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ICAO's RPAS/3 Symposium

EMERGING TECHNOLOGIES – the balance between legacy and innovation

Three breakthrough technology domains paving the way for the of future aviation

P. FOSSIER – THALES

0 RPAS require evolution of legacy technologies …

Category	Examples
Flight control	Antennas, Speed control, Flight controller, embedded computers
Navigation	GPS, altimeter, accelerometer, gyroscopes, magnetic compass, airspeed, positioning / image recognition cameras, obstacle sensors
Mission specific equipment	HD camera, thermal camera, LIDAR, temperature sensors, weather sensors

This could be seen as an incremental evolution of a legacy technology portfolio … but it means significant and continuous progress in SWaP (*Size, Weight and Power*) , cost and performance !

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0 … but also maturation of some specific ones

- **Collision avoidance / warning** : *"Sense & Avoid"*
- **Automatic take-off & Landing** *(ATOL)*
- **Communication systems** : *create or improve connectivity (incl. communication for BVLOS operation, fulfilling spectrum demand), high availability and QoS*
- **Security** : *anti-jamming, anti-intrusion, "Geo fencing"*
- **RPAS delivery** : *safety, airworthiness, Air Traffic Integration*
- **Mission management** : *Command & Control, on-board / off-board allocation, automated operations : move towards full autonomy for RPAS*

Strong innovation focus required in technology, regulation, procedures

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0 However, there are some key breakthrough ahead

1. UAS are at the heart of the Digital Transformation, where value comes from data

2. UAS provide an advanced vision of the future of manned aviation, and pave the way for its future

3. As a result, UTM cannot be a legacy ATM continuity, it must embed data-driven approach and will transform future ATM

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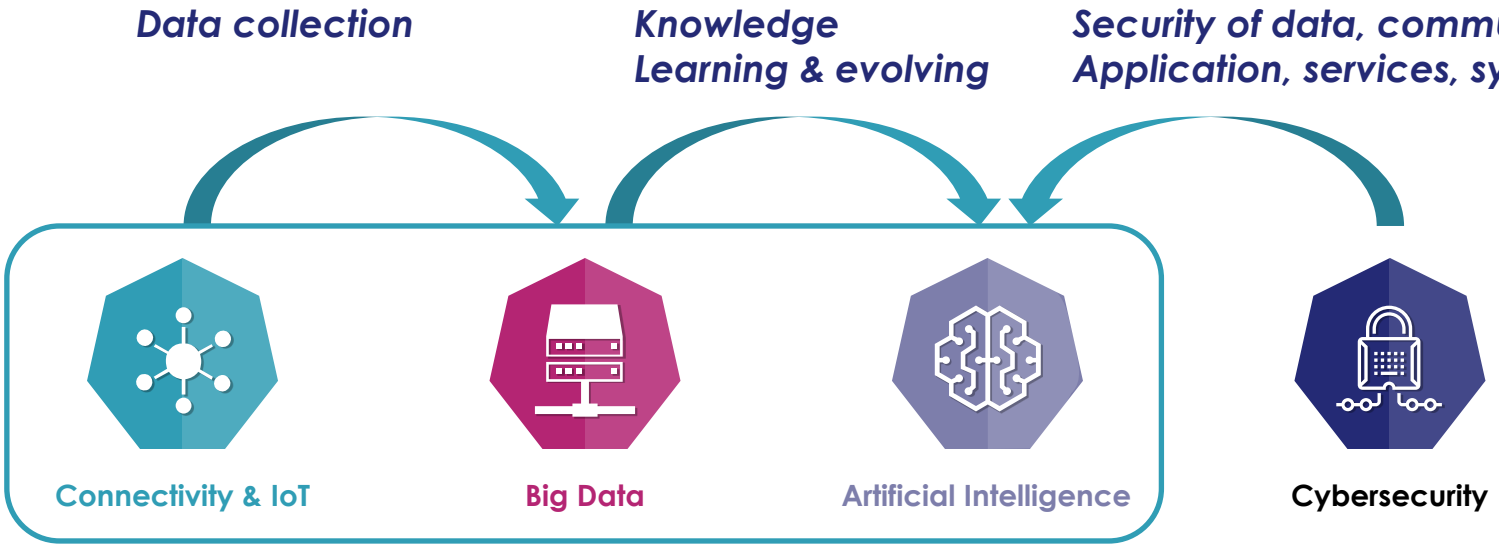
1 4 key digital technologies to enable critical digital decision chains



