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The trend towards autonomous systems

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Significant market perspectives within a not so distant future

By 2030:

Exponential market growth

Civil applications dominating the market

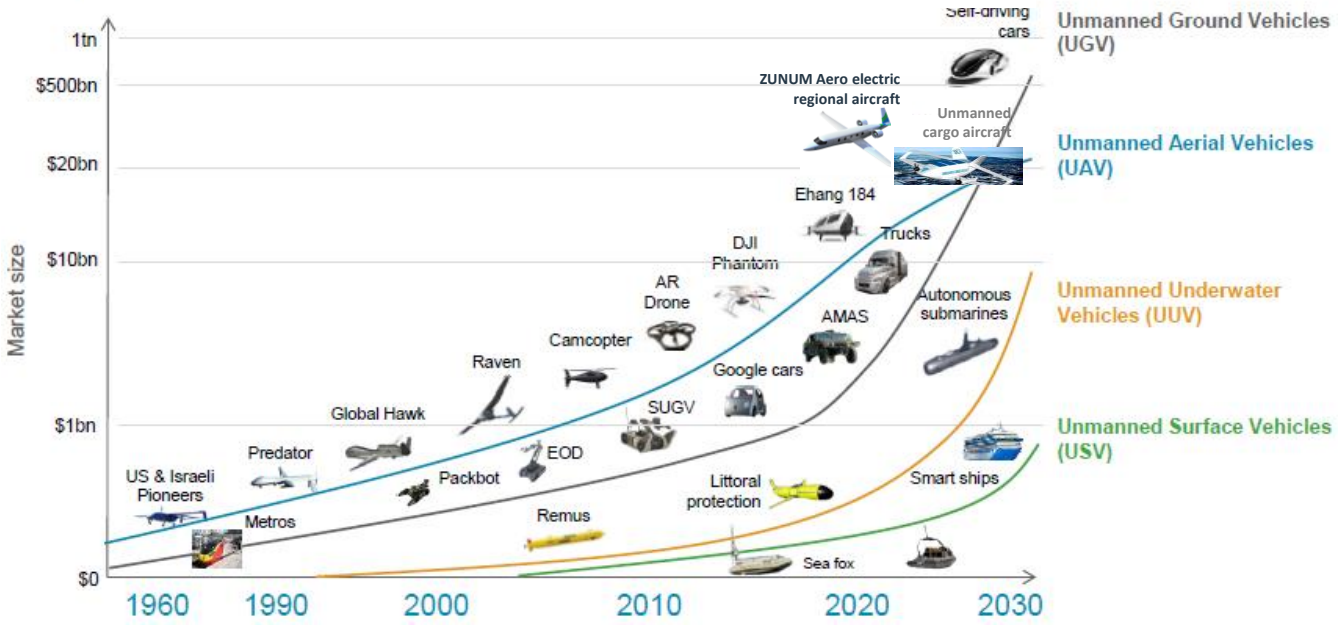
Ground vehicles to outnumber aerial vehicles

Today:

Predominantly military applications

Air is the largest market with emergence of civil applications

Unmanned systems' market size evolution per vehicle type
Logarithmic scale



Source: Oliver Wyman,Thales

« By 2030, the autonomy market could represent 500B€ and 20% of the overall vehicle market »

