

## RFI ICAO DRONEENABLE 2023

RFI "A": What solutions are needed or are being developed to address CNS Requirements in Low Level Airspace

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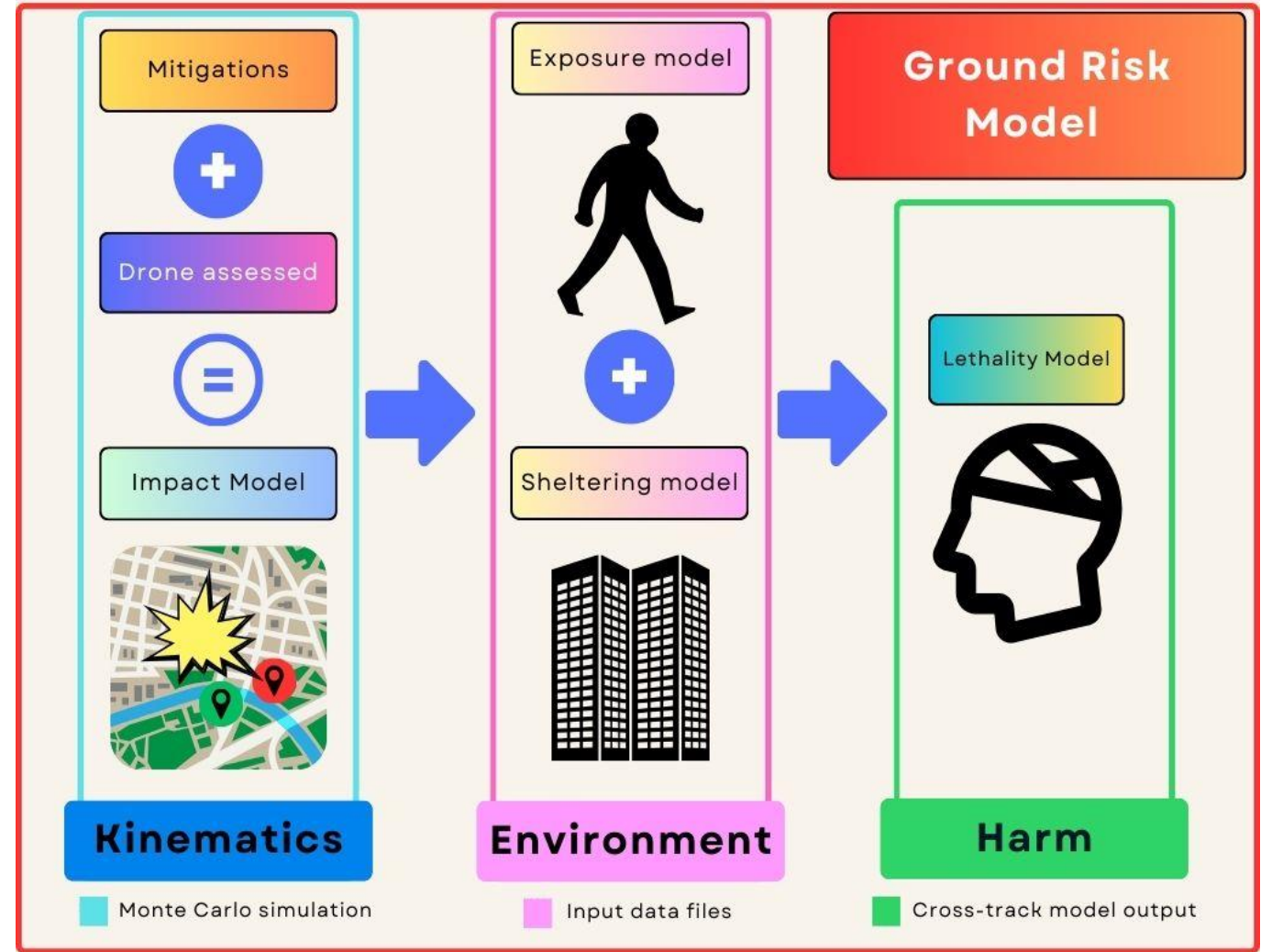
