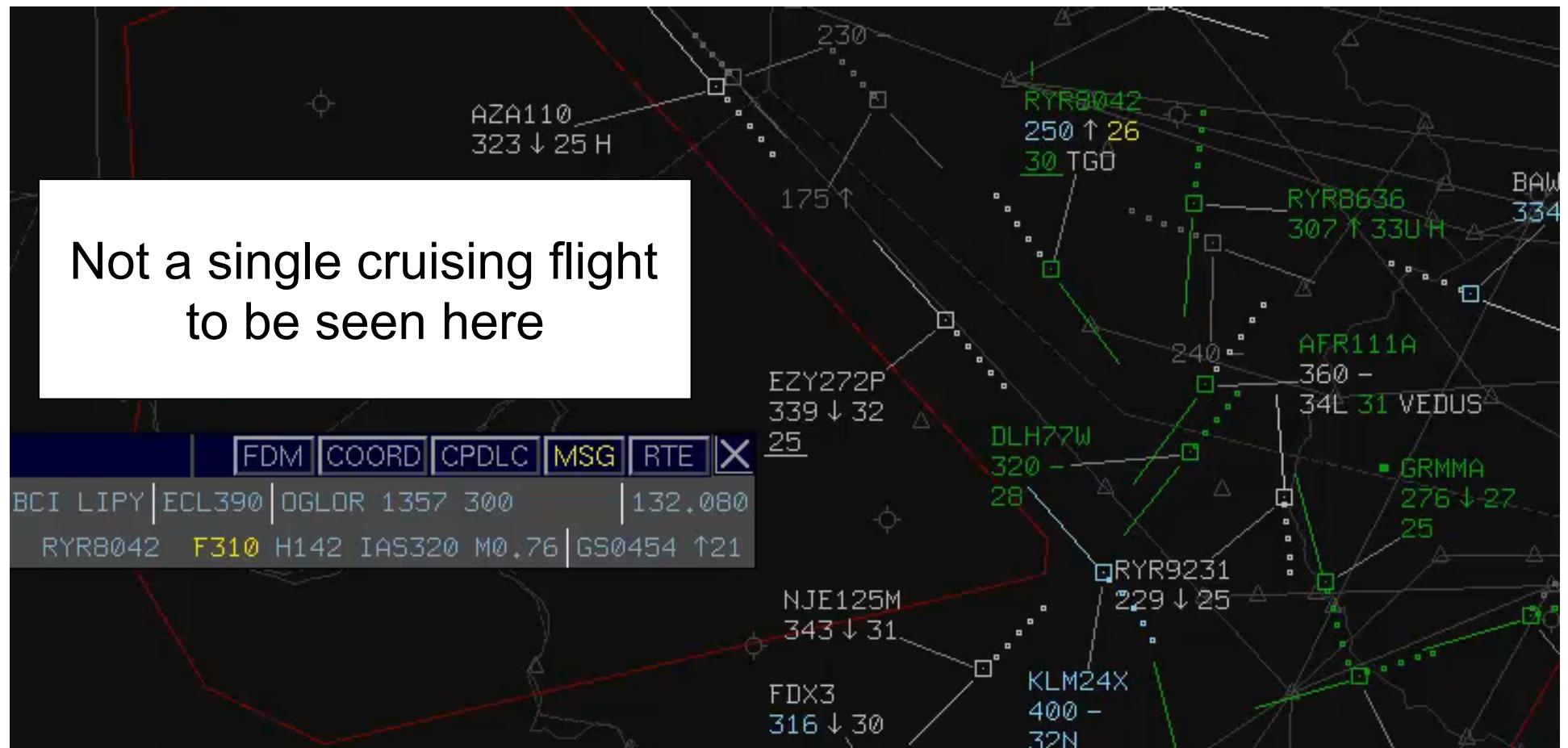Maastricht Upper Area Control Centre

ATC tools preventing airborne conflict

EUROCONTROL

MAASTRICHT UAC
Sector Boundaries, Routes,
Way Points and
major Aerodromes

SCOTTISH UIR

KØBENHAVN FIR

AMSTERDAM FIR
THE NETHERLANDS

LONDON UIR
UNITED KINGDOM

RHEIN UIR
BREMEN FIR

Holstein High Sector
FL345+
132.780

Holstein Sector
FL245-FL345
125.925

Jever High Sector
FL345+
134.705

Jever Sector
FL345-
136.460

HANNOVER UIR
BREMEN FIR
GERMANY

Celle High Sector
FL335+
132.905

Celle Sector
FL335
133.055

Münster High Sector
FL335+
133.215

Münster Sector
FL335-
133.856

Delta High Sector
FL345+
132.685

Delta Sector
FL345
132.635

Solling High Sector
FL335+
131.380

Solling Sector
FL335-
134.710

Ruhr High Sector
FL335+
135.490

LANGEN FIR

Ruhr Sector
FL335-
132.615

Koksy High Sector
FL335+
132.705

Koksy Sector
FL245-FL335
132.205

Brussels West High Sector FL 335+

BRUSSELS
FIR/UIR