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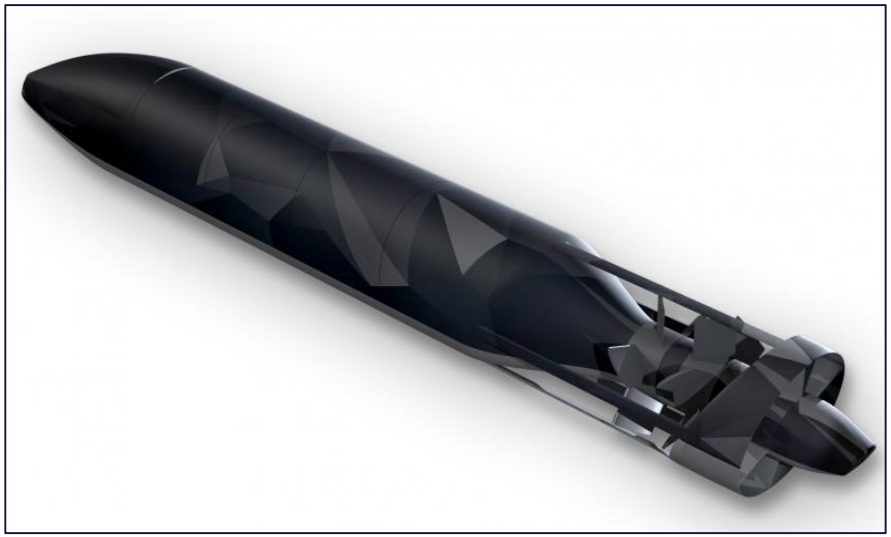
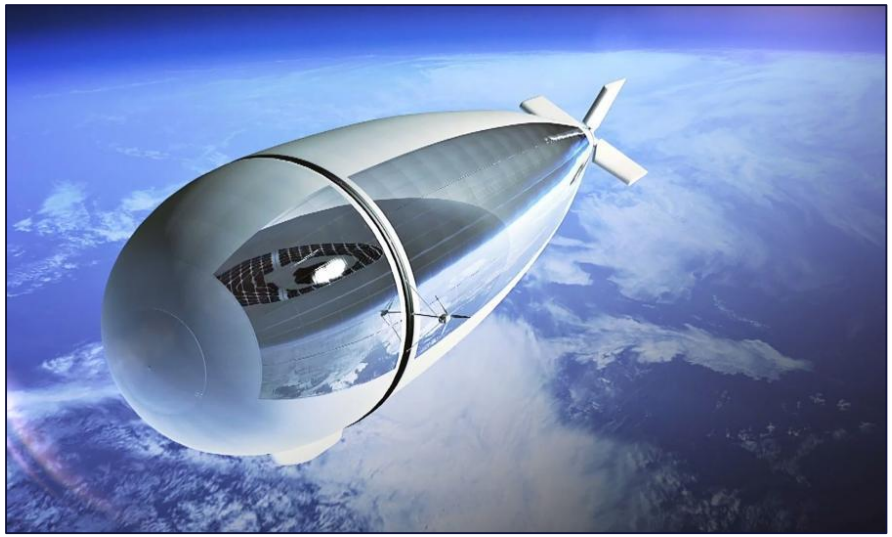
Autonomous platforms





