



# *12<sup>TH</sup> ICCRTS*

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## *C2 CONCEPTS, THEORY & POLICY TRACK*

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**Republic of Singapore**



***FULA PAPER***  
***Flexible Utilization of***  
***Limited Airspace***

**Location:Asia**  
**Capital City:Singapore**

# ***FULA PAPER***

## ***Flexible Utilization of Limited Airspace***

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***Joint Collaboration  
DSO National Laboratories &  
Future Systems Directorate***





***“Where art thou Singapore?”***

# ***SIZE*** *does matter.....*



***A sovereign nation between neighboring  
Malaysia & Indonesia***

# ***FULA CONCEPT***

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## ***Scope***

- ***Key Problem Space***
  - ***C2 WF Concepts Experimentation***
  - ***Pushing Ops-Tech Boundaries***
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*“What airspace problem?”*

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*Not a problem.....*

*“**BIG** SKY SMALL **BULLETS**”*

# ***BIG SKY, SMALL BULLET...***

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***Birdie Shot***



***Question***

***What is the chance of a golf ball hitting a bird?***

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# *Airspace Challenge Contextual Problem*

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## *Key Challenge....*

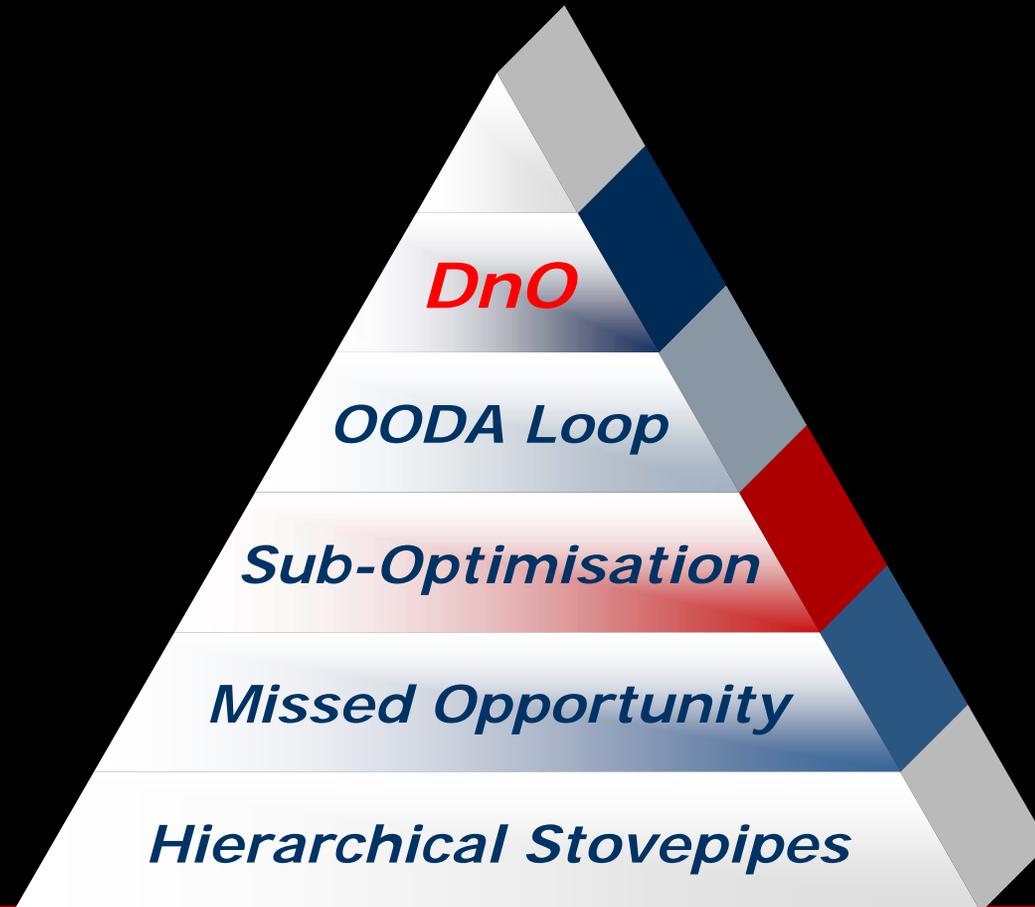
With proliferation of munitions, manned & unmanned aircraft, is there an *airspace problem* in the operating environment?

Is *current "Divide-&-Operate" way of managing airspace* a major limiting factor in airspace optimisation when multiple missions are launch simultaneously?

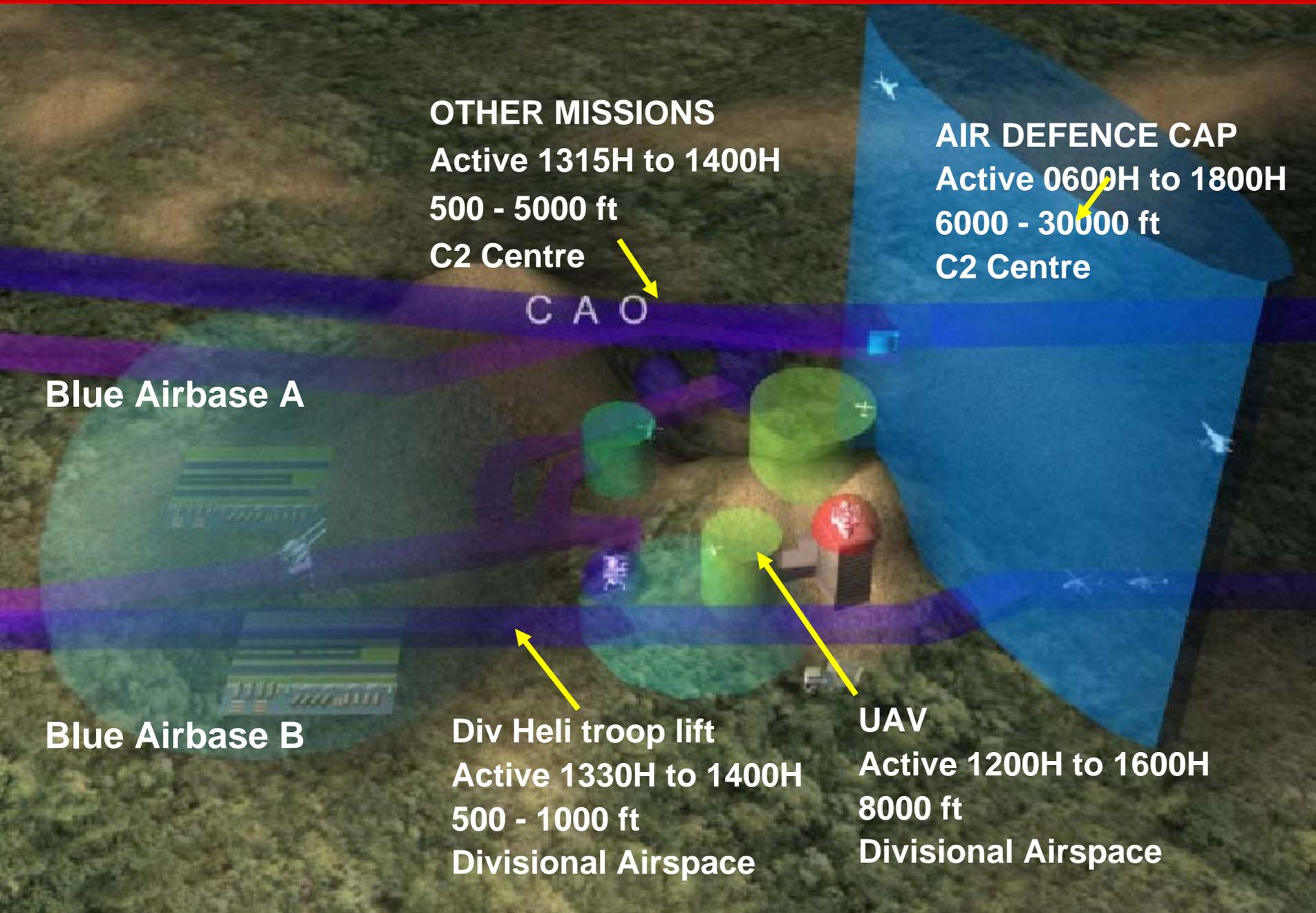
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# *Problem of Divide-&-Operate Rule*