Nicky High Sector
FL335+
133.710

Nicky Sector
FL245-FL335
135.980

Olno High Sector
FL335+
126.980

Olno Sector
FL335-
132.955

Brussels East High Sector FL 335+

Lux High Sector
FL335+
132.315

Lux Sector
FL335-
133.385

FRANCE UIR
PARIS FIR
FRANCE

RHEIN UIR
MÜNCHEN FIR

RHEIN UIR
MÜNCHEN FIR

LEGEND
AIR TRAFFIC SERVICES

ATS POINTS

RADIO FACILITIES

AIRPORTS

ROUTES

BOUNDARIES

AREAS

MAASTRICHT UAC SECTORISATION CHART

Not a single cruising flight to be seen here

Most Important ATC Tools in MUAC to avoid Airborne Conflict

- Tool "0": STCA
- Tool 1: Enhanced Mode S (EHS)
- Tool 2: Probe (What-if, "pre-STCA")
- Tool 3: Radio Direction Finding

Tool "0": STCA

Operationally since 14 Feb 1980

- Based on <u>surveillance data</u>:
  - Position
  - Mode C
  - Tracked attitude
- Since Jan. 2007 also based on <u>ATCO's intent</u> (CFL)
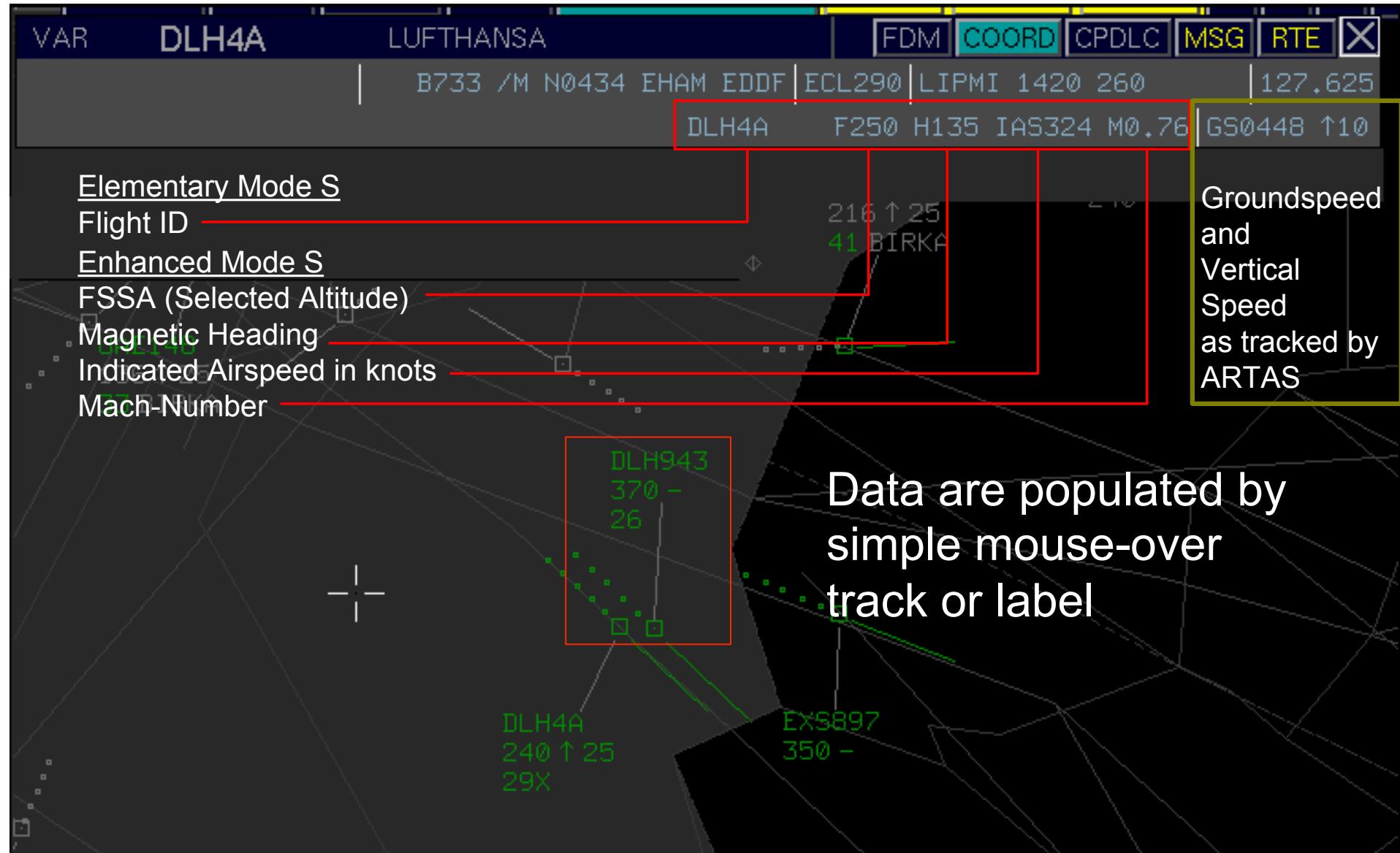- Since June 2012 also based on <u>cockpit's intent</u> (FSSA)

