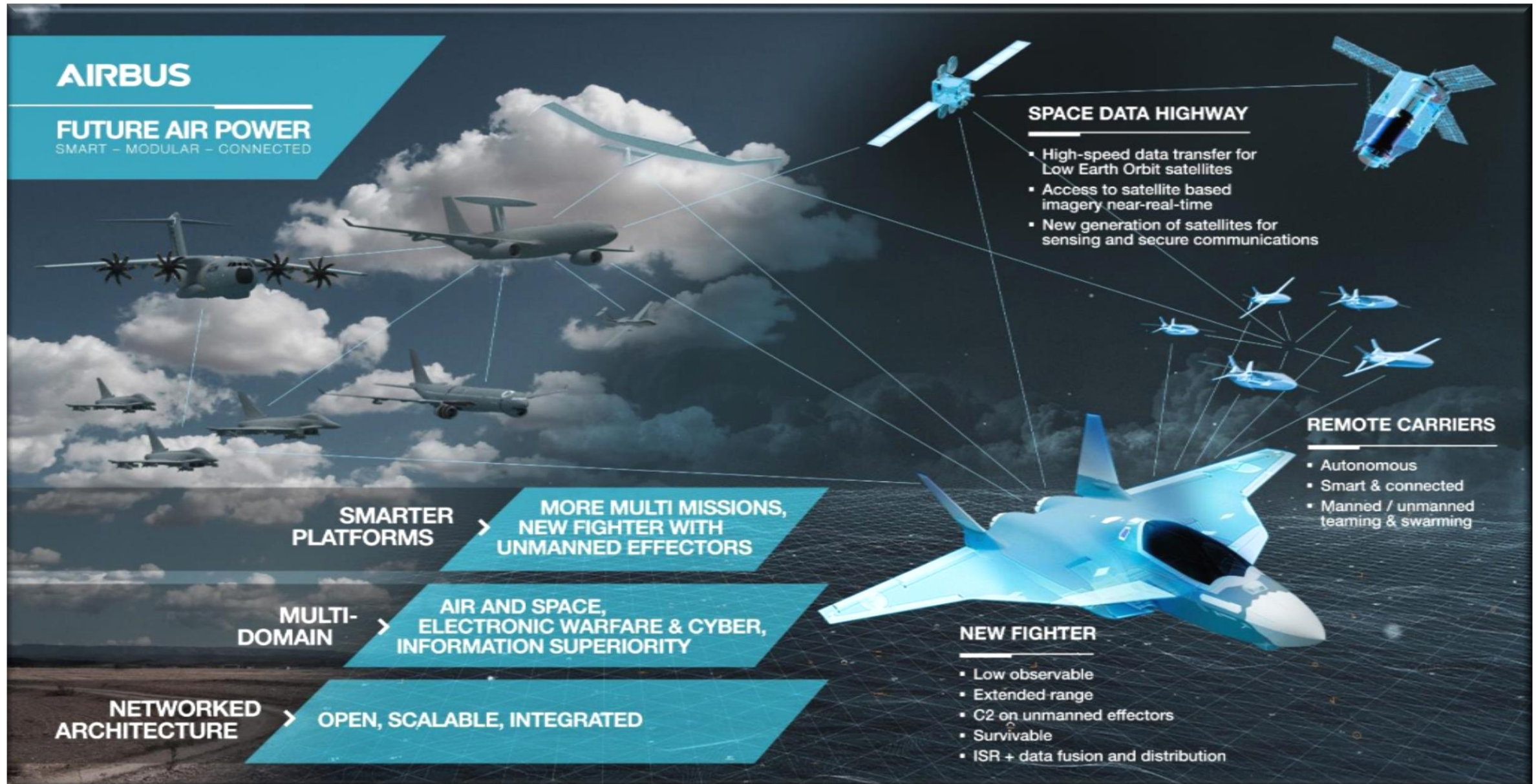# The evolution of the UAS operational environment and its effect on future training