Autonomous Underwater & Surface System

Stratobus

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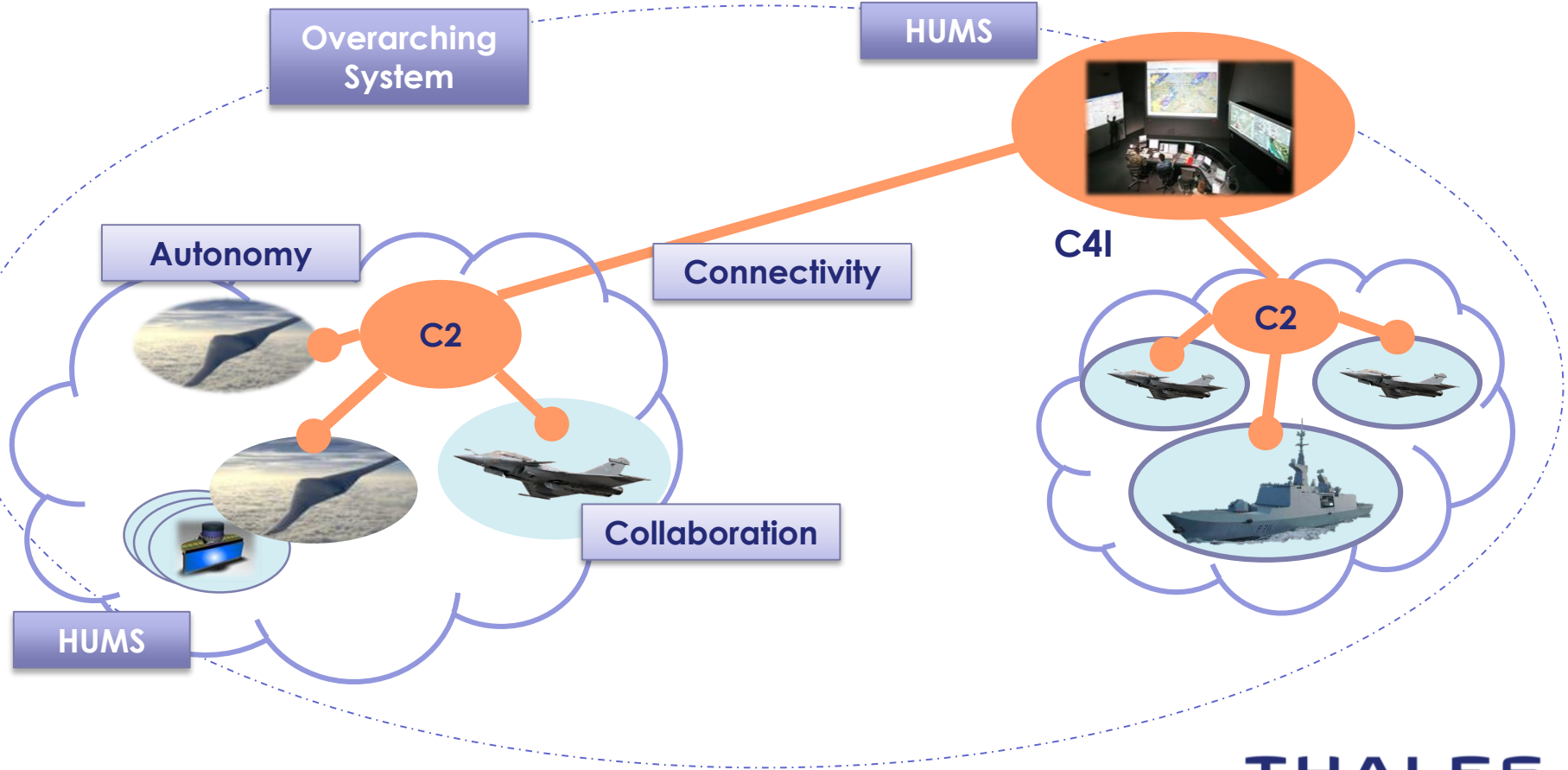
Understanding the Context Change



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Global Trends

Defence systems

Multiple Innovations with
Intelligent, Autonomous,
Connected, Collaborative
'Objects', that are understandable
when analysing the
Overarching System level

Civilian applications

- Space
- Air
- Land
- Sea

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From current « Decision-Aid » to future « Decision-Making »

- «**Autonomy** is the **level of independence that humans grant a system to execute a given task** in a stated environment. »

Autonomous functions

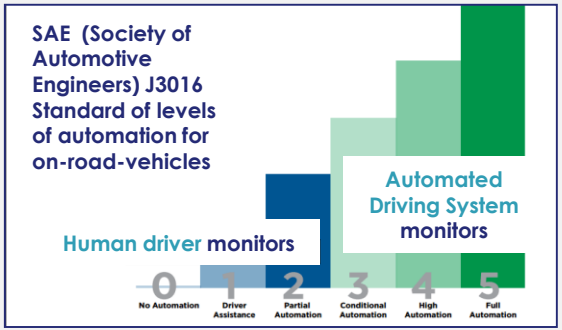
Autonomous sensors

Partially autonomous systems

Autonomous systems

System of Autonomous systems

« It is based on a **combination** of **sensors** and **advanced computing to navigate** this environment and the **software** sophistication necessary for **machine decision-making » .** *The US Army Robotic and Autonomous Systems Strategy, March'17*



