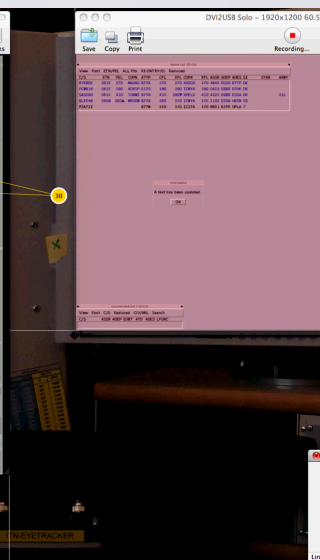
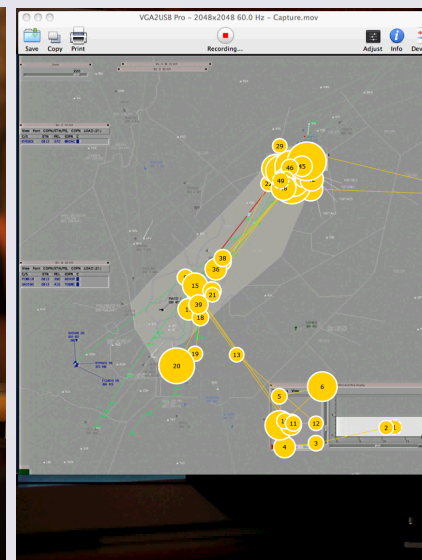




HUMAN-AUTOMATION COLLABORATION STRATEGIES

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This study was sponsored by
the Swedish Transport Administration and
the Air Navigation Services of Sweden (LFV)

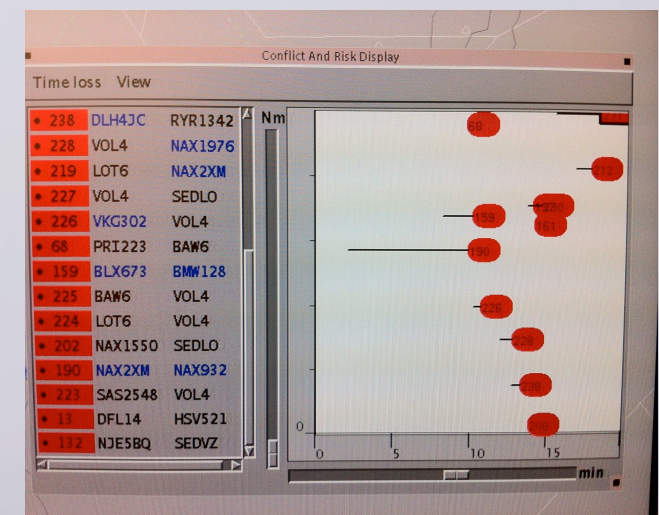


SAFETY PROBLEM

- Separation Incidents 2011-2012 in Swedish Air Space
- Either ATC did not pay sufficient attention to the tools (should try harder)
- Or the tools were not sufficiently clear (should be designed better)



Perhaps I should check one more time?



Case study - to uncover
basic human-automation
collaboration strategies

CASE STUDY

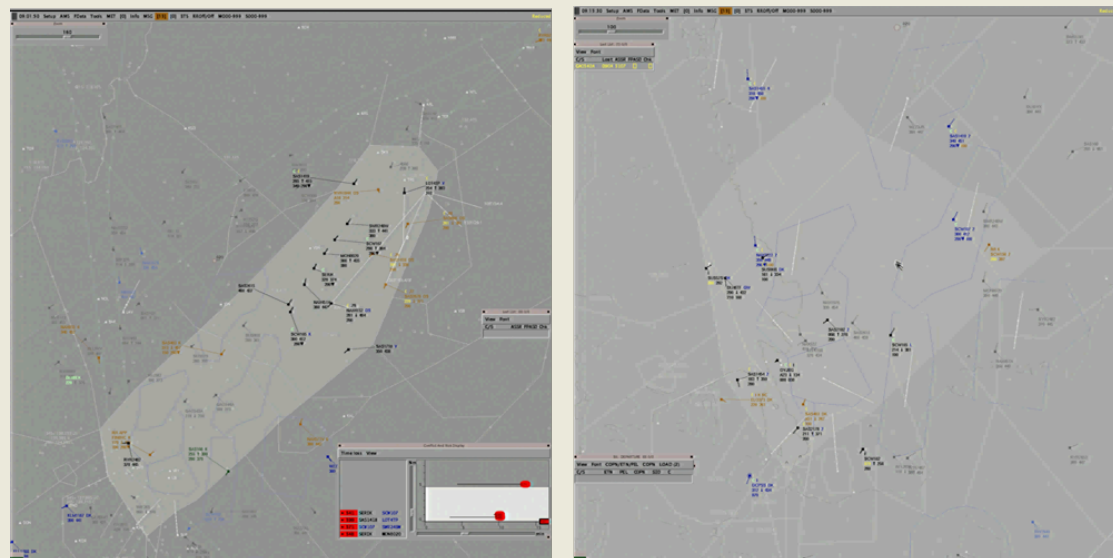
Scenarios with
irregularities

During
verification-of-
competence
training

12 fully licensed ATCOS with valid ratings
6 male, 6 female, 9-38 years of experience

6 Planner

6 Executive



Overflight and climb / descend areas

Divided into four conditions

- 3 Planner - overflight
- 3 Planner - climb/descend
- 3 Executive - overflight
- 3 Executive - climb / descend

MTCD was only used in overflight area

SITUATION AWARENESS

Based on Lundberg (2015)

Dimension

Primary measure

Processes

A process ...

eye tracking

SA, how?