Big Data and AI are strongly interconnected, as well as dependent on cybersecurity and IoT/connectivity

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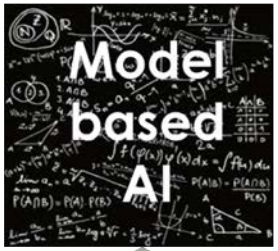
1 AI processes information but can be based on models and/or on data

Ability to process information by artificial means:

- **Perceive**
  - Rich, complex and subtle information
- **Learn**
  - Within an environment
- **Abstract**
  - To create meanings
- **Reason**
  - To plan and decide

Two approaches to AI



Knowledge
Models of reality

Big Data
Real data

Deep Learning

Acceleration 2012 - 2017

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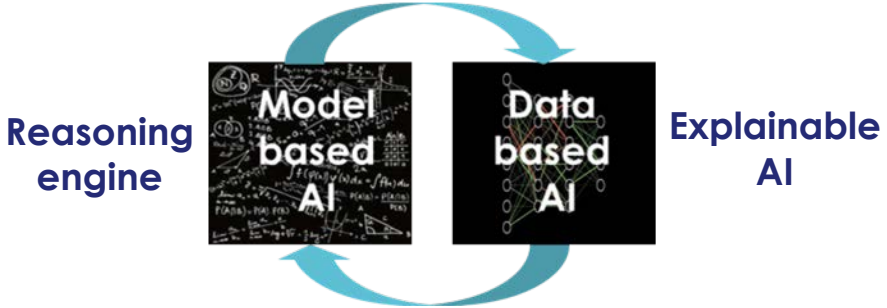
1 Some key challenges of deep learning based AI

Challenges

- Trust & security !
- Frugal Learning
- Combination of real data, simulated and synthetic data Corpus balancing
- Vulnerability of open neural network architectures

Hybrid AI

- Explainable AI
- AI system validation and certification



Hybrid AI: combining model and data based AI
A key differentiator leading to trustable, then certifiable AI