Tool 1: Enhanced Mode S (EHS)

- Safety Targeted
- Better Situational Awareness
- More accurate Conflict Detection
- Saving R/T time
- Caters for ultra-fast and user friendly HMI
- ATCO comfort = safety… & capacity!
- Made possible by a special OPS validation process

EHS DAP Display

EUROCONTROL — member of **FABEC**

VAR DLH4A LUFTHANSA FDM COORD CPDLC MSG RTE X

B733 /M N0434 EHAM EDDF | ECL290 | LIPMI 1420 260 | 127.625

DLH4A F250 H135 IAS324 M0.76 | GS0448 ↑10

Elementary Mode S
Flight ID

Enhanced Mode S
FSSA (Selected Altitude)
Magnetic Heading
Indicated Airspeed in knots
Mach-Number

Groundspeed
and
Vertical
Speed
as tracked by
ARTAS

216 ↑ 25
41 BIRKA

DLH943
370 –
26

Data are populated by simple mouse-over track or label

DLH4A
240 ↑ 25
29X

EXS897
350 –

- **Selected Altitude Warning Tools**:

  - Step 0: manual check by the ATCO ("passive" SA warning), simply by comparing the FSSA in the FIM for a single flight. (operational since July 2009)

  - Step 1: SA Alerting Tool, ("active" SA warning), to display the discrepancy between Cleared Flight Level (CFL) and SA in the track label. (operational since December 2009)

  - Step 2: FSSA used by Probe (What-If), in conjunction with the CFL.

  - Step 3: FSSA used by STCA. Creates additional warnings if FSSA is "worse" than CFL. Saves valuable seconds. Strongly reduces Nuisance STCA warnings.

FSSA Alert step 0 (passive)

Downlinked Selected Altitude (airborne) in yellow because of mismatch with CFL (ground)

- Let's have a look in real life to the active Selected Altitude Alert (still without use of it in STCA)

FSSA Alert step 3: used in STCA

Note that now, with STCA also using FSSA, the Grace period would have been lifted at this moment (because conflict is imminent)