States

... of understanding what goes on in
uncertain dynamic situations....

actions

SA, what?

Systems

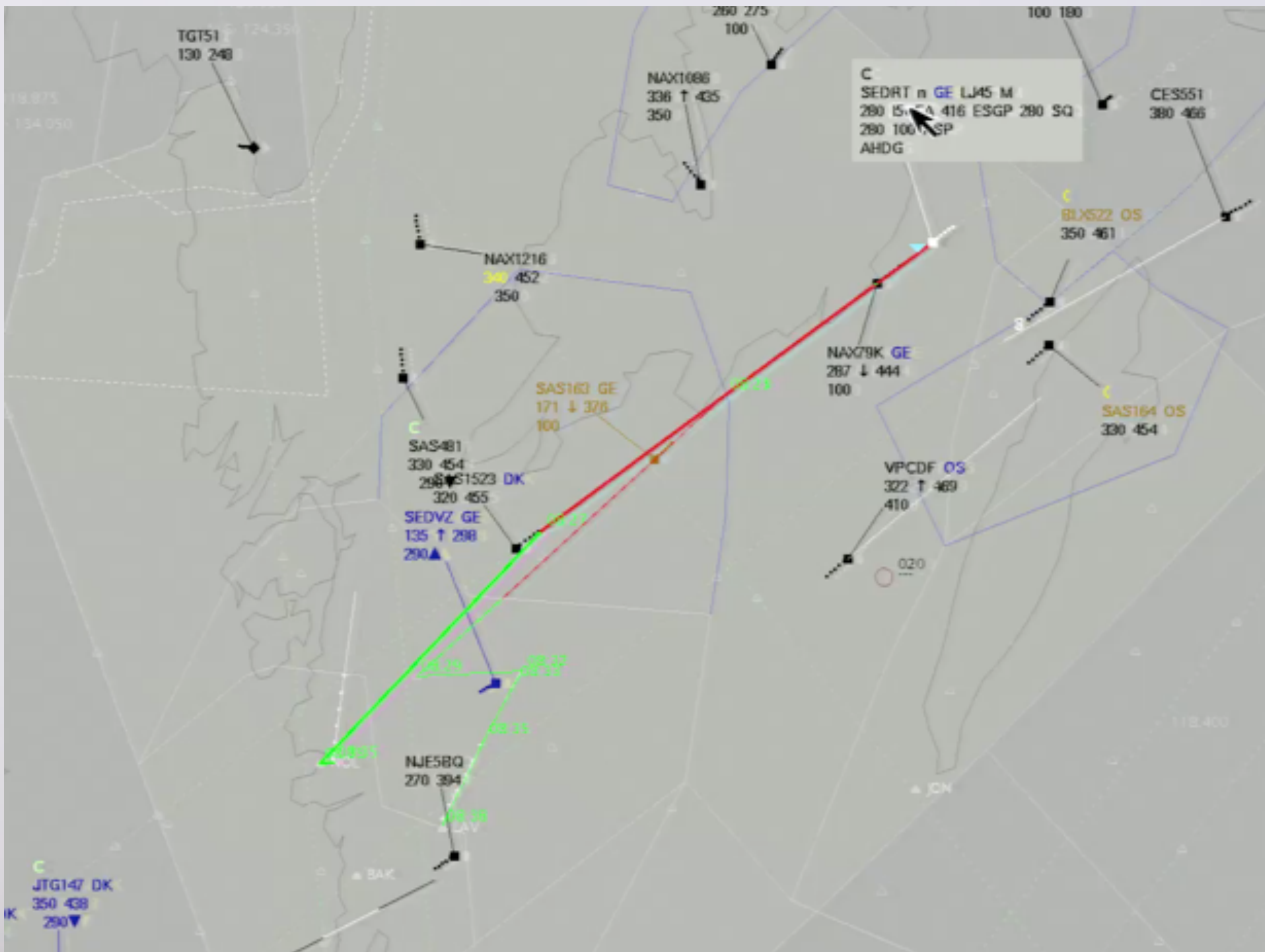
... through collaboration with automated
tools and other agents...

video/audio recordings

SA, where?