- Autonomy implies **responsibility**, partly or totally, **transferred** from the human **to the machine** and imposes strict **safety** and **security** rules and standards. In the **military** domain, a number of missions will remain operated with a "**man in the loop**".
- **2016 Level 2** of **vehicle automation** is **in high-end OEMs offer / Tesla cars. Full autonomy** is **level 5**

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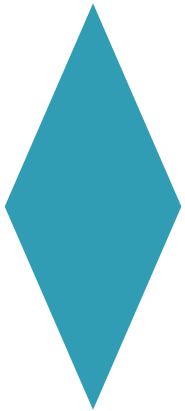
Key enabling technologies for an autonomous system

Sub-systems

- Regulations
- Swarming (large number of cooperative drones)
- Man Machine Teaming
- C2 Station
- Safe & Secure Data Distribution
- Safe & Secure Communications
- Safe & Secure Precise Positioning & Navigation
- Sense & Avoid
- Geo-Fencing, Identification & Registration
- Generic, Overarching Architecture



Technologies

- Simulators
- Processing Computers
- Data Links
- Artificial Intelligence
- Big Data
- Decision Aid
- Sensors (radars, lidars, cameras)
- MEMS inertial systems
- Sensor Fusion & Hybridation
- Smart power management
- Safety & Validation
- Cyber security

Digital technologies (connectivity, big data, AI, cybersecurity) will play a transformational role, leading also to new business models

Cyber security & safety

Beyond usual encryption, anti-intrusion, SoC, usual certification

GeoFencing, GeoCaging

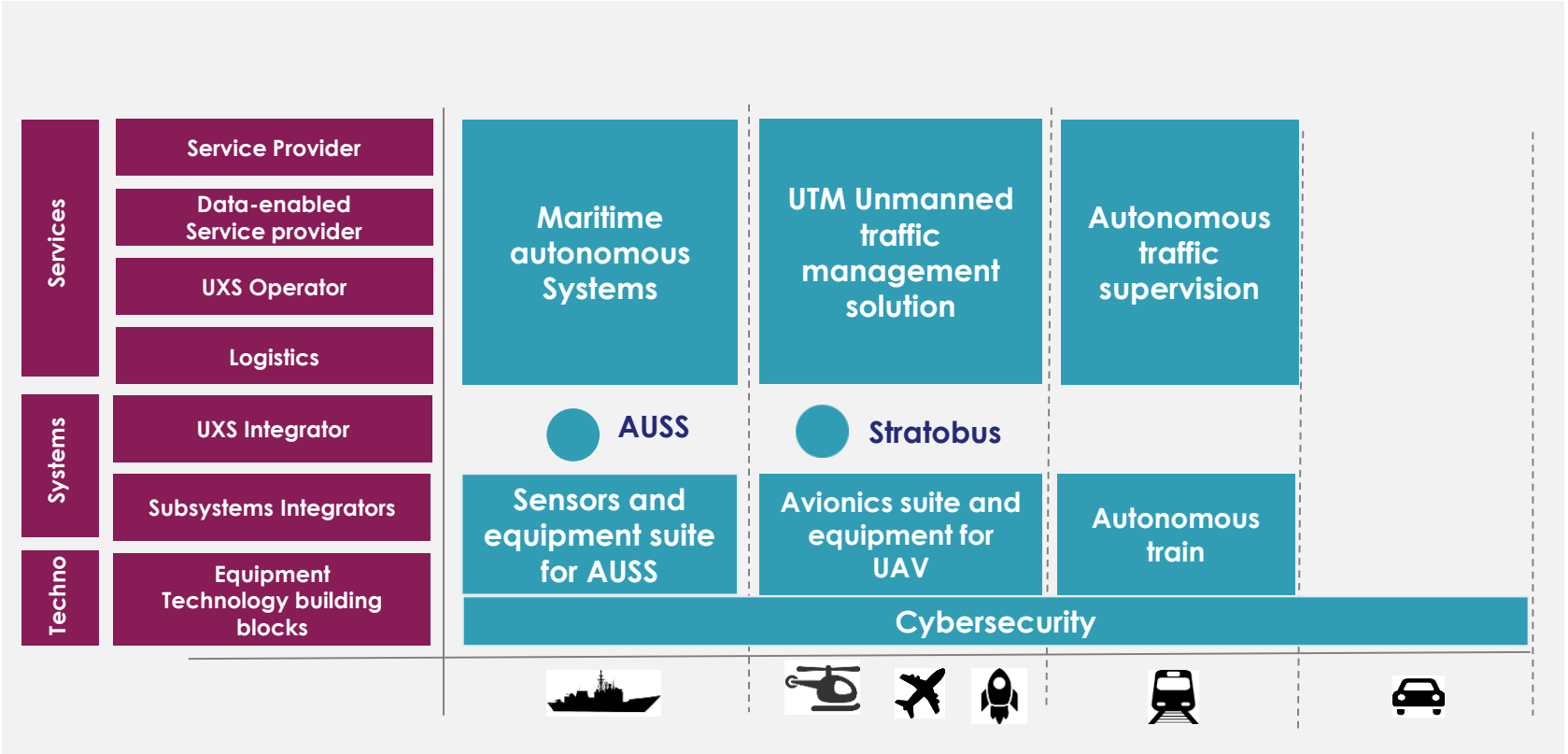
- Authentication
- Localisation integrity (anti-spoofing, anti-jamming, etc)
- Geo Data integrity
- Vehicle anti tampering
- Associated regulations and laws