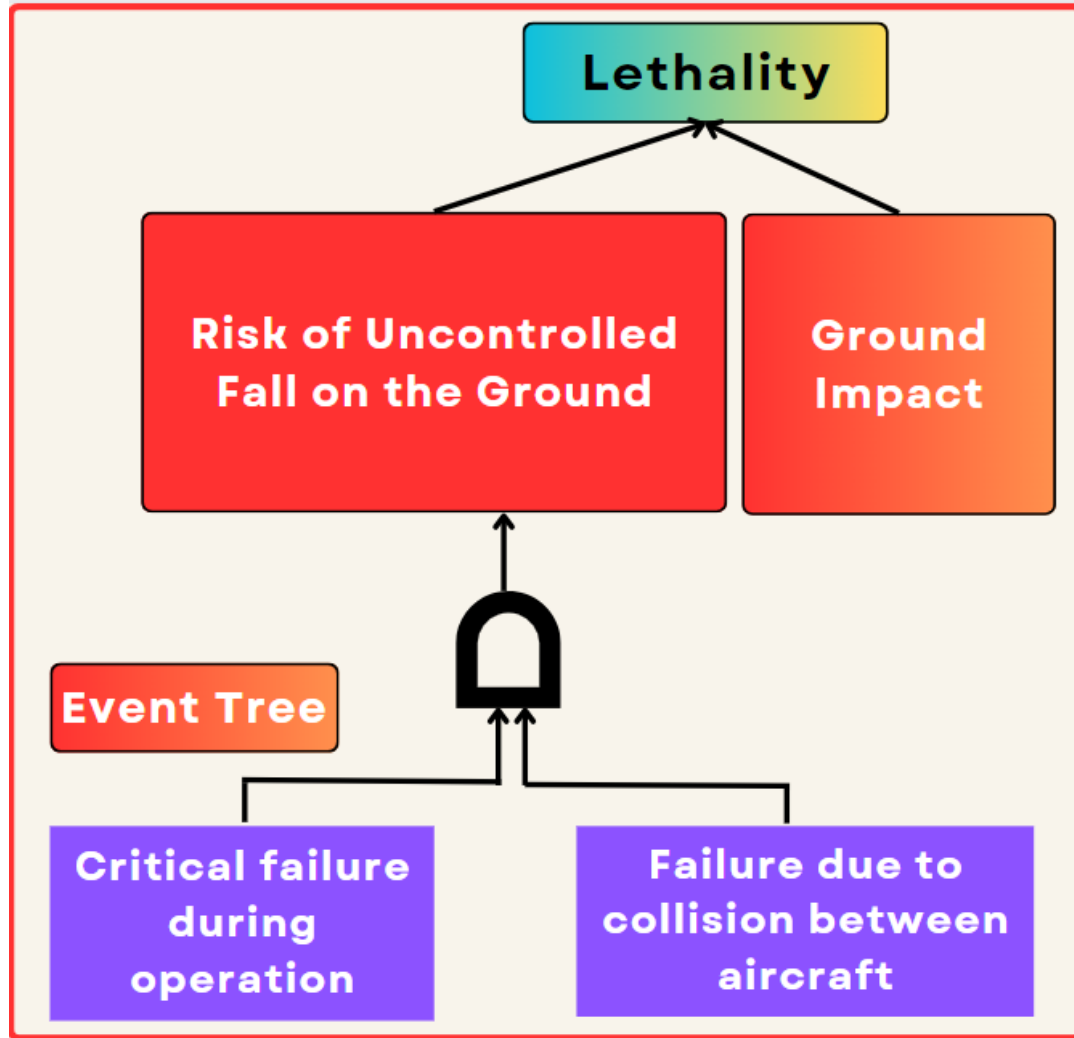
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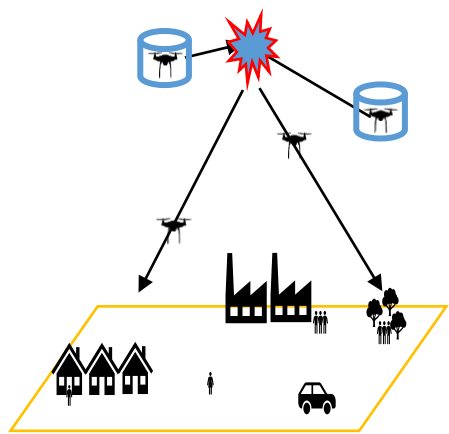
DECEMBER 5<sup>th</sup> 2023, MONTREAL

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# Ground Risk Model Architecture