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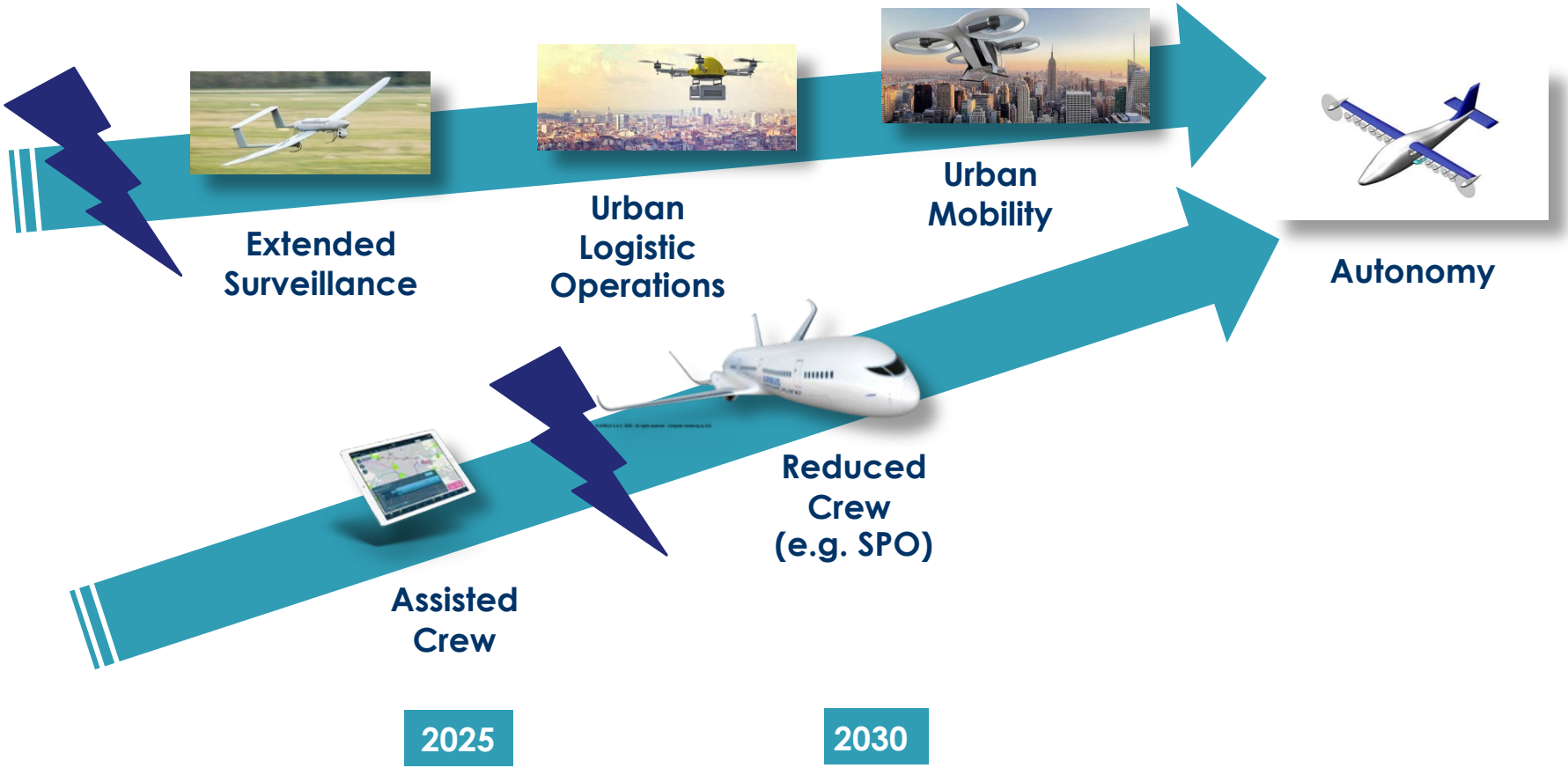
2 Steps towards autonomy



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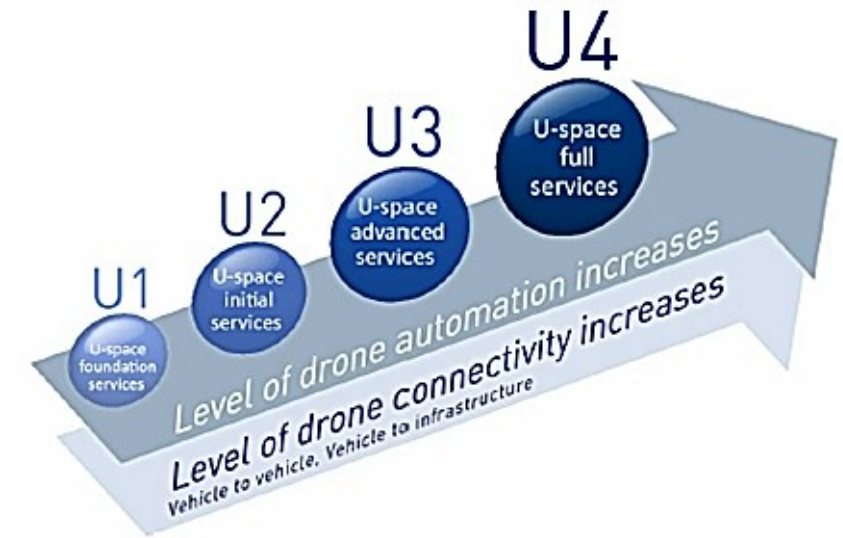
2 Drones control : Moving Towards High Levels of Automation