That is an alert 11 seconds earlier than before, and before the DLH has started descending.
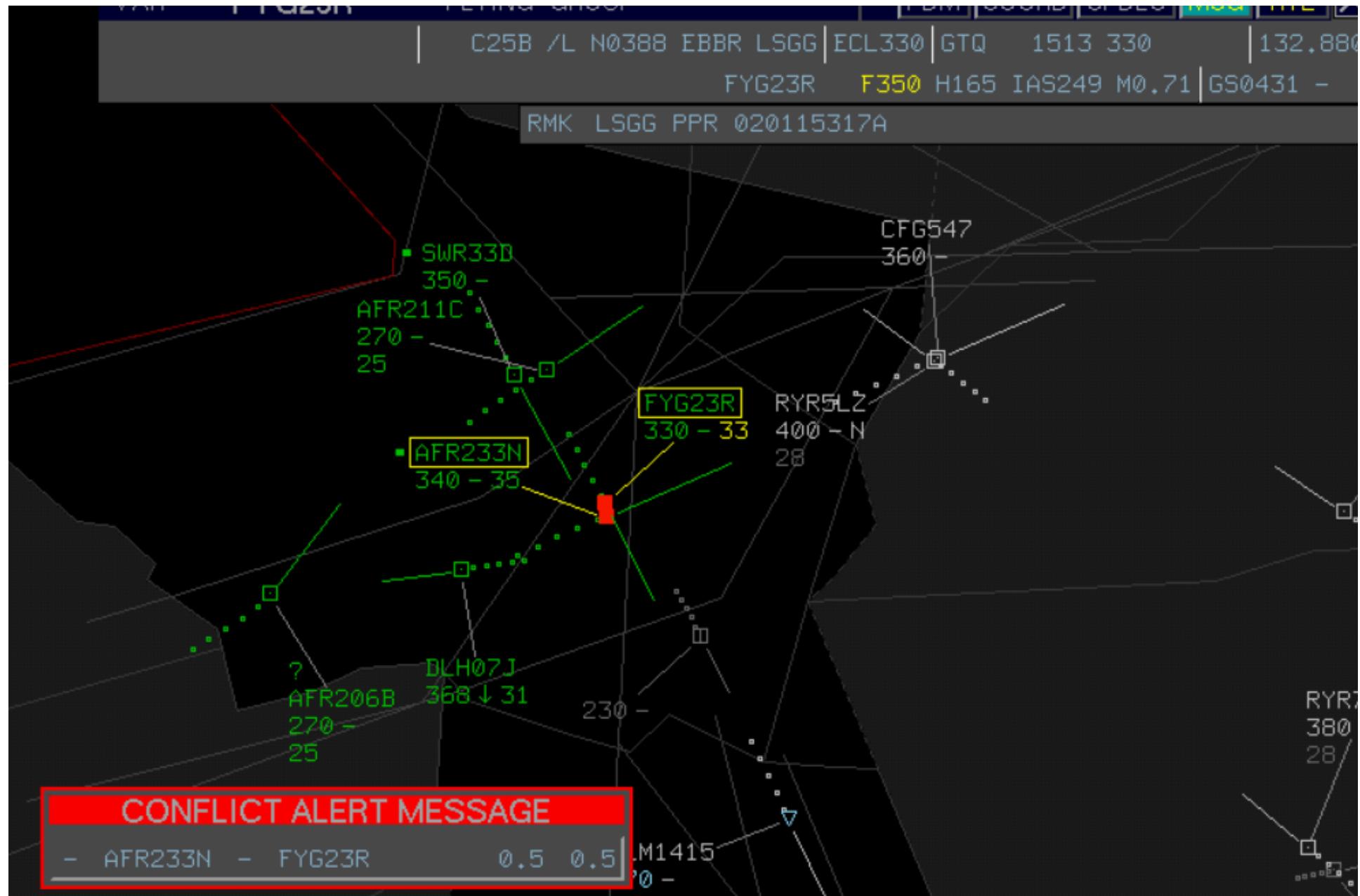
Now STCA is listening to FSSA (and stops the Grace Period immediately). Valuable seconds are gained to intervene!