CONFLICT AND RISK DISPLAY



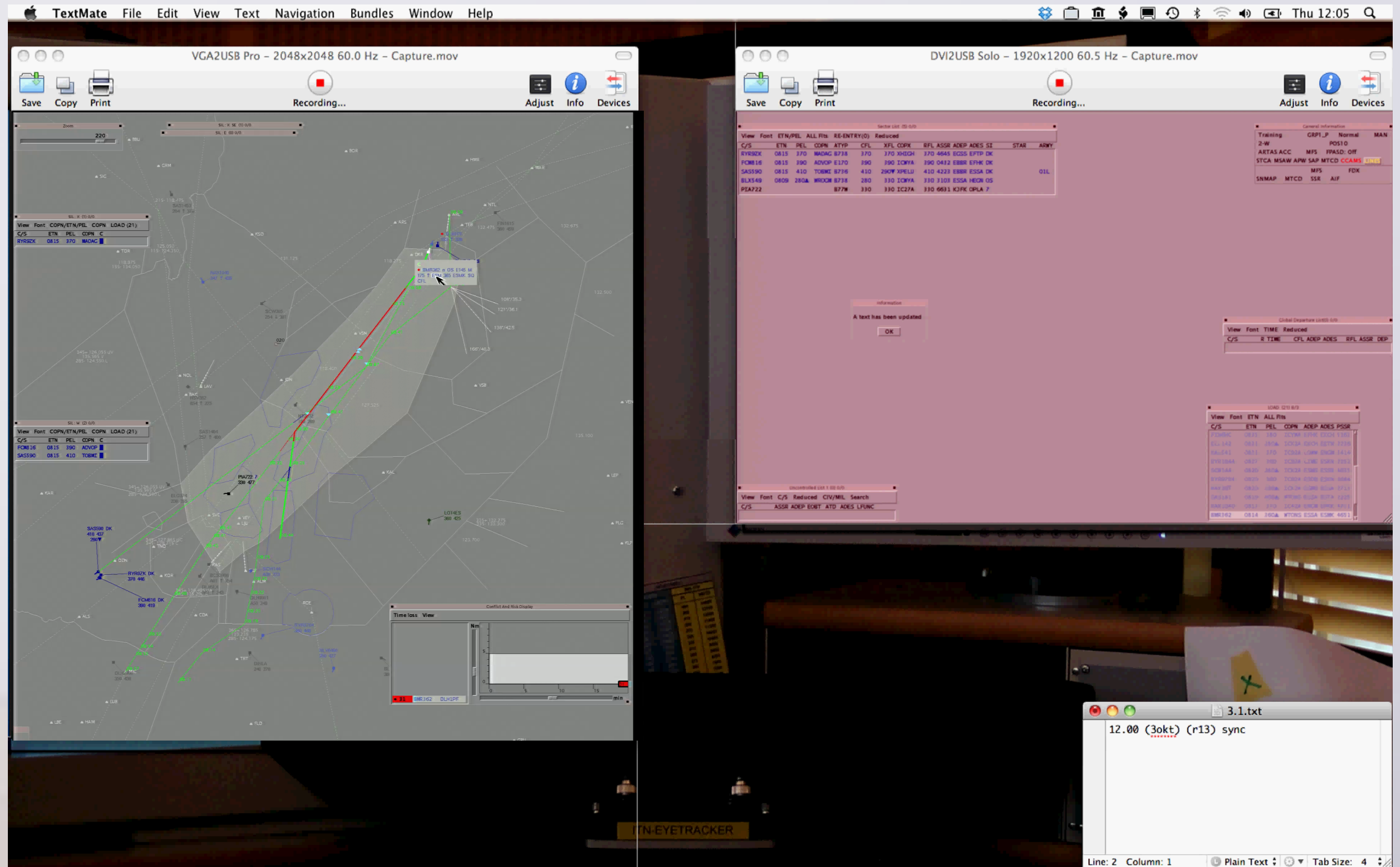




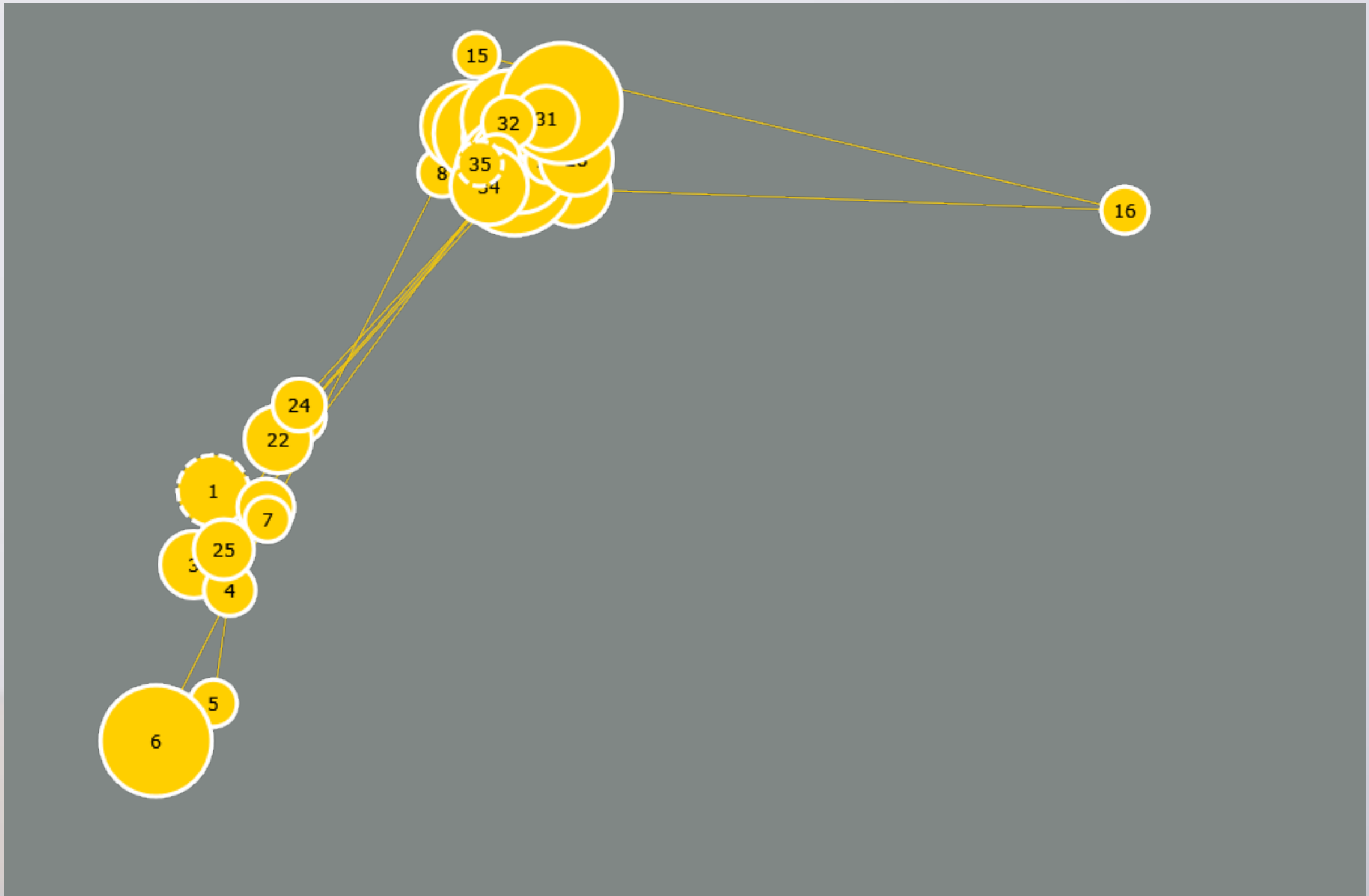
SA Process: Eye tracking recording

EPISODE ANALYSIS