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# Flexible Utilization of Limited Airspace (FULA)





# FULA COGNITIVE VISUALIZATIONS



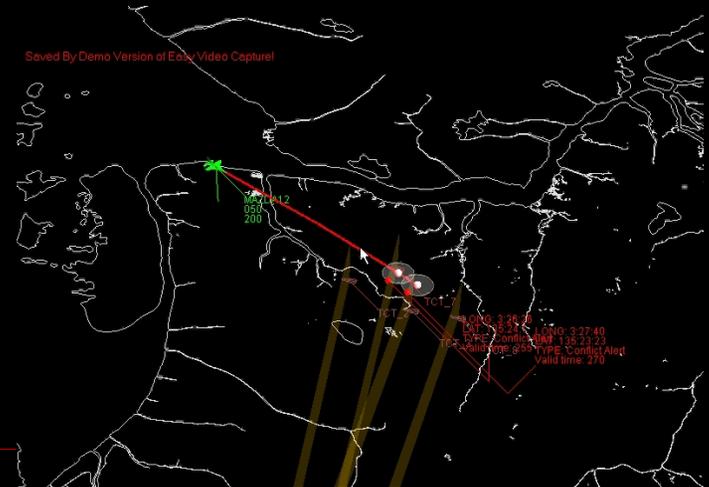
Human Eye Dynamic in/out Focusing



Aided Focus (AF)