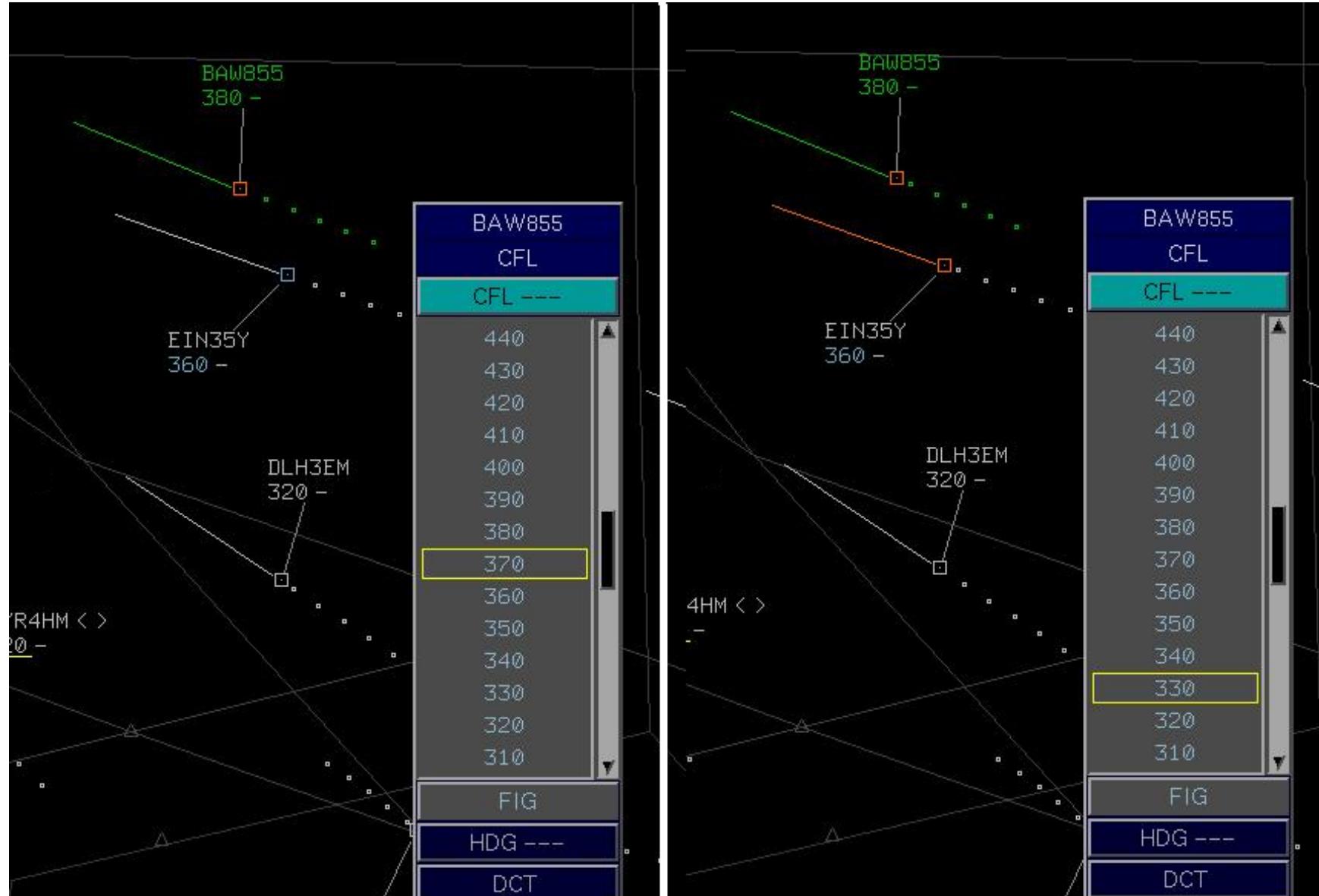
- Let's have a look in real life to the Probe
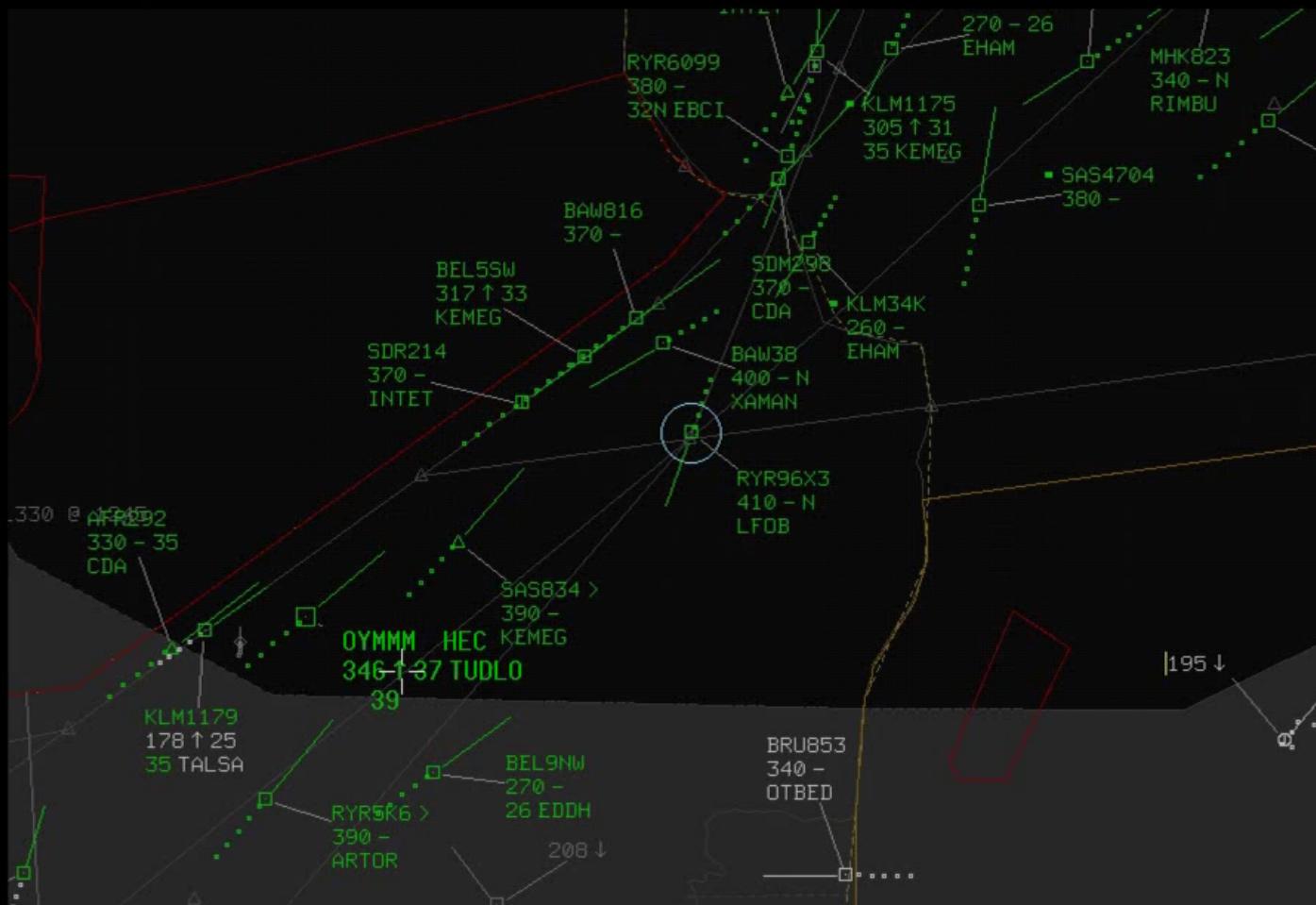
- Enhanced Mode S is able to catch misdirection of clearances…