**Lethality**

=

**Risk of Uncontrolled Fall on the Ground**

X

**Ground Impact**

Probability of fatal injuries to third parties on the ground  
 TLS  $\geq 1E-7$

Collision risk + Failure risk

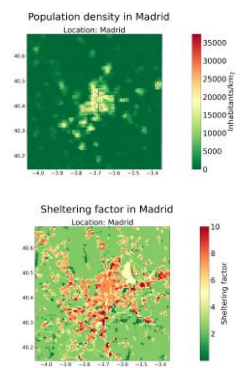
The probability of impacting on a person

The probability of the impact evolving into a fatality

UAS	MTBF (h)	Acceptable Collision/Failure Rate (Fall on the ground)
DJI MAVIC	65	1.54E-02
DJI Phantom 4	560	1.79E-03
Talon (fixed wing)	4400	2.27E-04

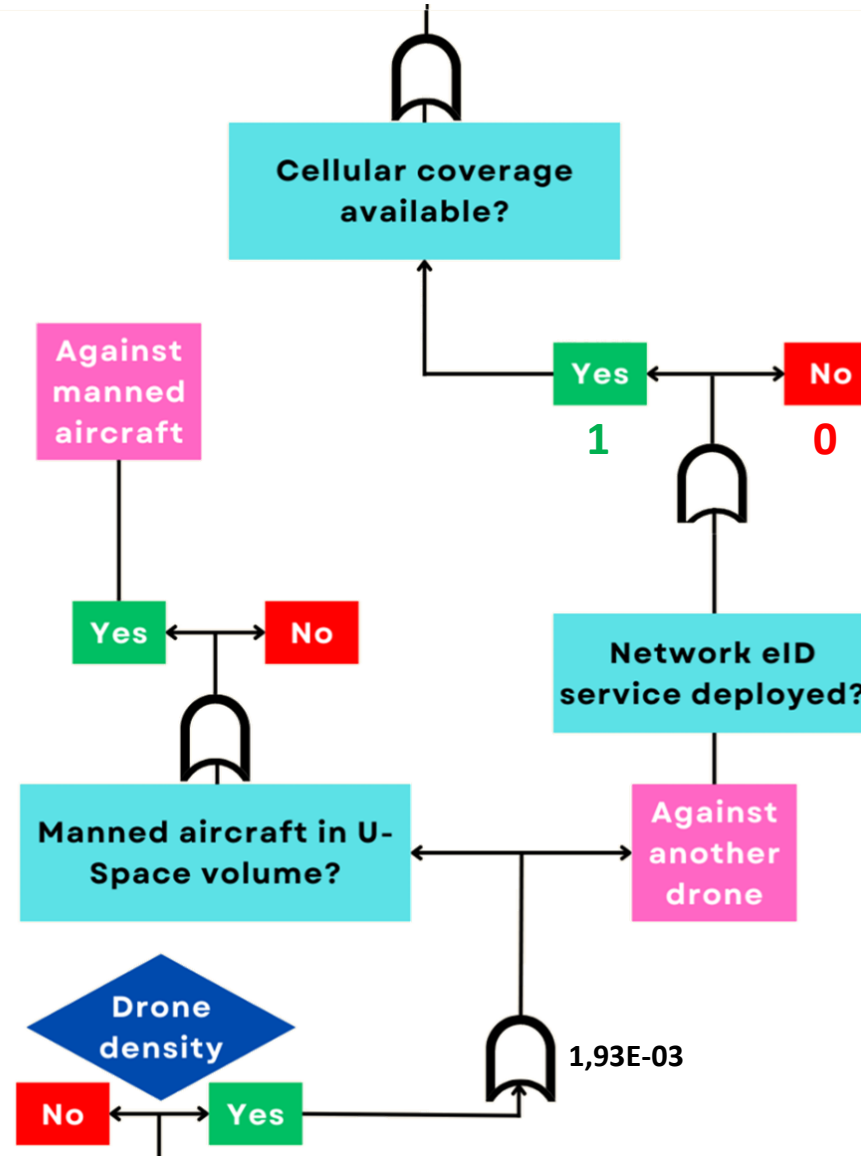
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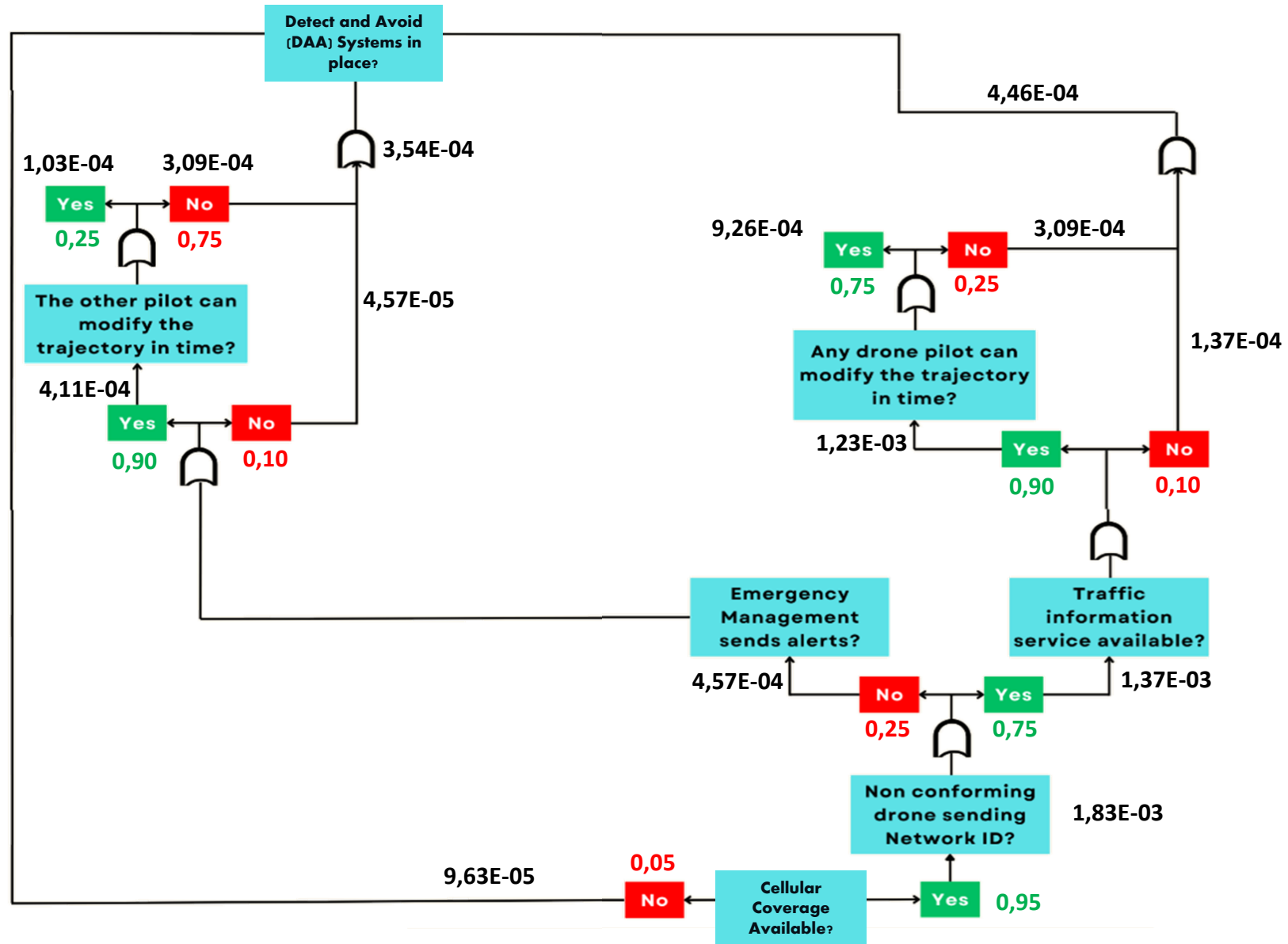
- Population density map (Eurostat)
- Sheltering factor
- Kinematic energy