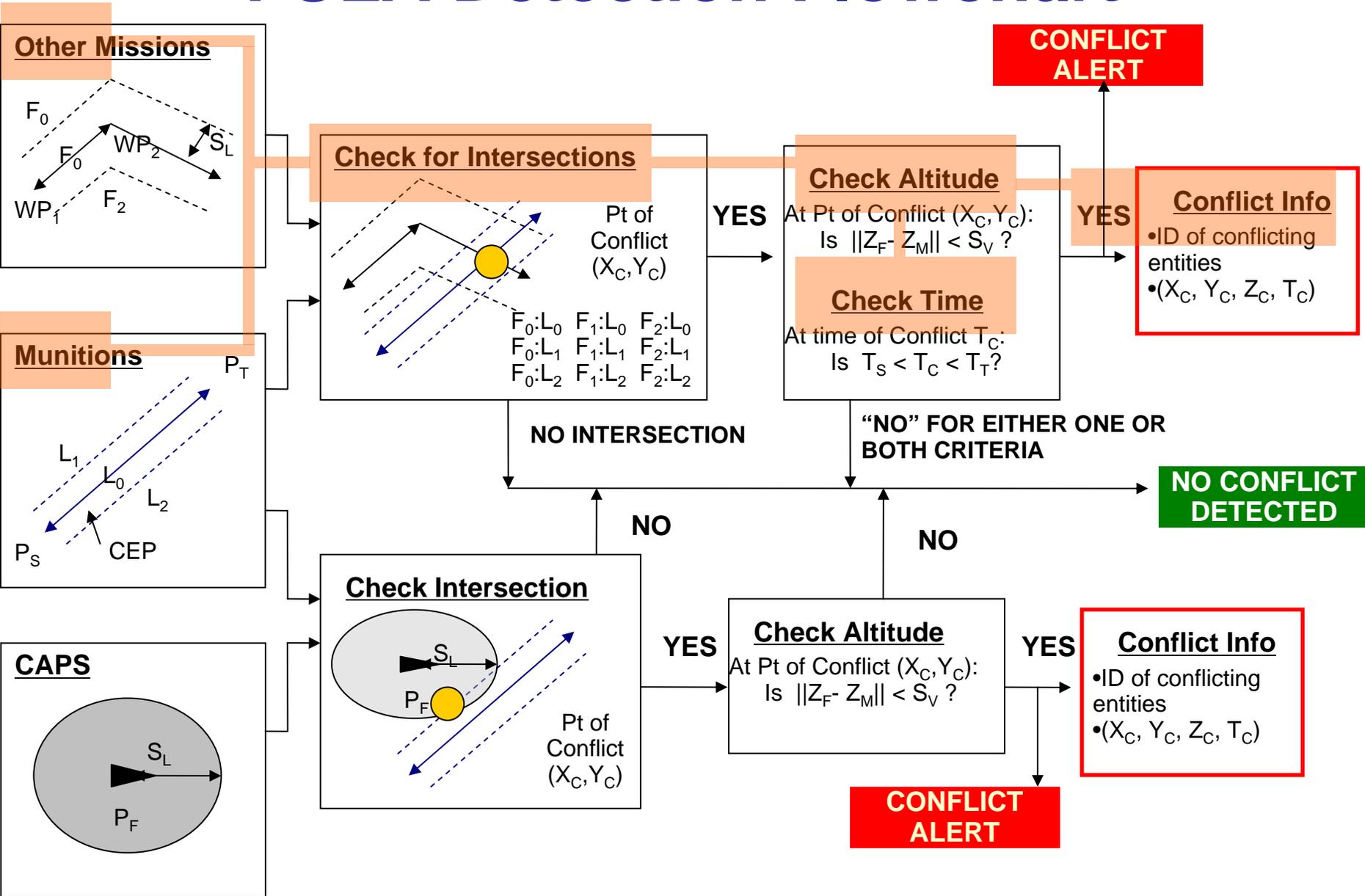


Patterns in Motion

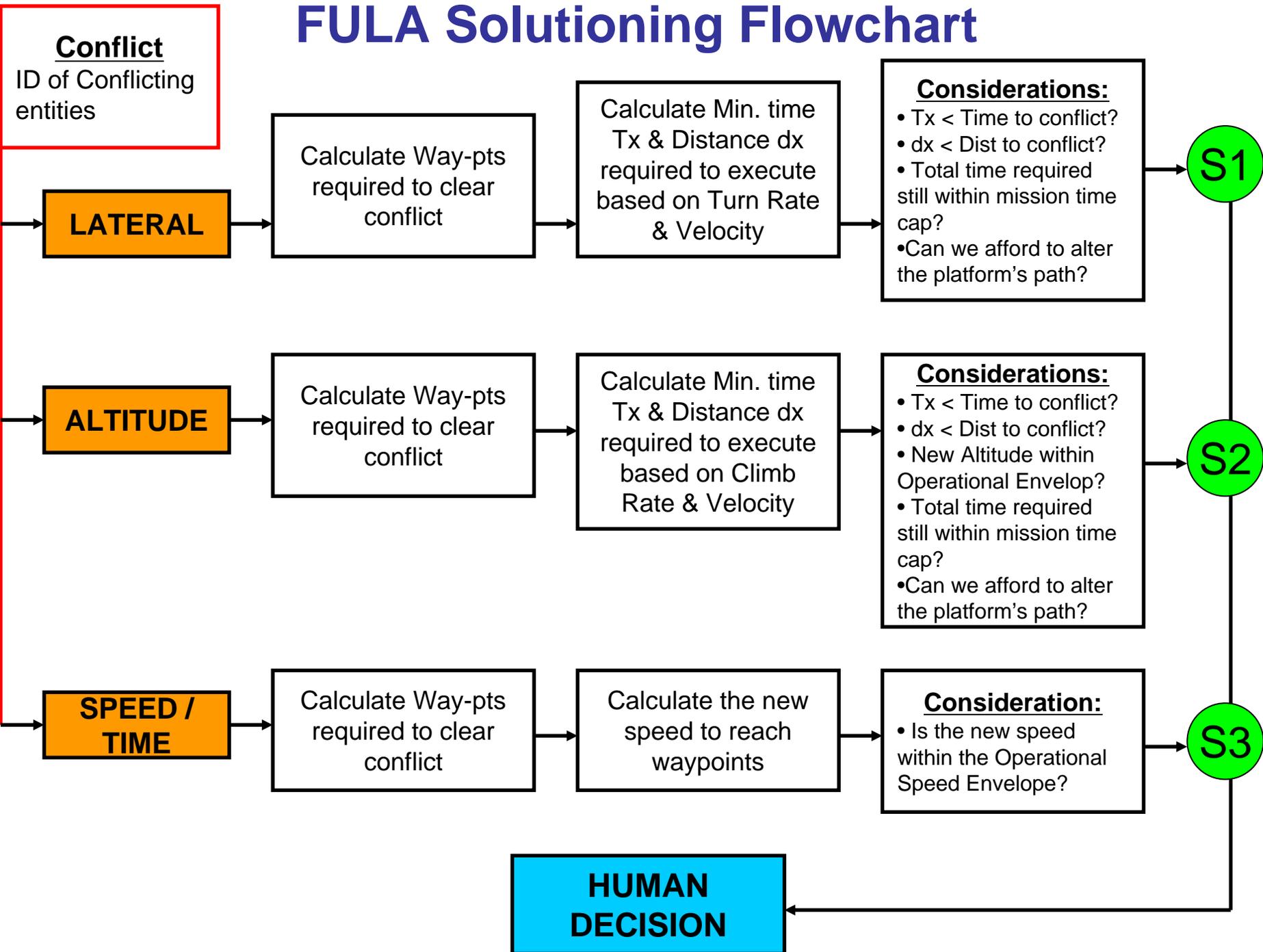


Kinetic Visualization (KV)

# FULA Detection Flowchart



# FULA Solutioning Flowchart



# Safety Clearance

## Munition Classes

Circular Error Of Probability (CEP)

Lateral  m

Vertical  m

## Unmanned Classes

Blue UAV Safety Clearance

Lateral  miles

Vertical  ft

## Manned Classes

Blue Fighter Safety Clearance

Lateral  miles

Vertical  ft

Blue CAPS Fighter Safety Clearance

Lateral  miles

Vertical  ft

Blue Helicopter Safety Clearance

Lateral  miles

Vertical  ft



***IS BELIEVING***

***RECORD OF DEMO  
IN FLYING ENVIRONMENT***

MAZDA  
050  
209

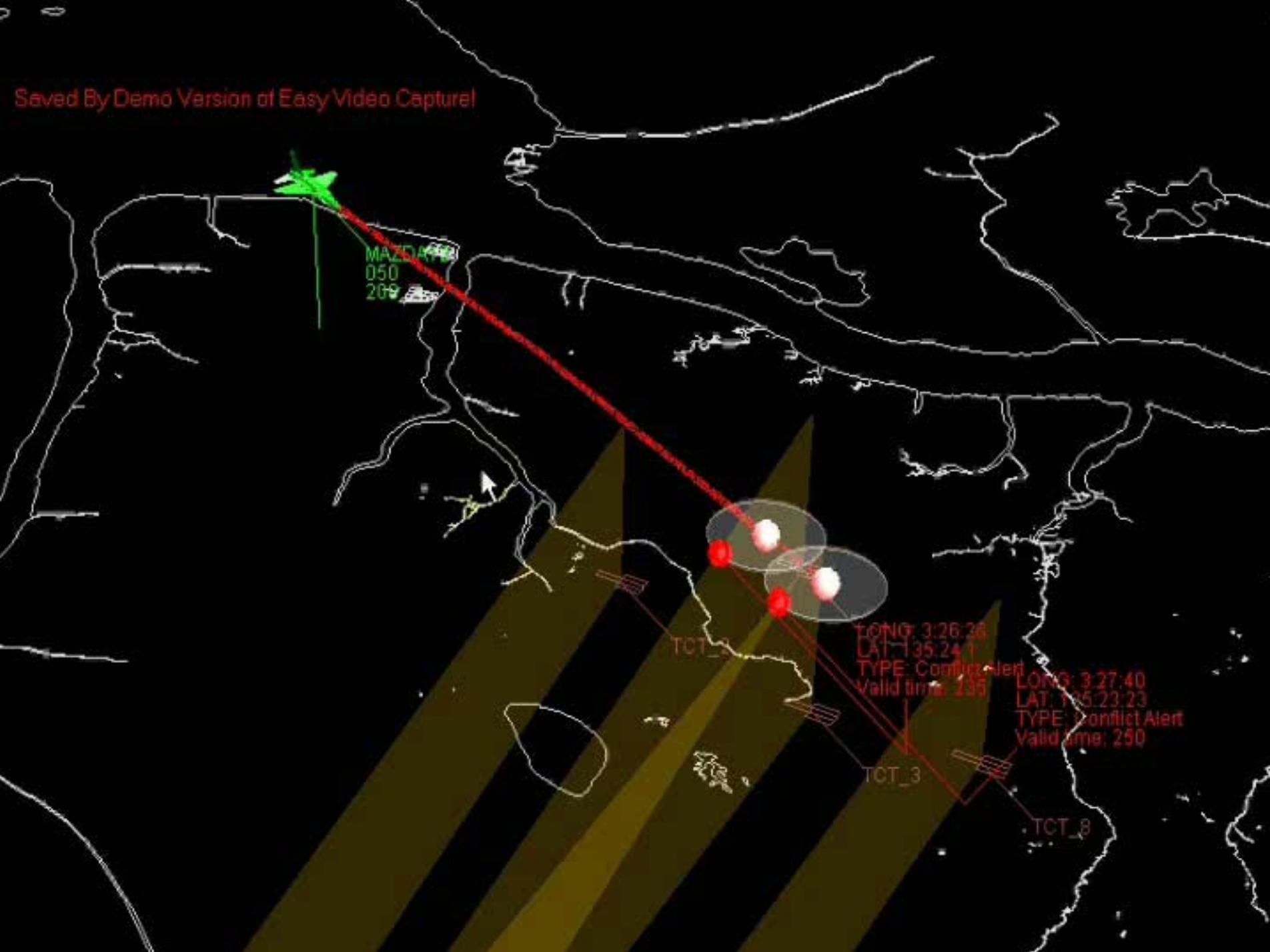
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LAT: 135:24:1  
TYPE: Conflict Alert  
Valid time: 235