Certification

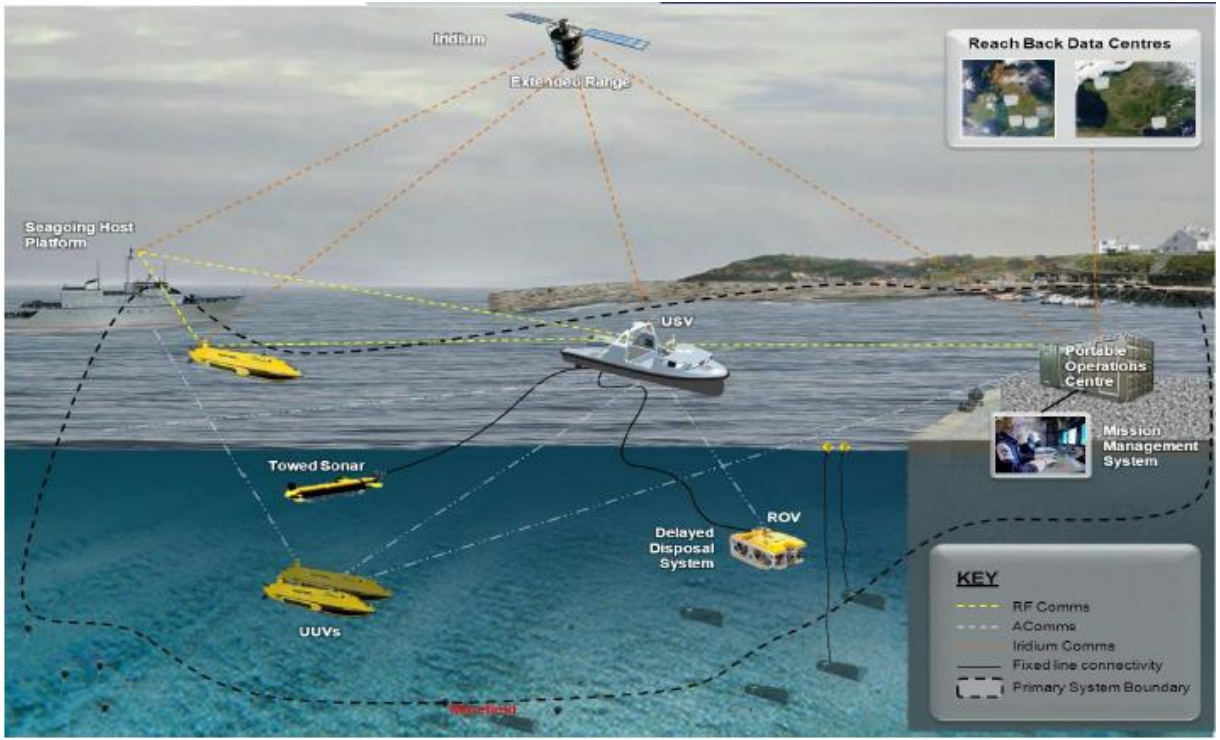
- Test data, real and generated
- Learning Process and Data
- Architectural patterns
- Explainable AI
- Certification principles