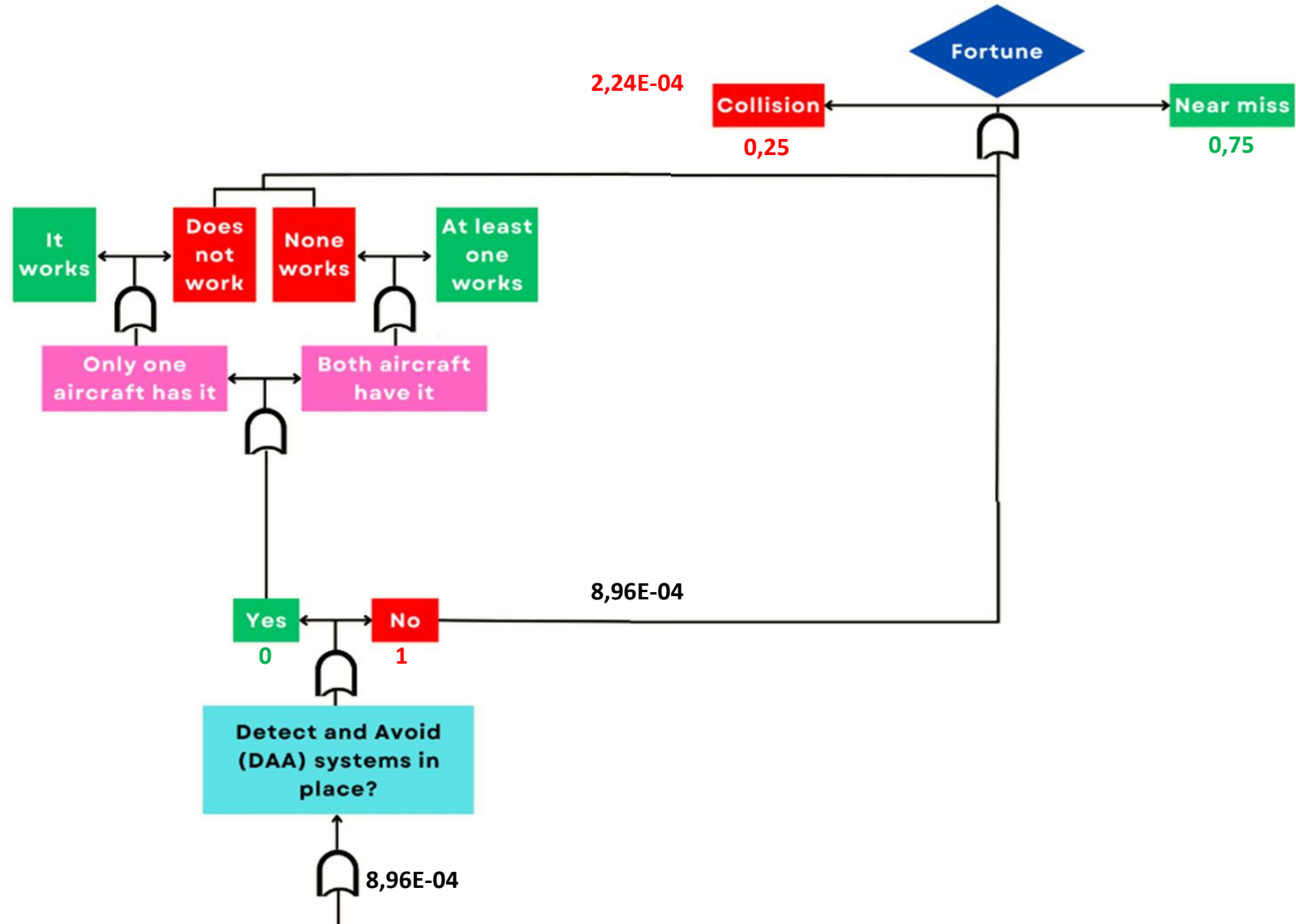


**Ground Risk Model**







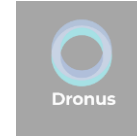


## Key Points for CNS Analysis

- To reach a maximum collision rate of  $2.27E-4$ , as demanded by the most stringent UAS considered in this analysis, a minimum **availability of 95% must be requested for the cellular service and a continuity of service of 98.75%**
- More stringent operations would demand greater availability and continuity of service values for the cellular service supporting network remote identification.
- In the event of a **loss of CNS services, mitigation measures** would need to be implemented:
  - continuous monitoring of CNS networks
  - in parallel different CNS providers on board of the UAS