DEFENCE AND SPACE

Enrico Mollenhauer
May 16th 2019

AIRBUS

Evolution

Airspace Integration

Fundamentals and Pre-requisites

Legal Perspective, Regulation and Procedures

Airspace Integration

Fundamentals and Pre-requisites

- Legal framework (liability, privacy etc.)
- airworthiness, insurance, licensing,
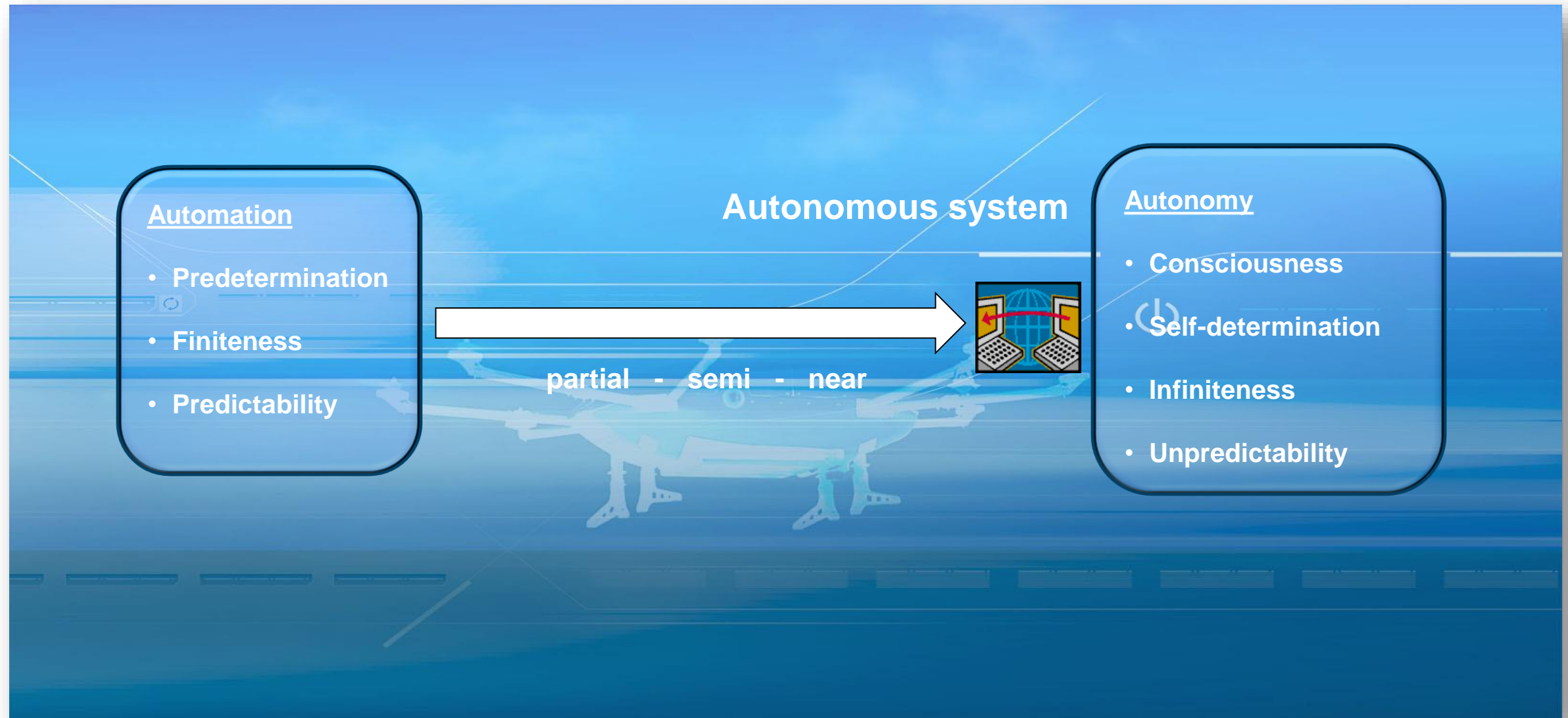- established rules, regulations, and procedures