When a conflict becomes visible on CARD, then what does the ATCO do?



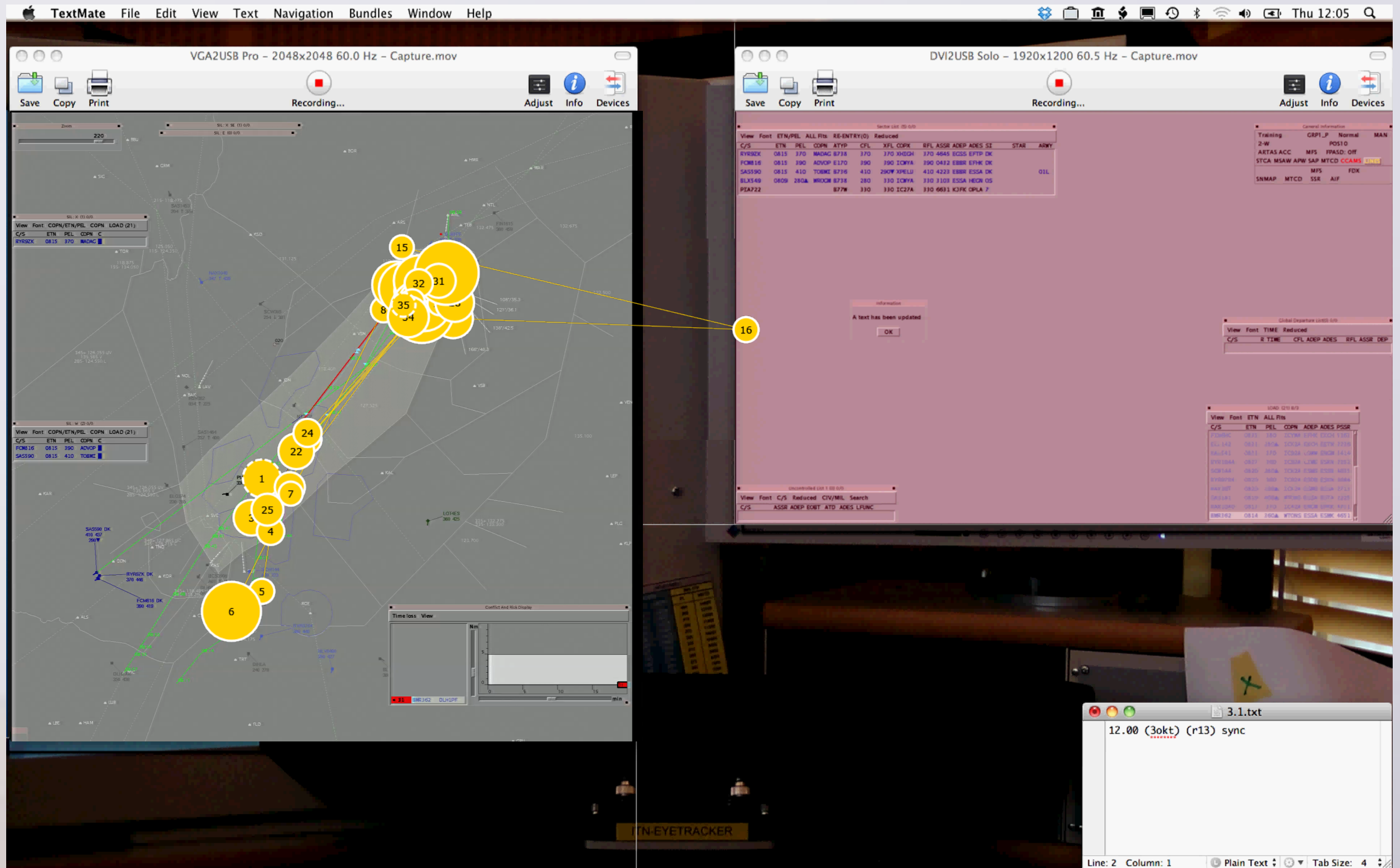
GAZE PLOT based on eye tracking recording