With Autonomy, new challenges emerge for Cybersecurity and Safety

Thales presence in autonomous systems



Maritime Autonomous Systems



MAS value chain

- Mission mgt + integration to CMS
- Mission packages (inc payload)
- Command and control (multimission & domain)
- Comm network (above and below water)
- Vehicle Mgt System (comm & payload)
- Vehicle navigation
- Vehicle control systems
- Vehicle Including design

Need for a shared vision on operational needs and constraints

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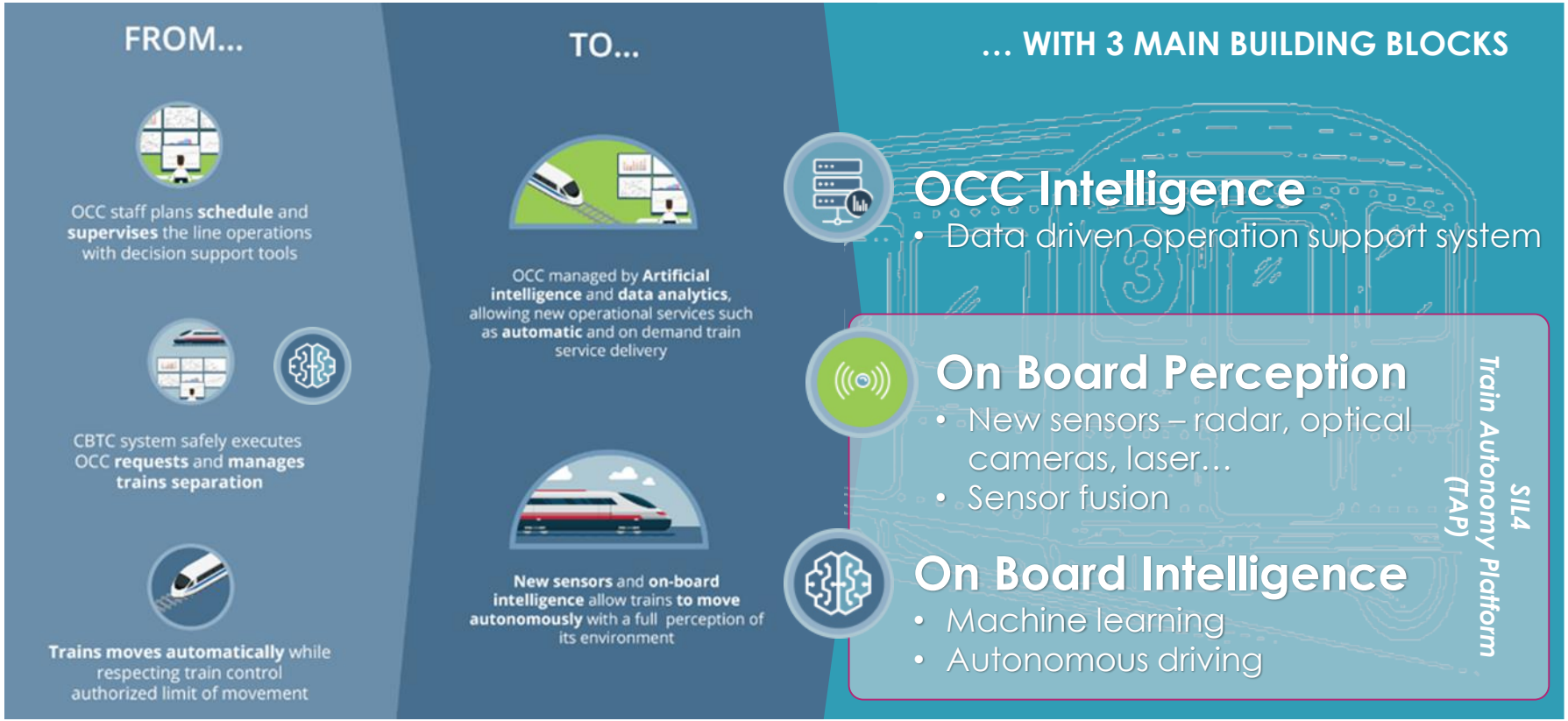
Train Autonomy: what's at stake?