# U-ELCOME



**Service Providers (CISP, USSP, ANSP)**



**National Local Authorities**



**Drone operators**



**Airports**



**Industries**



**Universities Test & Research centers**



# Example of performance measurement in practice

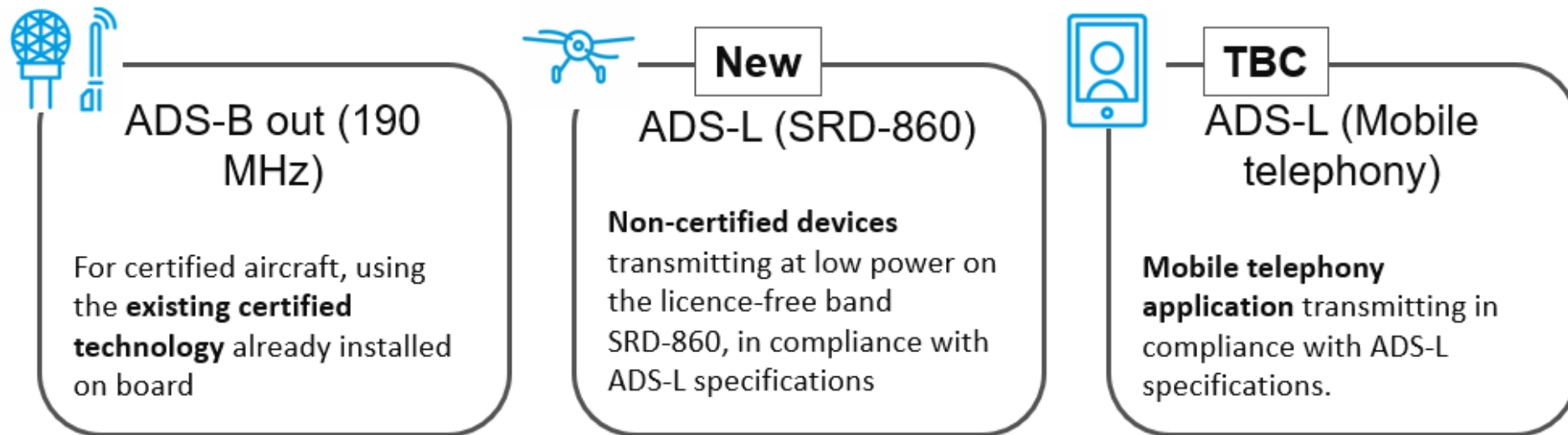
## U-ELCOME

EU Nation	City
France	<ul style="list-style-type: none"> <li>Brétigny LF-R333</li> <li>Saint Quentin en Yvelines (5 sites)</li> </ul>
Spain	<ul style="list-style-type: none"> <li>Navarra</li> <li>Catalonia Region</li> <li>Madrid</li> <li>Seville &amp; Jaén</li> <li>Zaragoza</li> <li>Fuerteventura (Canary Islands)</li> <li>A Coruña</li> <li>Valencia</li> </ul>
Italy	<ul style="list-style-type: none"> <li>Milan</li> <li>Venice</li> <li>Rome</li> <li>Naples</li> <li>Others</li> </ul>