Airspace Integration UAS specifics

- Air Traffic Control (ATC) operating procedures, processes, rules, and regulations for new types of operation
- Traffic Management Solutions
- Advanced UAS Pilot knowledge skills and attitude
- Situational Awareness and Airmanship
- Communication being displaced from the aircraft
- C2 link specifications and procedures to respond to interruption or loss of the C2 link
- Flight Termination Procedures

AIRBUS

Evolution

Airspace Integration

Automation

Legal Perspective, Regulation and Procedures

Automation

Automation

- **Predetermination**

- **Finiteness**

- **Predictability**

partial - semi - near

Autonomous system

Autonomy

- **Consciousness**

- **Self-determination**

- **Infiniteness**

- **Unpredictability**

Level of Automation and Human-Machine Interaction

Responsibility PIC/Operator

Level of Automation

Autonomous

Autonomic

Automated

- **Unpredictability**
- **Human Role as Manager**
- **Monitoring**
- **Human Factors**
- **C2 challenges**
- **Information Need for adequate sit. awareness**

Human in the Loop　　**Human on the Loop**　　**Human ???**

Human-Machine Interaction

AIRBUS

Evolution

Cyber

Airspace Integration

Automation

Legal Perspective, Regulation and Procedures
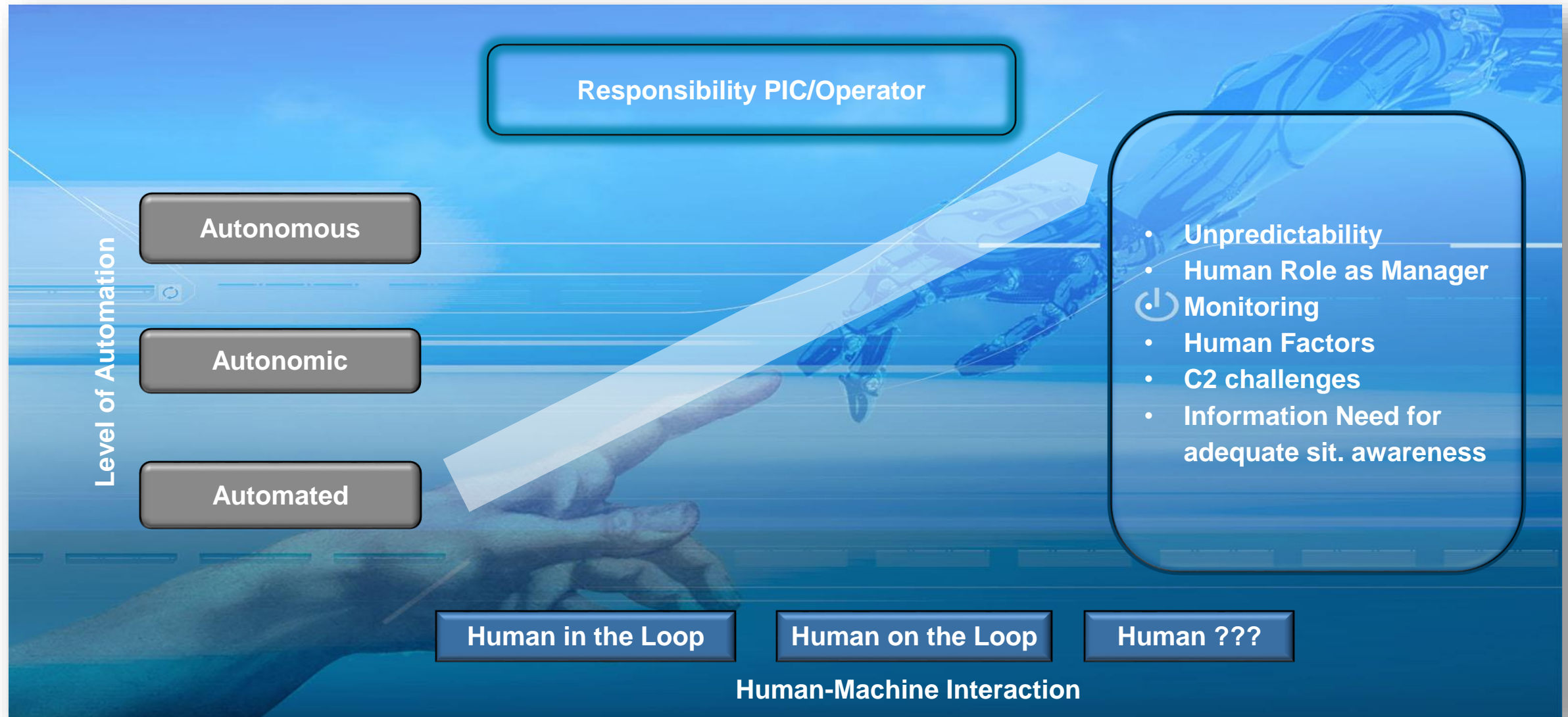
Cyber Threats