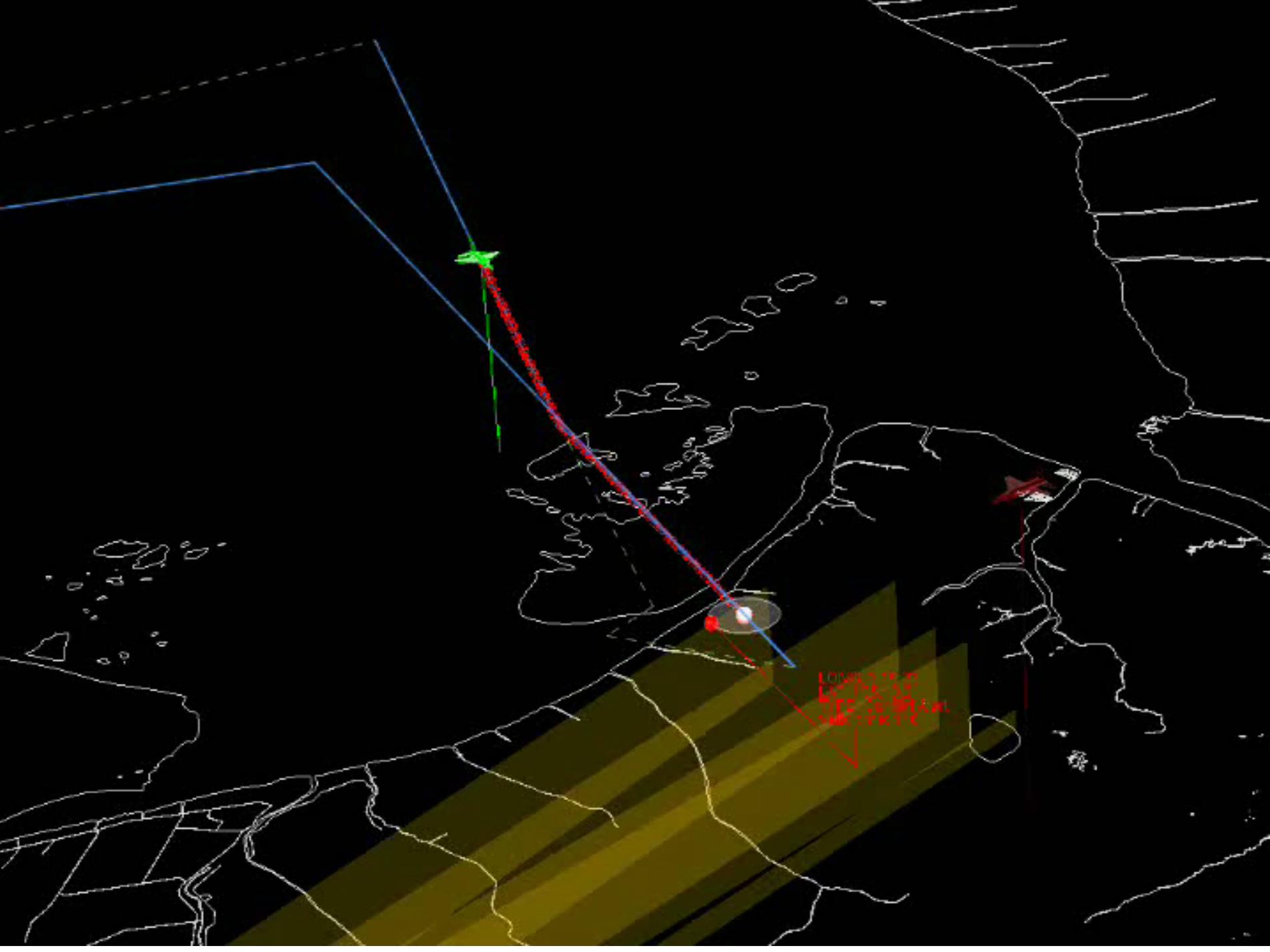
LONG: 3:27:40  
LAT: 135:23:23  
TYPE: Conflict Alert  
Valid time: 250