DoD Four Levels of Autonomy

Level	Name	Description
1	Human Operated	**A human operator makes all decisions.** The system has no autonomous control of its environment although it may have information-only responses to sensed data.
2	Human Delegated	**The vehicle can perform many functions independently of human control when delegated to do so.** This level encompasses automatic controls, engine controls, and other low-level automation that must be activated or deactivated by human input and must act in mutual exclusion of human operation.
3	Human Supervised	**The system can perform a wide variety of activities when given top-level permissions or direction by a human.** Both the human and the system can initiate behaviors based on sensed data, but the system can do so only if within the scope of its currently directed tasks.
4	Fully Autonomous	**The system receives goals from humans and translates them into tasks to be performed without human interaction.** A human could still enter the loop in an emergency or change the goals, although in practice there may be significant time delays before human intervention occurs.

DoD Unmanned Systems Integrated Roadmap FY2011-2036 THINKe

Aviation can leverage its safety background to implement a sound roadmap (automation, autonomy)

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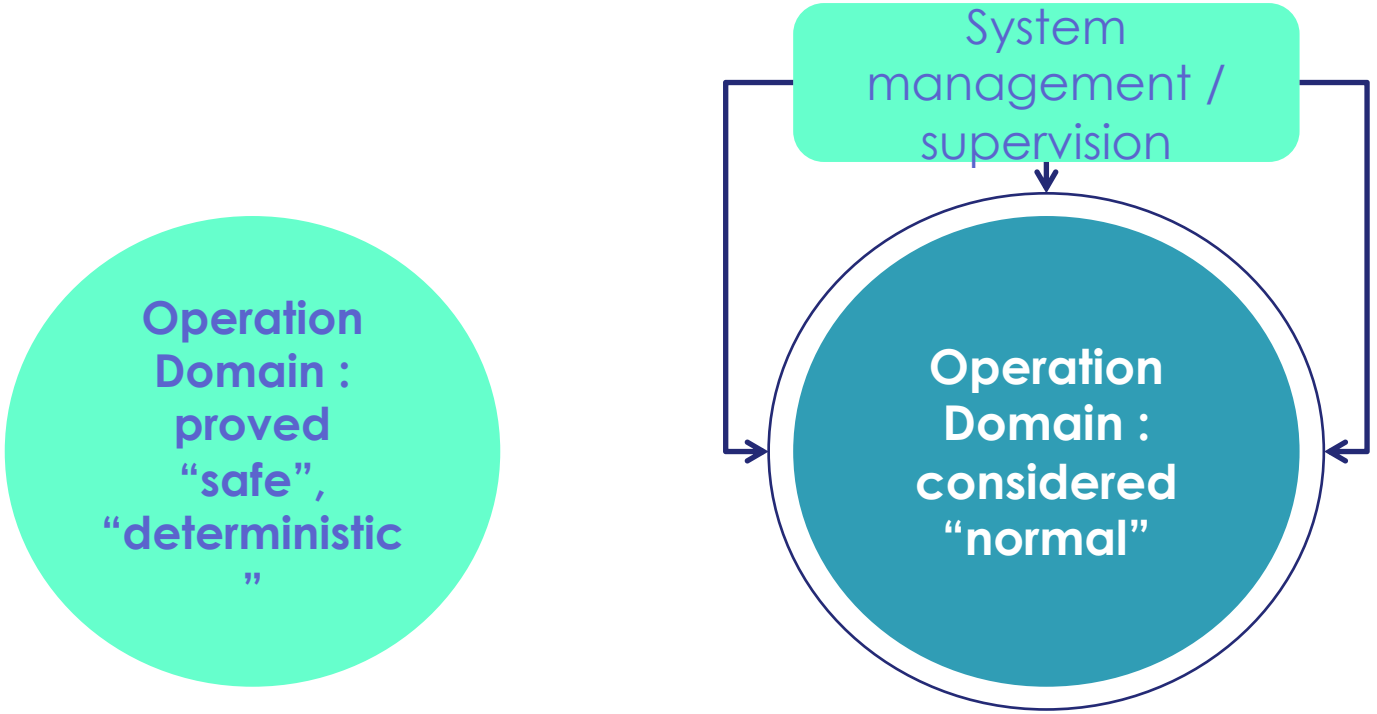
2 “Functional Health Monitoring”