Cyber-threats for UAS may be categorized according to the attacker's intention:

- **Intelligence.** Attackers could intercept and monitor the unencrypted data or information the UA transmits to the ground.

- **Disruption of the UAS.** Intentional modification of computer systems

- **Takeover of the UAS** by taking over communication layouts and exploiting the system's bugs, or by way of 'smart entry' into the GCS and its computer systems or RPA's avionics.

Dror Ben-David, 'Cyber Takeover of large UAVs', Israeli Defense, no. 15, pp. 46-47, Aug. 2013

AIRBUS

Evolution

Cyber

Airspace Integration

Human Factors

Automation

Legal Perspective, Regulation and Procedures

AIRBUS

Human Factors – Precondition for Unsafe Acts

- **Environmental Factors** like technological factors

- **Conditions of Individuals** like inattention and channelized attention.

- **Personnel Factors** like self-imposed stressors or crew resource management

AIRBUS

UAS Training Simulator

Resulting requirements for the training system

- Coherence simulator / unmanned system

- Open and modular architecture

- DIS and / or HLA-compatible for networking

- Capability for Experimentation of system behavior, validating training

- Capability to run complex mission scenarios

- High Fidelity Synthetic Environments

Lessons Learned

- Involve Subject Matter Experts asap

UAS Mission and Tactics Trainer

AIRBUS

Mission Readiness Training

Aim of those missions is

- Rehearsal of mission specific standards

- Awareness for situations that can lead to failure

- Apply different strategies to counter suboptimal behavior

- Reproduce the correct behavior during live operation

- Adapt mission complexity in the simulation concerning weather, airspace, enemy and emergency procedures

Embedded state of the art HF Training for Teams & Inter Teams

Integrated Feedback Loop for high quality training

Live Virtual Constructive

The advantages and opportunities:

- Cost-effective training with mixed participation

- Validating training and certification considerations

- Experimentation – Large-scale validations

- LVC applications offer persistent, distributed, participative environments

- Manned / unmanned pilot interactions (MUMT)

- LVC permits real-world communications

AIRBUS

Summary

In summary you should remember:

- **Airspace Integration, Automation, Cyber Threat** and **Human Factors** will change the way UAS are operated in the future

- There are **measures** to deal with those evolutions in order to ease the change

- **Training** plays a vital part in adapting for the future

- **Live, Virtual, Constructive, Mission Readiness Training and Mission and Tactics simulators** are players in UAS Training

AIRBUS

"When we least expect it, life sets us a challenge to test our courage and willingness to change;
at such a moment, there is no point in pretending that
nothing has happened or in saying that we are not yet ready.
The challenge will not wait."

Paulo Coelho, Brazilian author

Thank you

AIRBUS