TCT\_3

TCT\_3

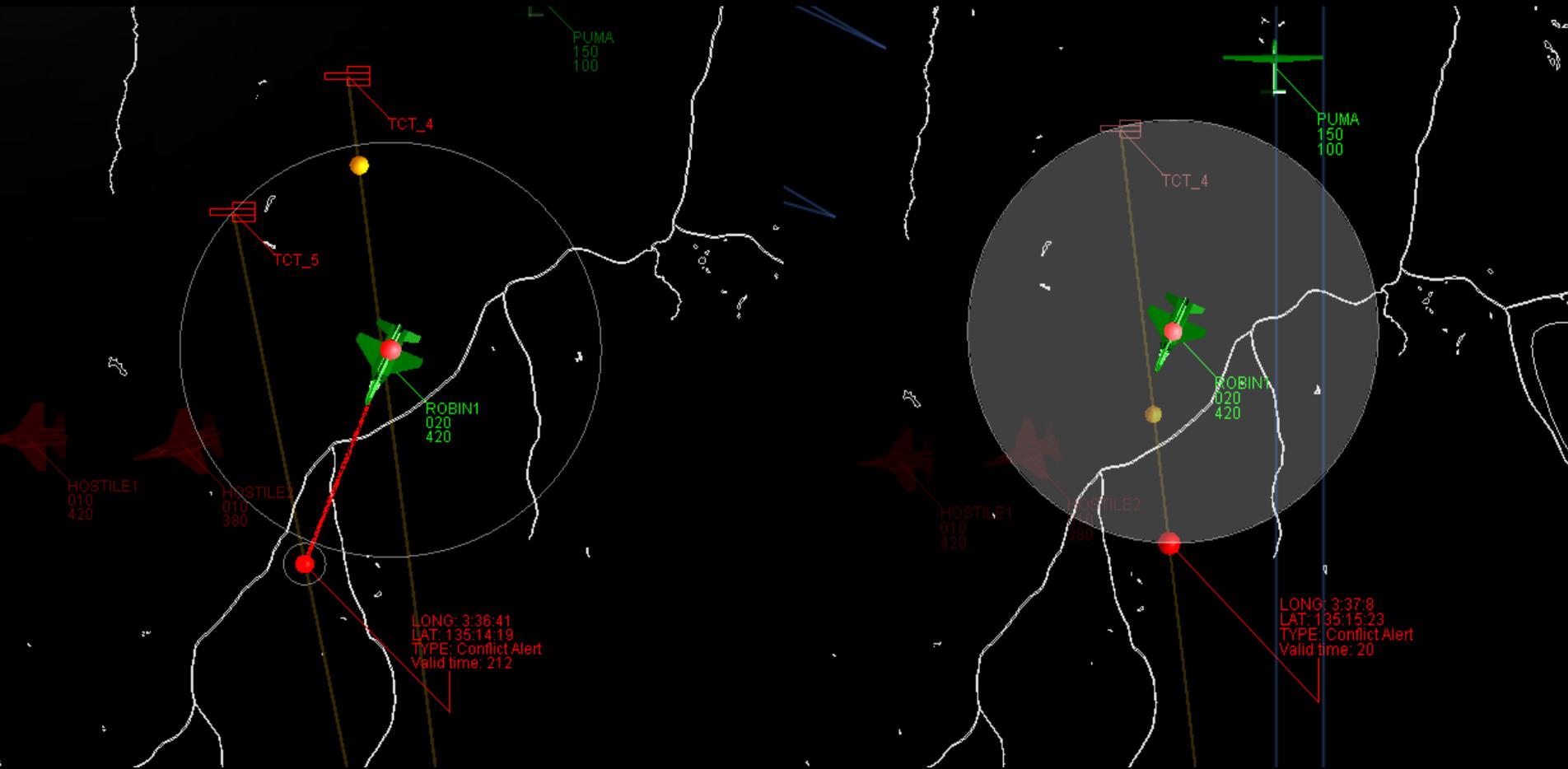
TCT\_8





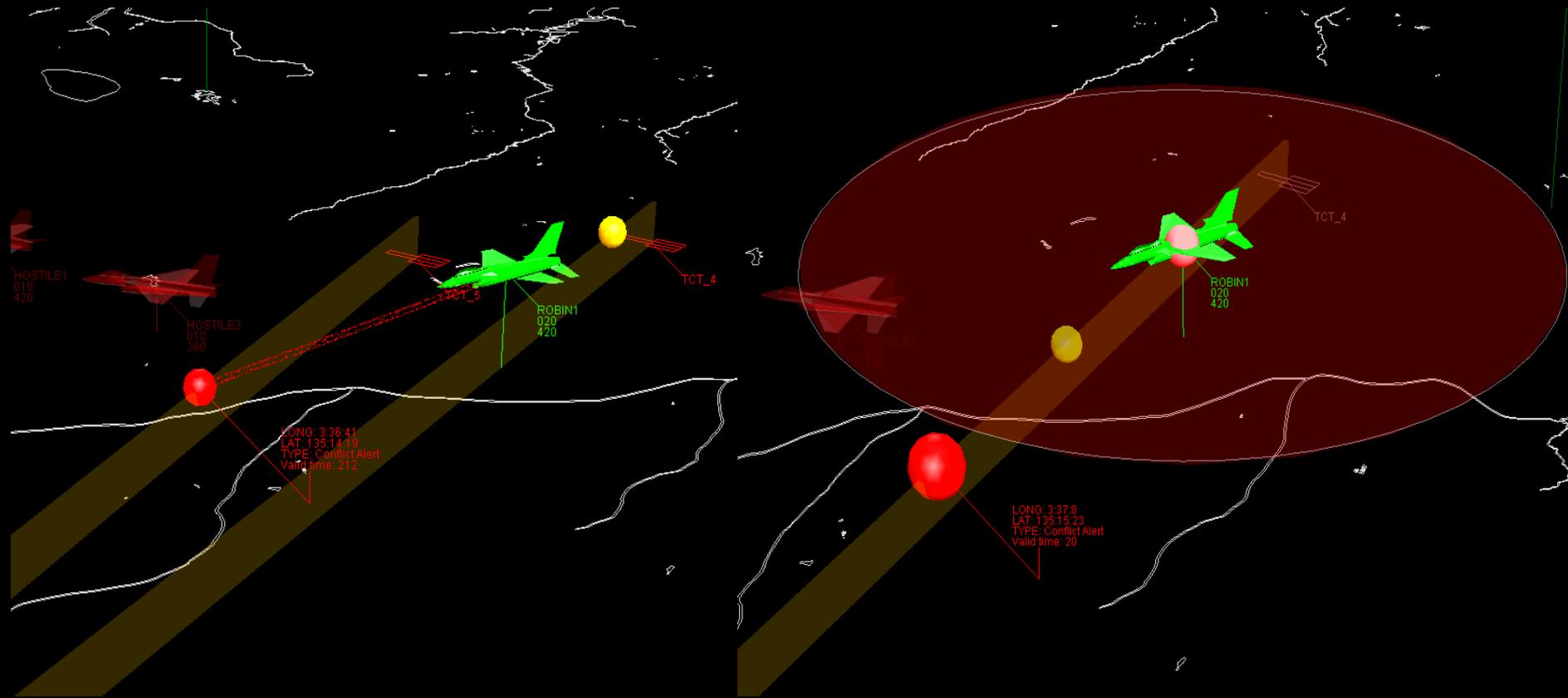
LOGGING THE  
LOCATION OF THE  
STAR AND THE  
DOT