SA Process: Eye tracking recording

EPISODE ANALYSIS

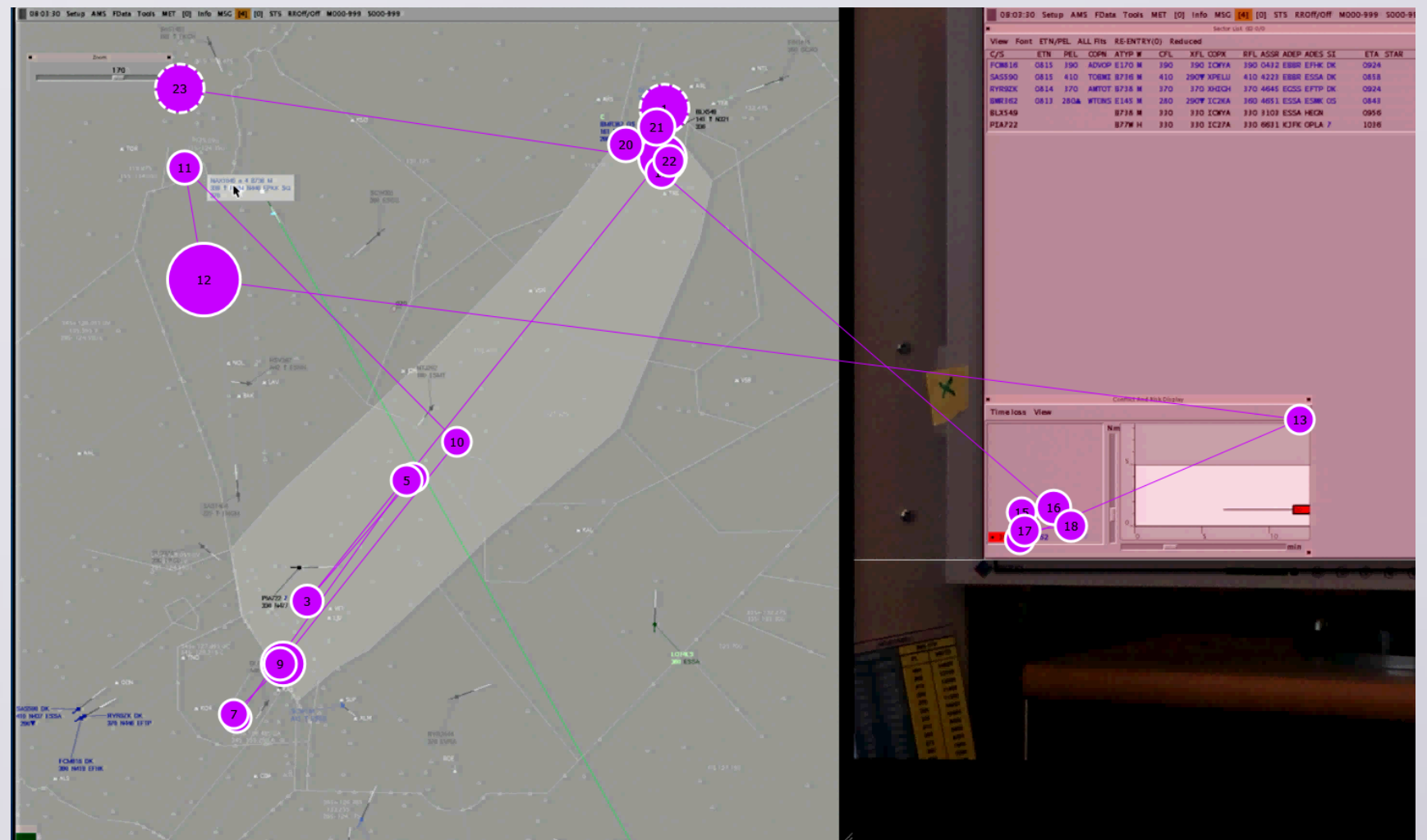
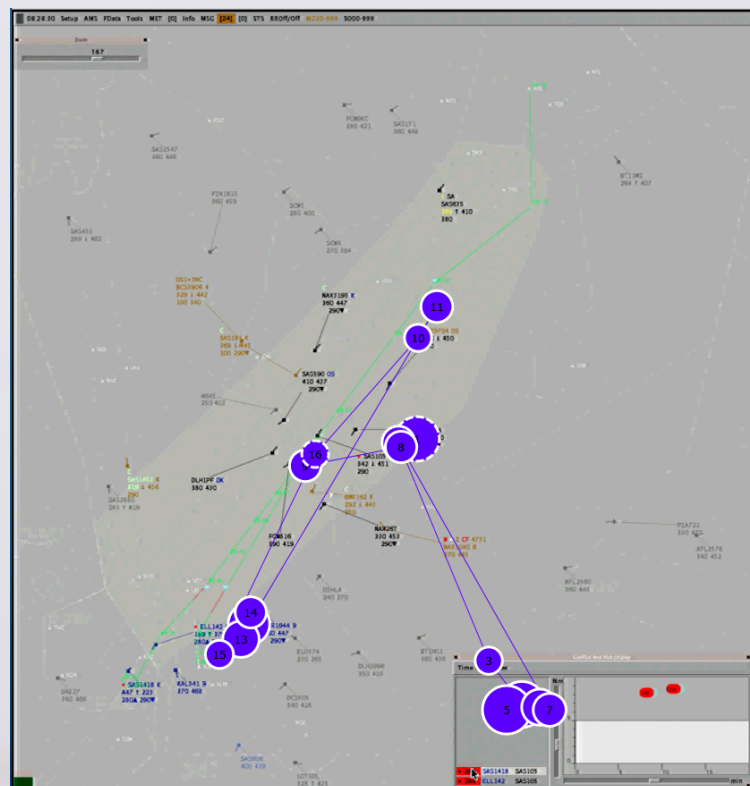
When a conflict becomes visible on CARD, then what does the ATCO do?
(What role does CARD and FLEG have in conflict detection?)