   as long as a vertical clearance is involved.
- But misdirection of a Heading instruction may as well be dangerous!

- Solution: Highlight the transmitting station (area)

Any Questions?

- Reliance?
- Validation?
- Quantitative effect FSSA warning
- Other EHS applications

End of the presentation

The remaining slides are extra, or for questions

Quantitative assessment of the Safety Improvement brought by FSSA alert

- All reported events filtered for separation infringements with primary type = level bust. 105 events since 2004.
- In 35 cases, FSSA alert would have made the difference
- **= 1/3!**

2012 incident: A/C was not Mode S / FSSA equiped

2004	5
2005	5
2006	8
2007	6
2008	5
2009	2
2010	3
2011	**0**
2012	**1**

# Unique semi-live and live Validation

1. Numerous iterations between ATCOs and developers on their application screens and on the Test and Development partition of the MADAP system.

2. ATCO validation and parameter finetuning, using the ATC simulator (equal to the operational system) using pseudo pilots.

3. Further validation and parameter finetuning by running the new software on full operational replays on the same ATC simulator. There are no pseudo pilots; the flights behave just like they have been flown and controlled on the day of that recording.

4. Before complete on-line release of New Probe or EHS, further **live** validation by a restricted number of validating ATCOs.

   - The software is available in the on-line operational system, but only few knowledgable and briefed ATCOs have access to the tools. This restricted access is governed by the ATCO's log-in into the system. This allows the tools to be exposed to the validators in live operations, and the tool to be validated from the real job's "hot seat", not from a comfortable and safe position at the simulator.

5. Post-implementation corrections until no less than 100% satisfaction/efficiency achieved.

# Mode S EHS in MUAC implementation history

May 2009	OPS <u>validation</u> of 6 DAPs available via FIM
July 2009	**F.S.Selected Altitude** & Magnetic Heading available via Flight Information Message (FIM) for all controllers
Sept	
Dec.	
May	
July 2010	Introduction of an early warning for non-correlated and not yet assumed traffic entering MUAC airspace unplanned ("potential intruder").
	FSSA displayed in Radar Label of uncorrelated traffic (when mouse over)
	Heading Folder (input menus) driven by EH-S data
Nov. 2010	Speed input Menu driven by EH-S data, dependi... Mach-number
Feb. 2011	**FSSA used for** NTCA Conflict Declaration fo...
March 2012	Better indication of flights without FSSA
June 2012	**FSSA used in STCA!**