Resilience will need new capabilities in system management, where supervision will monitor and organize system stability and reconfiguration

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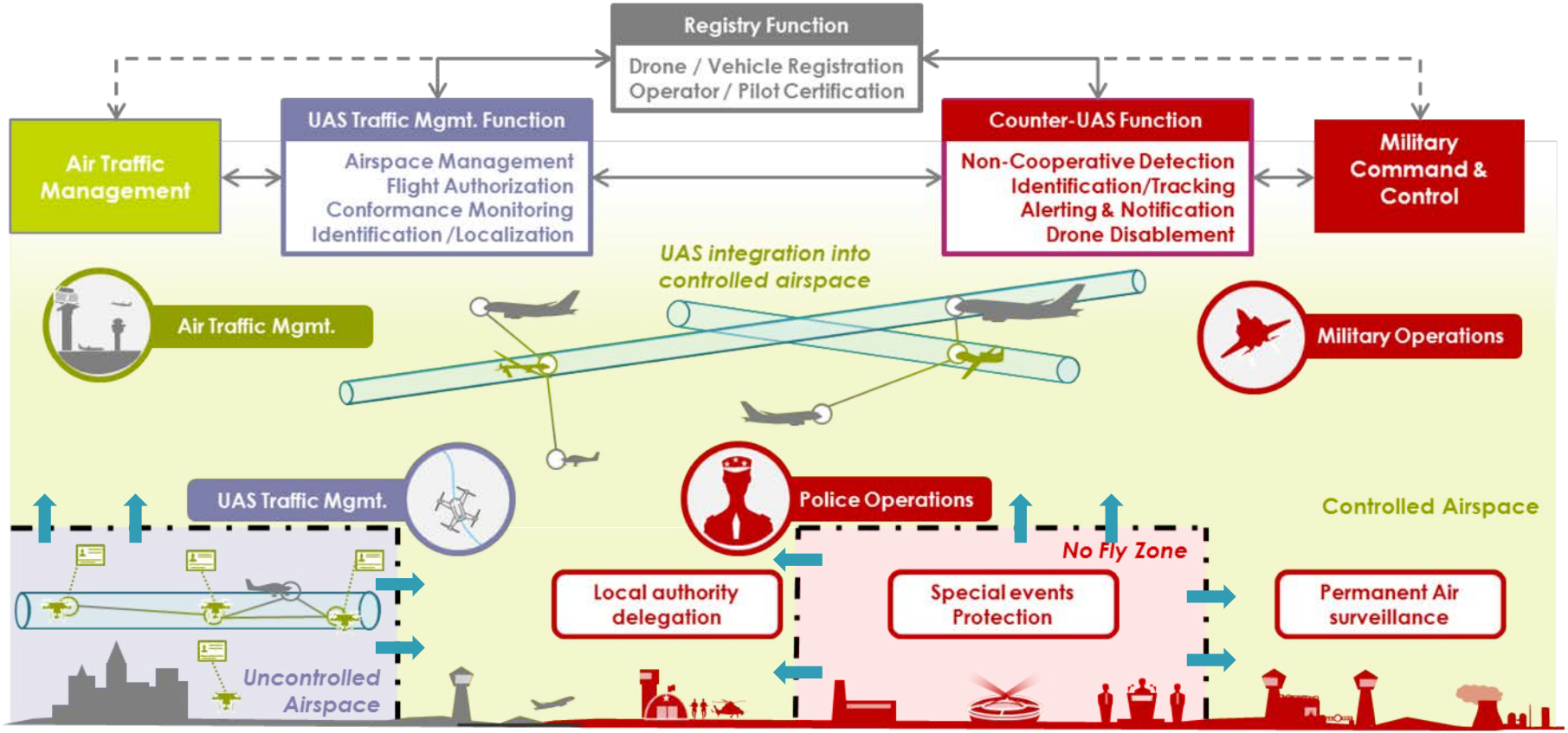
3 Drones Redefine Airspace Usage in both Civil & Military Domains