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Train Autonomy: A Step-by-step (R)evolution

Level of Autonomy	
Autonomous line operation	4
Full autonomous train control	3
Autonomous passenger protection	2
Low speed autonomous movement	1
Driverless GoA 4	

Step 2: Disruption

FULL AUTONOMY:

- Autonomy at full speed with passengers
- On-demand Train Service
- Fully automated operations both normal and hazardous situations

Step 1: Evolution

LIMITED AUTONOMY :

- Autonomy at limited speed, in degraded modes & in depot
- Dynamic train service management

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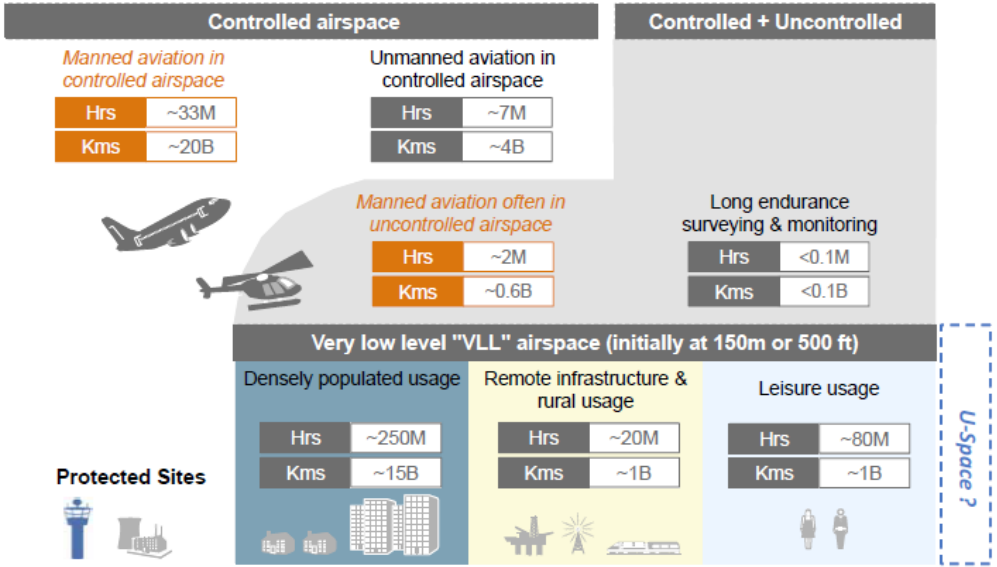
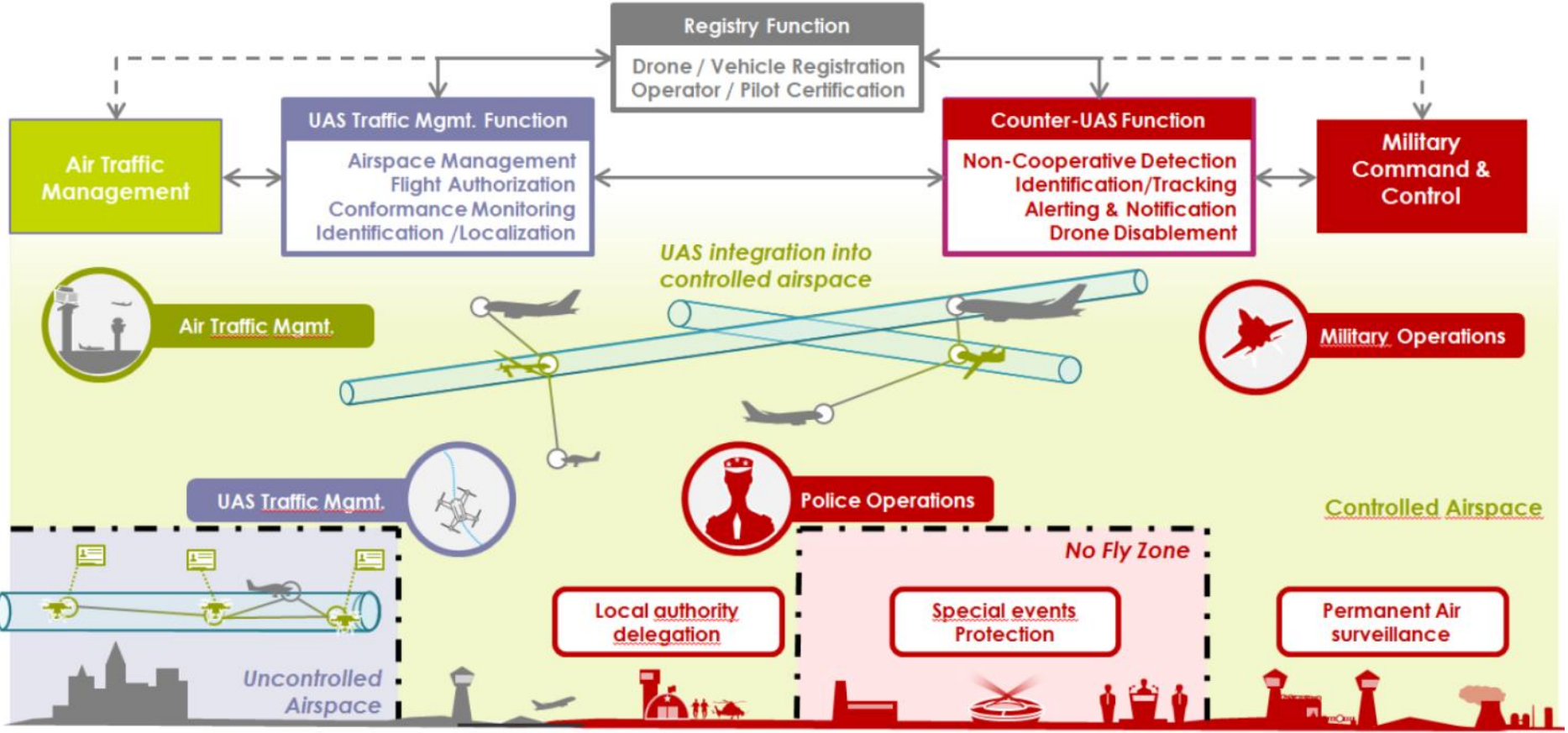
Unmanned Traffic Management « UTM »

Traffic projections **by 2050**: **~250 million hours** in very low level airspace
vs ~33 million hours in controlled airspace



Volume of **traffic** makes it **impossible** to **rely on** air traffic control principle of **human air traffic controllers clearing individual aircrafts'** flight plan

UTM, UAS and their operating environment



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Conclusions

- The autonomy is a growing market … beyond the platforms
- Autonomous systems will spread out
- Digital technology will play a key role
- New technical challenges
- New paradigm for security and safety, in particular with the advent of AI
- Issues to be tackled beyond the technical aspects: regulations & societal

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