<u>Also in Fallback!</u>

Hey?!
tool dependency?
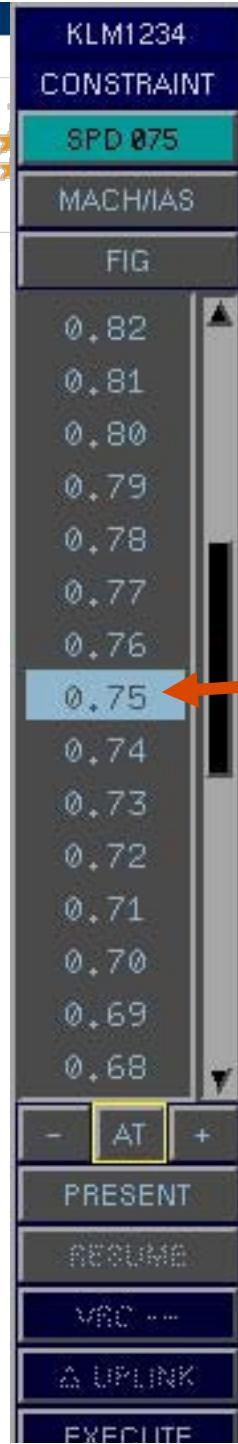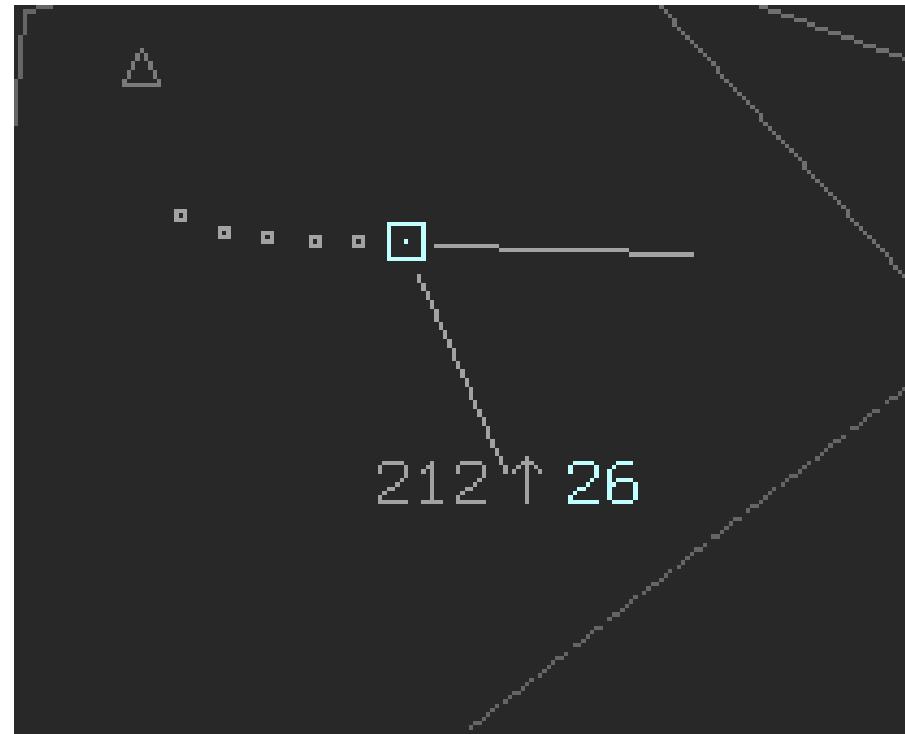
Menu centered around the EH-S received value,

depending on flight phase in IAS knots (for arrivals) or Mach-number (en-route)
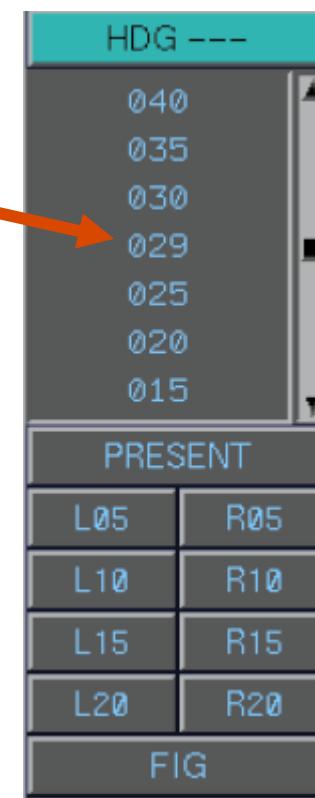
Early detection of potential infringements of airspace (unknown traffic below MUAC airspace with FSSA higher than FL245)