STRATEGIES

- A: Rely primarily on the automation, examine conflicts as they emerge on MTCD
- B: Rely primarily on an own independent scan, check MTCD now and then.
- : Combinations, variations?

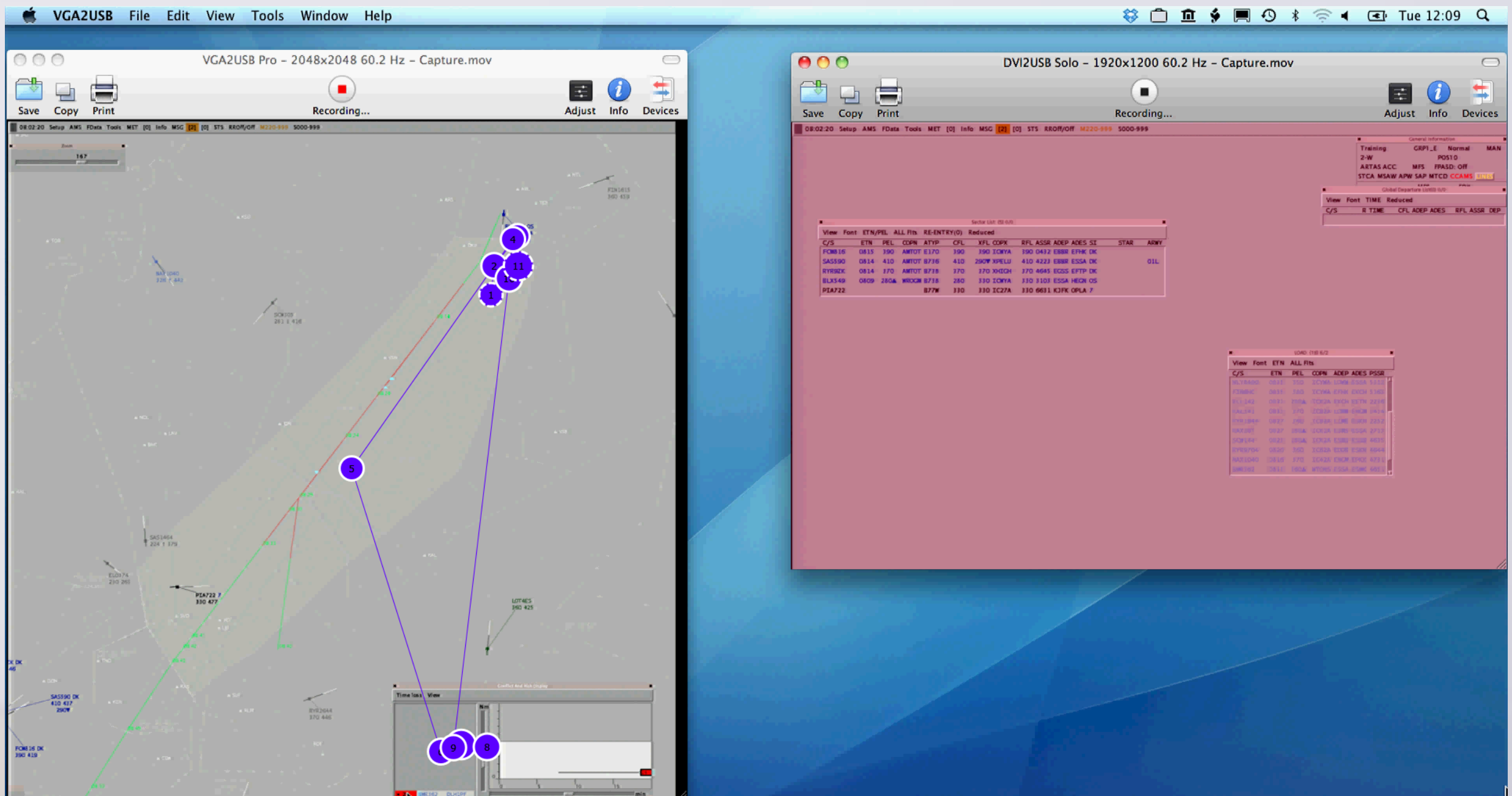