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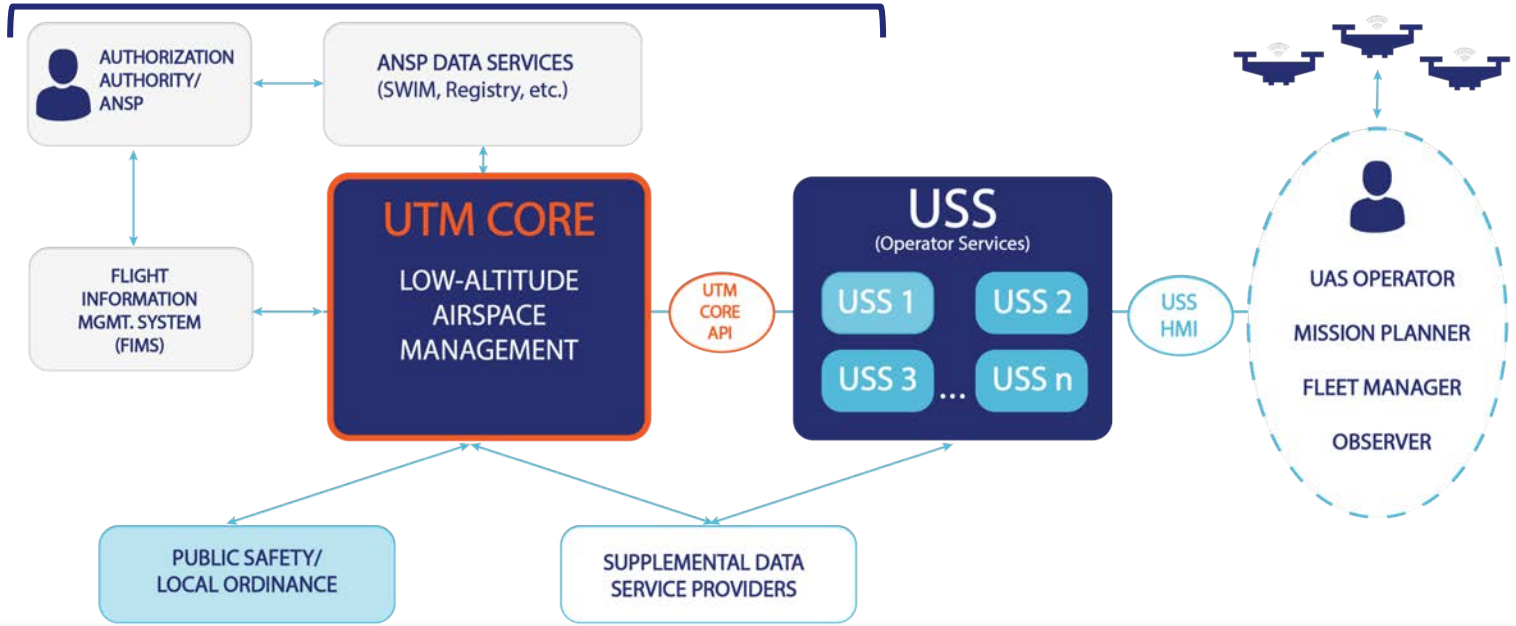
3 ECOsystem UTM Supports Safe & Secure UAS Operations

Thales UTM offer focused on Authority Side of problem (managing access to public asset → airspace)



Blending the world-class digital technologies acquired by Thales with market leading ATM knowledge to shape an advanced but workable solution for UTM

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3 Drone Air Traffic Integration requires counter-UAV technologies

Drone flew 'within wingspan' of plane approaching Heathrow

Report on near-misses also reveals pilots were shocked to see another drone hovering as high as 3,000 metres

AVEILLANT Gamekeeper "Holographic" Radar

- Mounted on hillside looking over Monaco and coastal area
- 90 degree coverage
- Instrumented to 5 km

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Thank you !

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