Less nuisance warnings

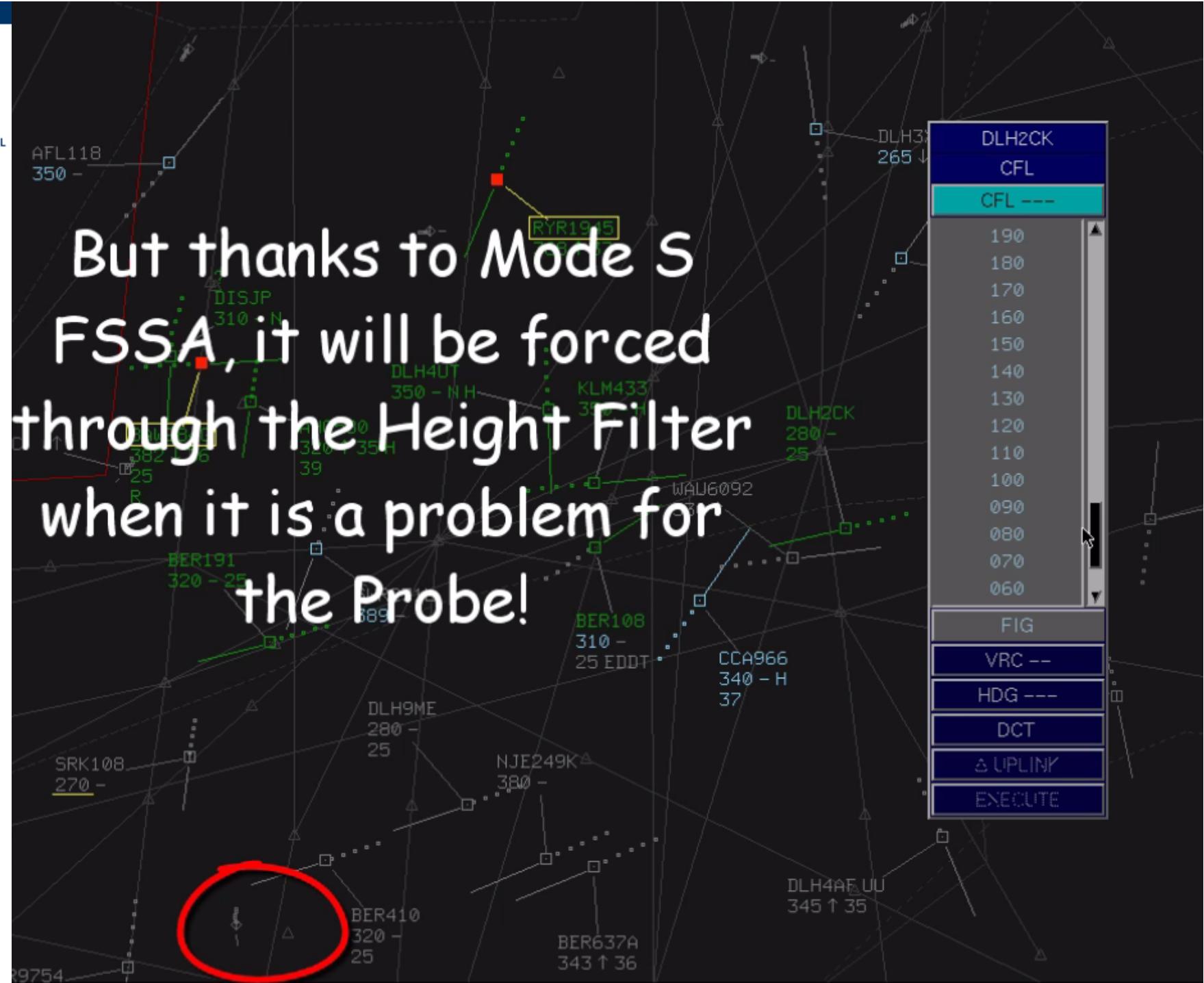(no nuisance STCA here with the uncorrelated track in trail if FSSA were in place)

FSSA in the Probe

But thanks to Mode S FSSA, it will be forced through the Height Filter when it is a problem for the Probe!

FSSA in the Probe