# Cognitive Visualisation



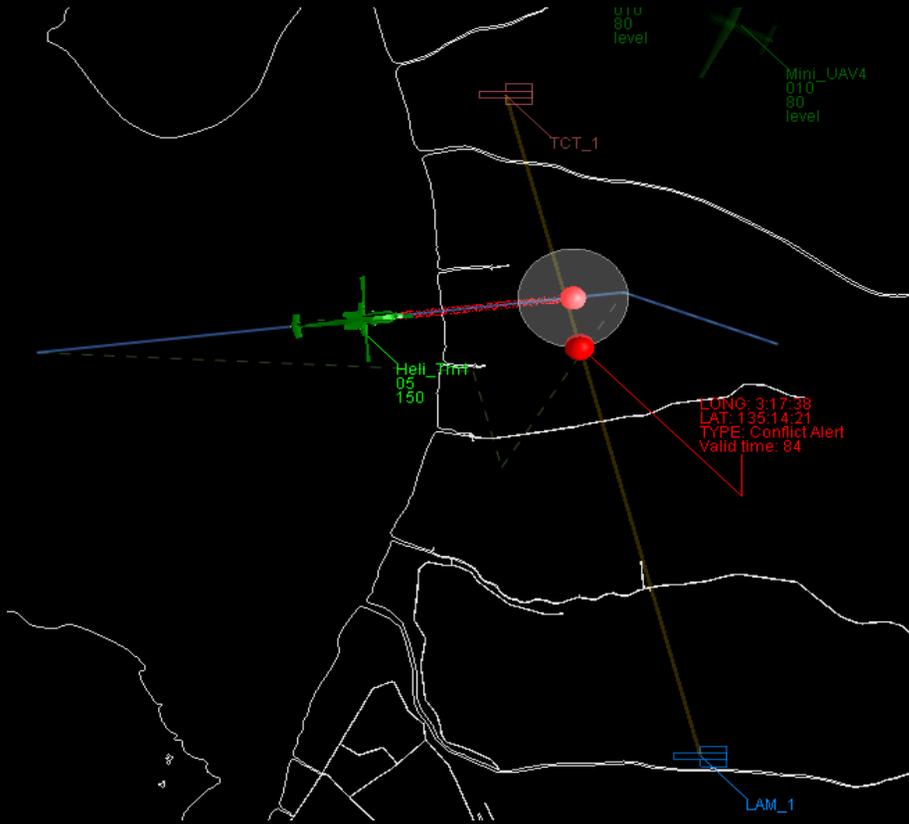
## Improved 2D View

# Cognitive Visualisation

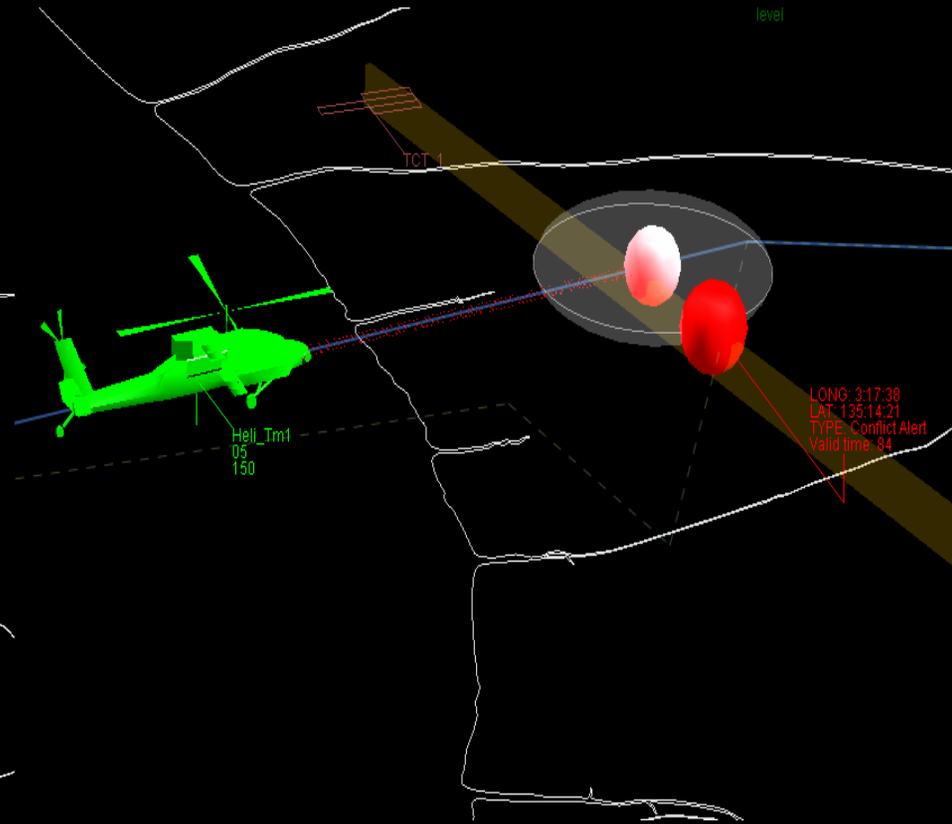


Improved 3D View

# Cognitive Visualisation



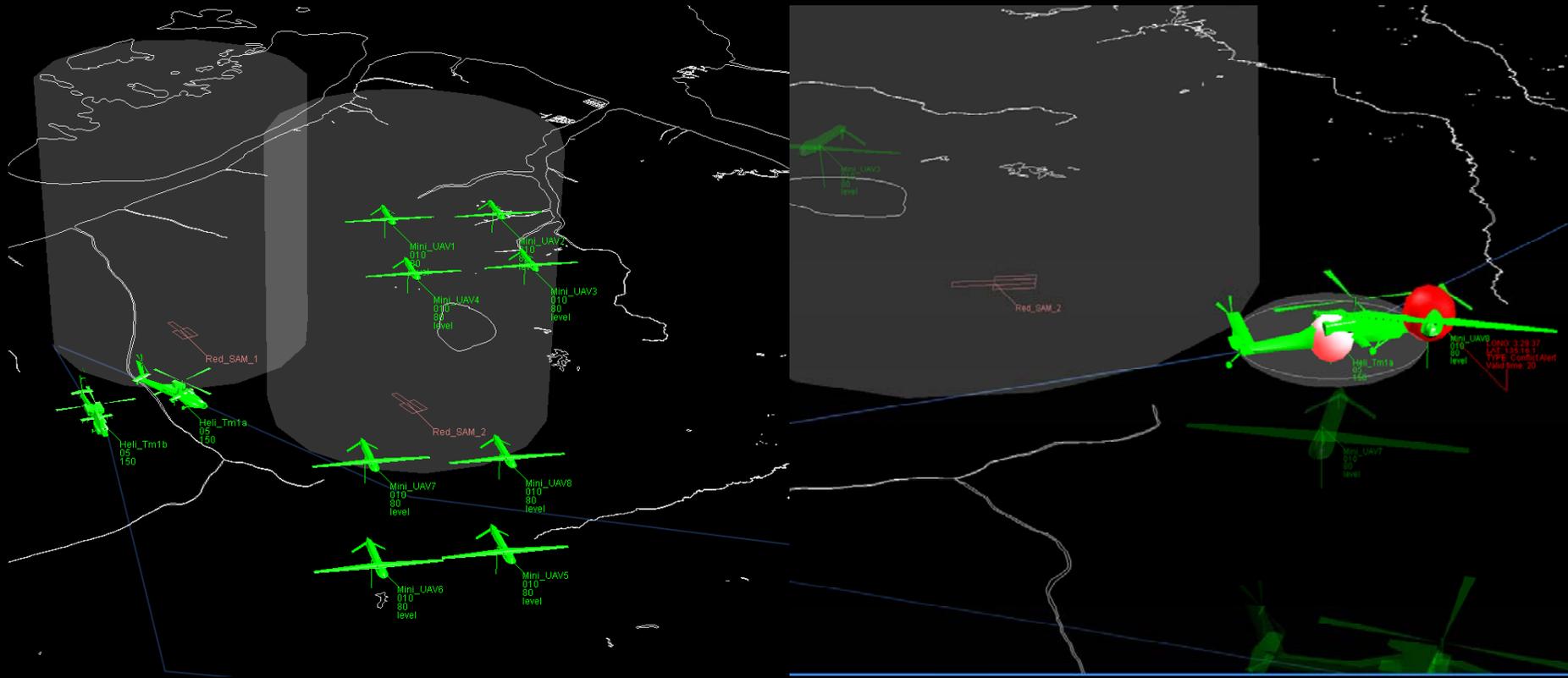
2D View



3D View

## Helicopter Ops

# Cognitive Visualisation SAM & Slow-Movers



**SAM Site**

**Heli & MiniUAV Conflict**

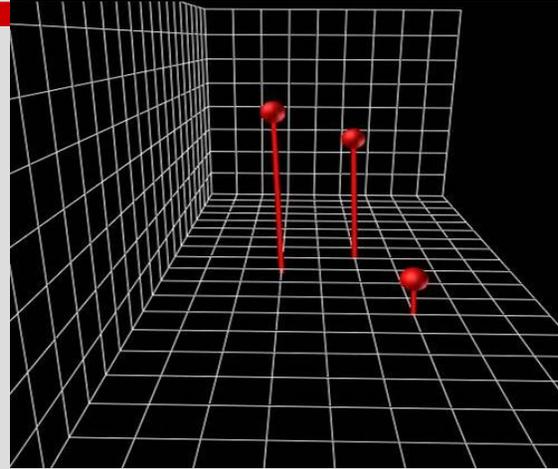
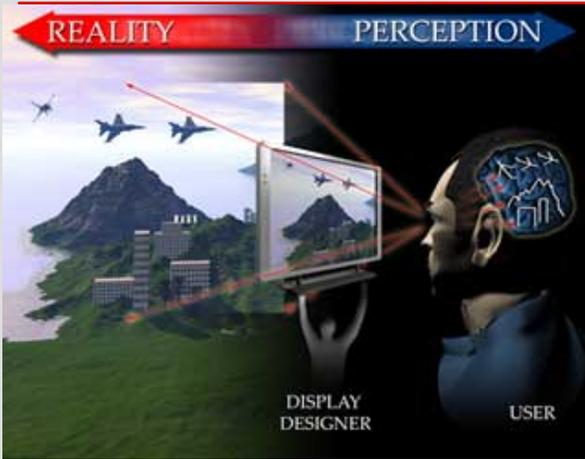
**4<sup>th</sup> Dimension for SIMOPS.....**