VS. B: INDEPENDENT SCAN



a. checking card first vs b. checking card *AFTER* examining the conflict

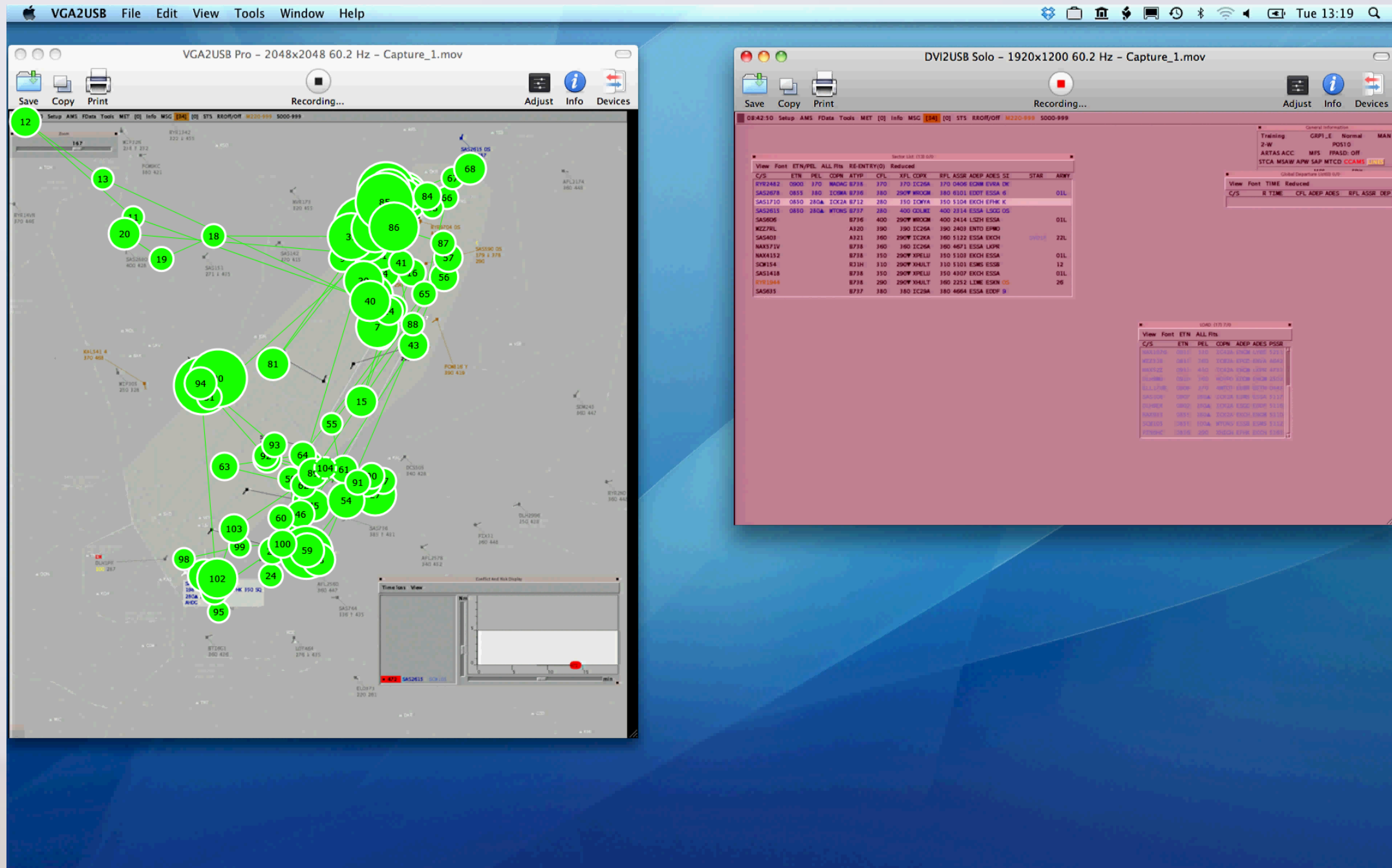
An ideal situation

E. LOOKING AHEAD



... how could this result in separation infringements....?