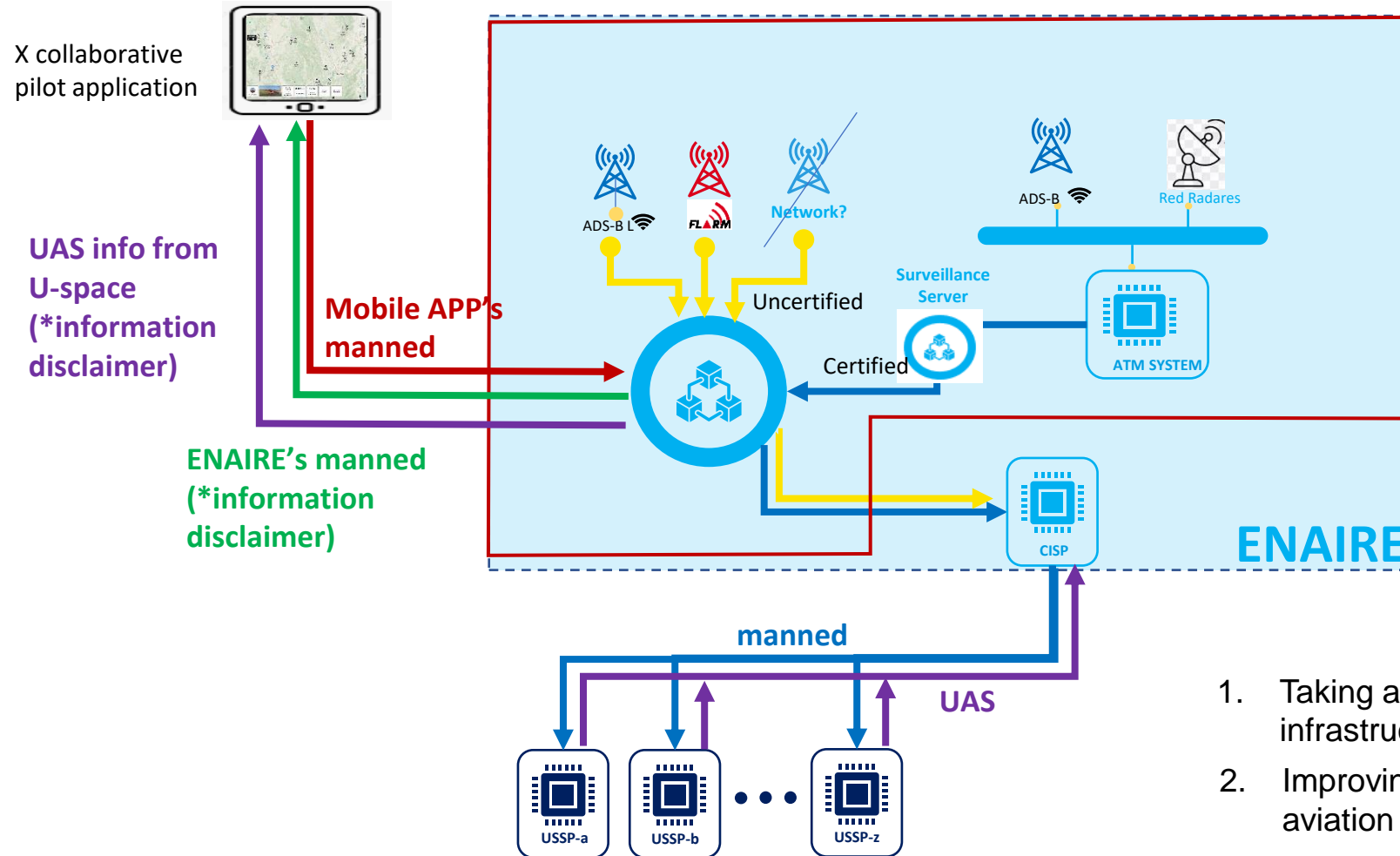


## Limited spectrum availability (e-conspicuity case)

- Spectrum limitation problems are expected for ADS-B.
- Different means of compliance for U-space (EU 666/2021)



## Bidirectional e-conspicuity



**DSIS**

1. Taking advantage of the existing infrastructure
2. Improving situational awareness for manned aviation
3. ADS-L (Network) best solution vs. costs

## Summary of CNS requirements

- High Availability and Continuity of service for cellular service would be needed to support Network ID
- In the event of a **loss of CNS services, mitigation measures** would need to be implemented:
  - ✓ continuous monitoring of CNS networks
  - ✓ in parallel different CNS providers on board of the UAS
- U-ELCOMe is evaluating CNS performance through U-space operational demonstrations. Example of e-conspicuity in U-ELCOMe's demonstrations.



## References

- Lin, X.; Fulton, N.; Westcott, M. Target level of safety measures in air transportation—Review, validation and recommendations. In Proceedings of the IASTED International Conference on Modelling, Simulation, and Identification (MSI 2009), Beijing, China, 12–14 October 2009.
- Howard, R.W. Breaking through the 106 barrier. *Aeronaut. J.* 1992, 96, 260–270.
- Stefano Primatesta, Alessandro Rizzo, Anders la Cour-Harbo (2018): “Ground risk map for Unmanned Aircraft in Urban Environments”
- [la Cour-Harbo, 2017] la Cour-Harbo, A. (2017). Quantifying risk of ground impact fatalities of power line inspection BVLOS flight with small unmanned aircraft.
- [la Cour-Harbo, 2020] la Cour-Harbo, A. (2020). Ground impact probability distribution for small unmanned aircraft in ballistic descent.
- European Commission, J. R. C. B. and (B.1), D. R. (2023). GEOSTAT 1 km<sup>2</sup> population grid. <https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/population-distribution-demography/geostat>
- Copernicus (2018). CORINE Land Cover / CLC 2018. <https://land.copernicus.eu/pan-european/corine-land-cover/clc2018>. [Online; accessed 19-September-2022]
- U-ELCOM Project : <http://u-elcome.eu/>

# THANK YOU,

? ? ANY QUESTIONS ?? ?