***PUSHING OPS-TECH  
BOUNDARY***

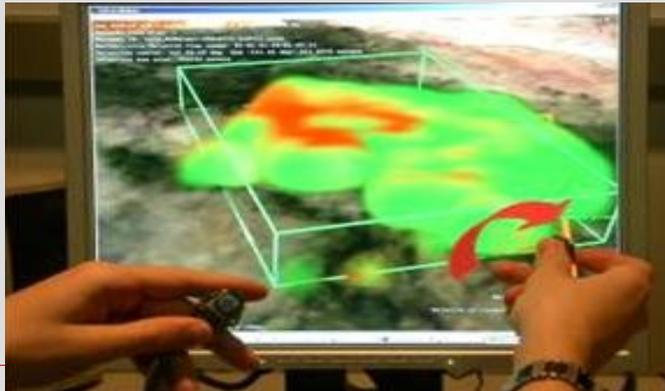


# *Pushing Augmented Cognition with 3D visualization + interaction*



**New artificial cues for precise relative position & distance judgement**

**Ensure one glance understanding**



**New advanced 3D interaction techniques**



**New multimodal interactions techniques**

# *One Context*

## *Dynamic Missions*

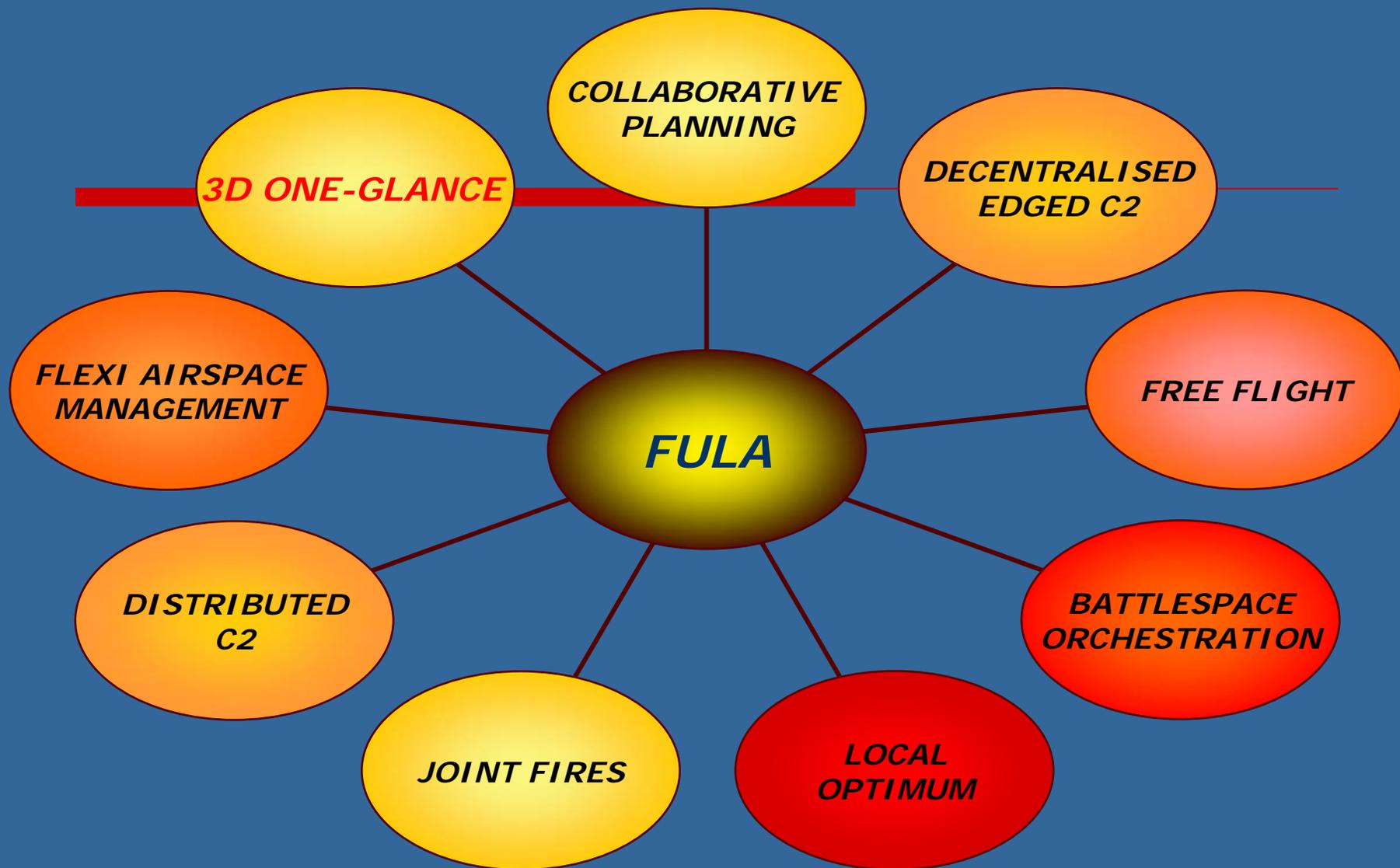
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*flexible employment of air power*  
*to deal with*  
*emerging concerns of high*  
*priority,*

*Flexible utilisation of airspace for*  
*assets across domains*

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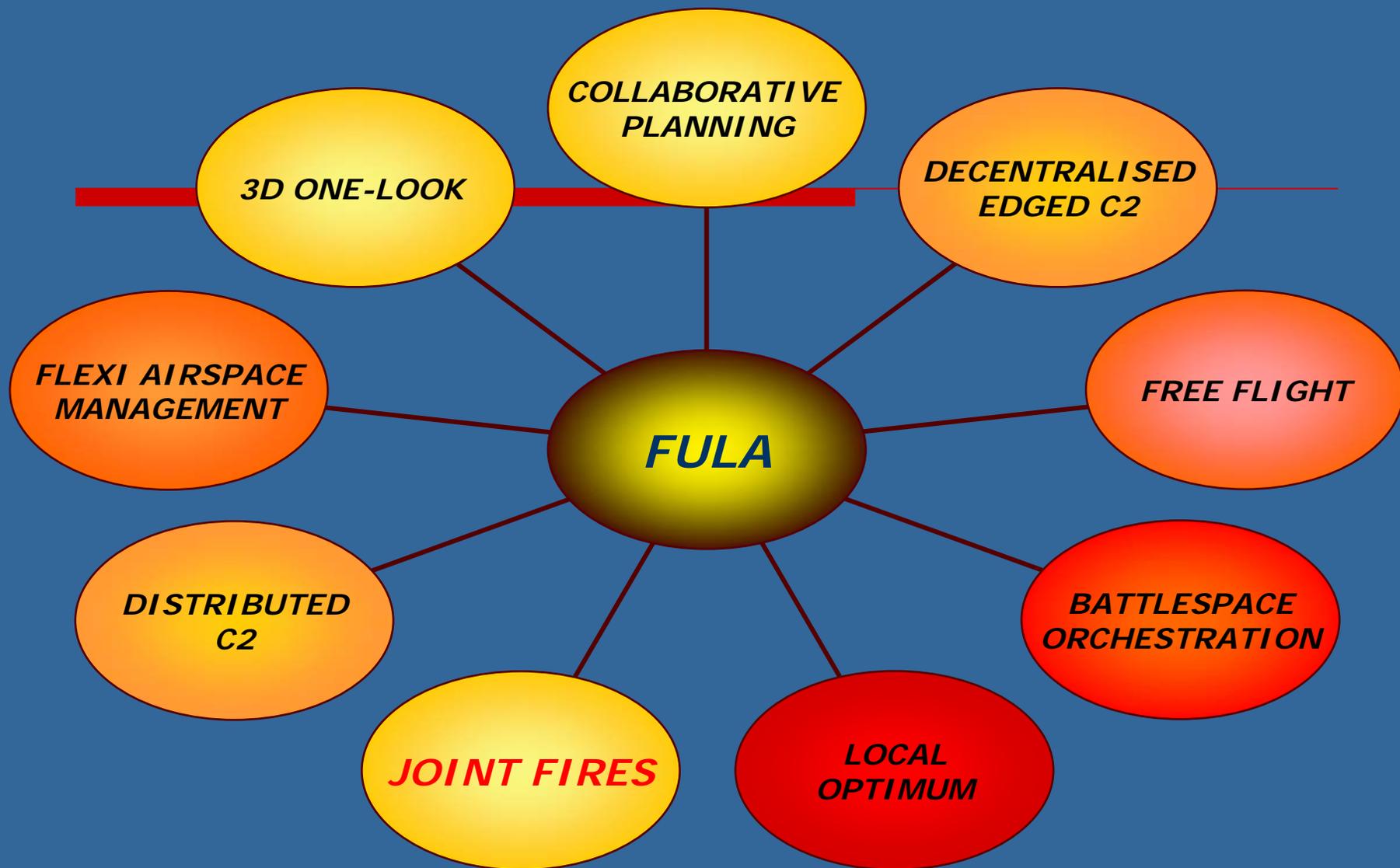
# *FULA – PUSHING OPS-TECH BOUNDARIES & ENABLING C2 WARFIGHTING CONCEPTS FOR EXPERIMENTATION*