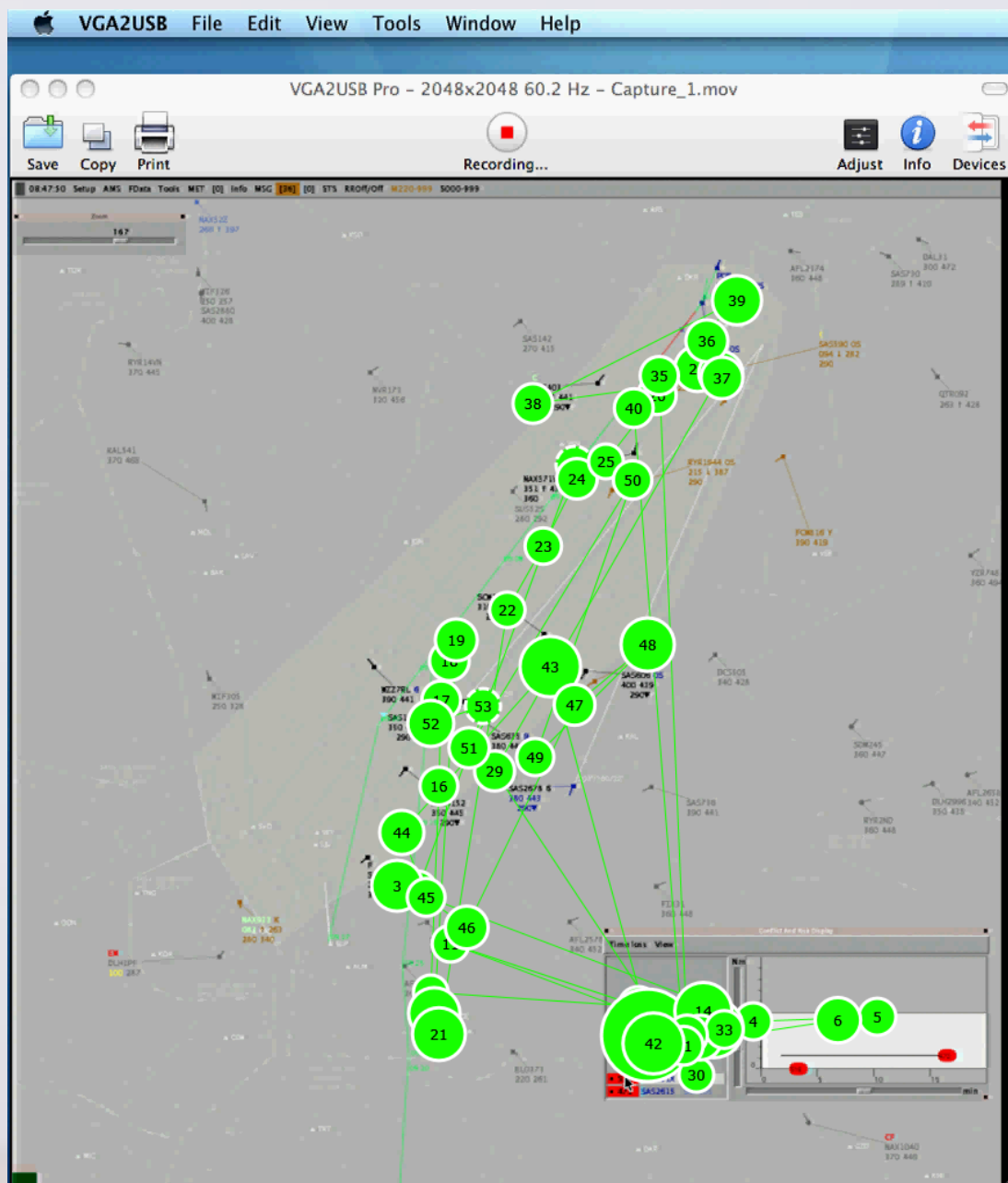
C. DELAY IN DETECTION



48 second delay

... how could this result in separation infringements....?

D. SHORT TIME TO CONFLICT



DVI2USB Solo - 1920x1200 60.2 Hz - Capture_1.mov

Save Copy Print Recording... Adjust Info Devices

08:47:50 Setup AMS FData Tools MET [0] Info MSG [18] [0] STS RROR/OFF M220-999 5000-999

General Information

Training CRP1_E Normal MAN
2-W ARTAS ACC MFS PASD: OFF
STCA MSAW APW SAP MTCO CCAMS UNIS

Global Departure UNIS 600

View Font TIME Reduced

C/S H TIME CFL ADEP ADES RFL ASSR DEP

C/S	ETN	PEL	COPN	ATYP	CFL	XFL	COPX	RFL	ASSR	ADEP	ADES	SI	STAR	ARMY
KLM1167	0908	190	AMTOT	8737	190	190	XHSGH	190	4414	EHAM	EFHC	OK		
DLH6983	0903	180	NOVPO	6190	180	180	IC2AA	180	2502	EDDM	ENCM	OK		
RYR2482	0800	170	NAOAG	8738	170	170	IC2BA	170	0406	EDDM	EVNA	OK		
SAS2678	0815	180	ICOMA	8738	180	200W	NRCCM	180	6101	EDDT	ESSA	6		
NAX451X	0815	280A	WTONG	8738	280	110	IC2BA	110	4221	ESSA	EDDM	OS		
SAS2615	0810	280A	WTONG	8737	280	400	CDLWC	400	2314	ESSA	LSZC	OS		
SAS1710	8712	110	110WYA	110	110	110	IC2BA	110	1104	EXCH	EFHC			
SAS606	8736	400	290W	NRCCM	400	2414	LSZH	ESSA	OS					OIL
WZZ77L	A120	190	190	IC2BA	190	2401	ENTD	EPND	6					
SAS401	A121	180	290W	IC2BA	180	5122	ESSA	EXCH						OIL
NAX571V	8738	180	160	IC2BA	180	4671	ESSA	LXPR						
NAX4152	8738	110	290W	XPELLU	110	5101	EXCH	ESSA						OIL
SKW154	831H	110	290W	XPELLU	110	5101	EXCH	ESSA						12
SAS1418	8738	110	290W	XPELLU	110	4107	EXCH	ESSA	OS					OIL
SAS631	8737	180	180	IC2BA	180	4664	ESSA	EDDF	9					

08:47:50

View Font ETN ALL Fts

C/S	ETN	PEL	COPN	ADEP	ADES	PSOR
NAX1076	0815	110	IC2BA	EDDM	LSZH	110
RYR2082	0812	170	AMTOT	EDDM	EDDM	170
NAX522	0811	440	IC2BA	EDDM	LSZH	440
DLH1708	0808	170	AMTOT	EDDM	EDDM	170
WZZ12H	0801	190	IC2BA	EDDM	EDDM	190
UNION	0800	110	IC2BA	EDDM	EDDM	110
SAS100	0800	110	IC2BA	EDDM	EDDM	110
UNION	0801	110	IC2BA	EDDM	EDDM	110
SAS105	0801	110	IC2BA	EDDM	EDDM	110
UNION	0801	110	IC2BA	EDDM	EDDM	110

...INFRINGEMENTS...?

- A delay in conflict examination (C)
- + short time to conflict (D)
- could result in an infringement.