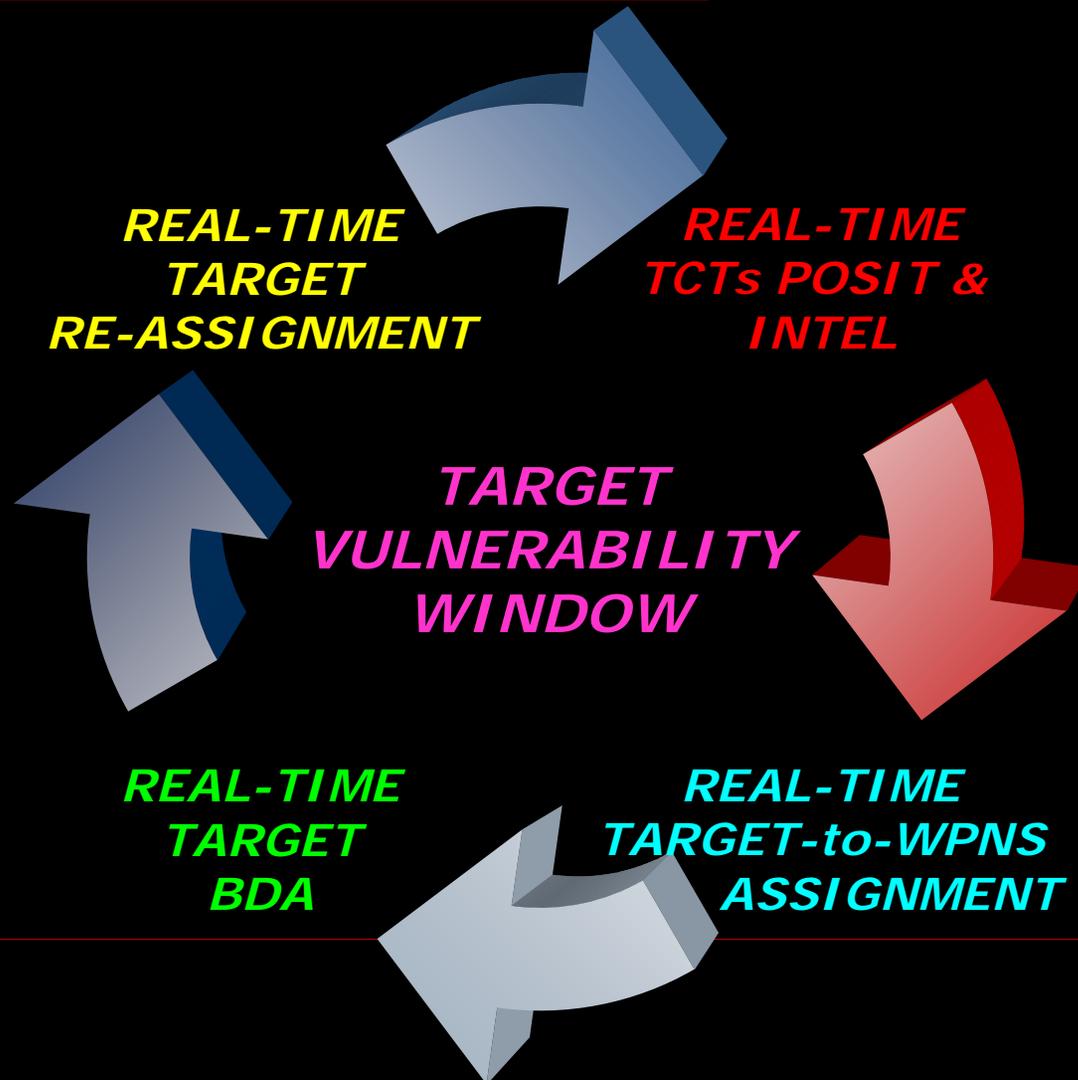
***3D BASELINE BATTLESPACE  
AWARENESS PICTURE***

# *FULA – PUSHING OPS-TECH BOUNDARIES & ENABLING C2 WARFIGHTING CONCEPTS FOR EXPERIMENTATION*



# *COMPRESSING THE SENSOR-to-SHOOTER LOOP*

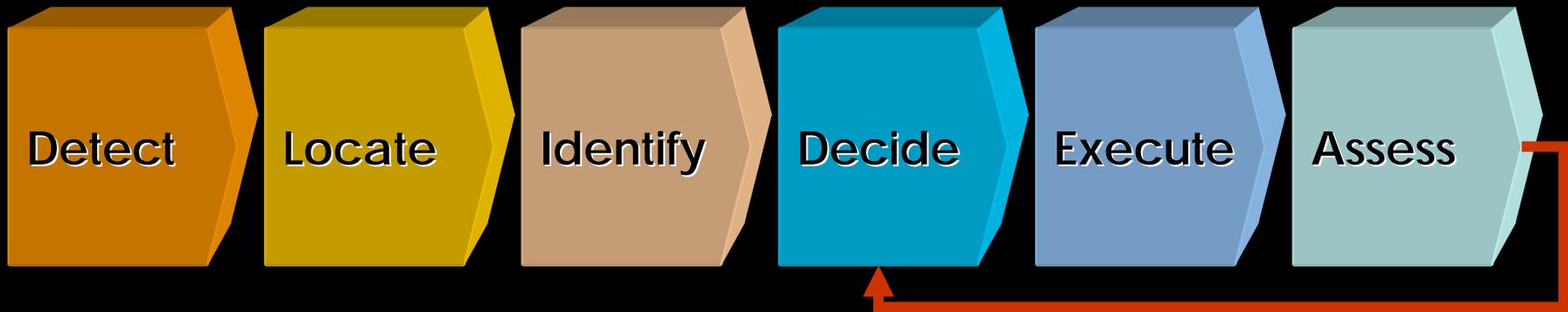
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# ***FULA - KEY ENABLER***

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## ***The Dynamic Cycle***



- Elusive**
  - Aggressive**
  - Compression of OODA Loop Cycle**
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***FULA CONCEPT  
A TRANSFORMATION IDEA  
THAT REQUIRES A  
TRANSFORMATIONAL MINDSET***



**SOURCE: HEDONISTICA.COM**

THE  
**FUTURE**  
OF  
COMMAND ... CONTROL ...



**12<sup>TH</sup> ICCRTS**

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*Thank You!*



**FULA**

