Safely Utilizing AI for Avionics and Pilot Operations

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AI-Enabled Autonomy Brings Many Advantages

Speeds Decisions

01

Enhances Lethality

02

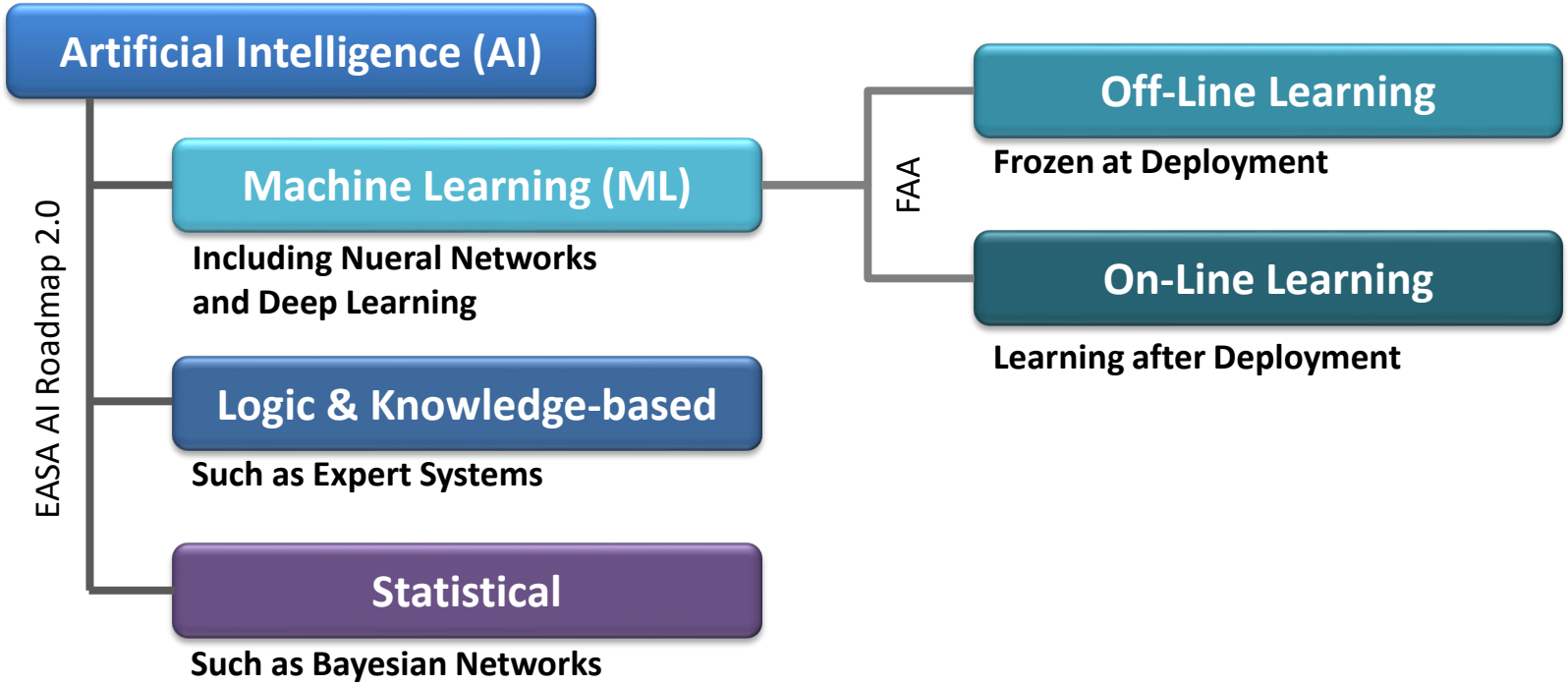
04

Lets the Crew Focus on the Strategy

03

Reduces Crew Workload

Categories of Artificial Intelligence

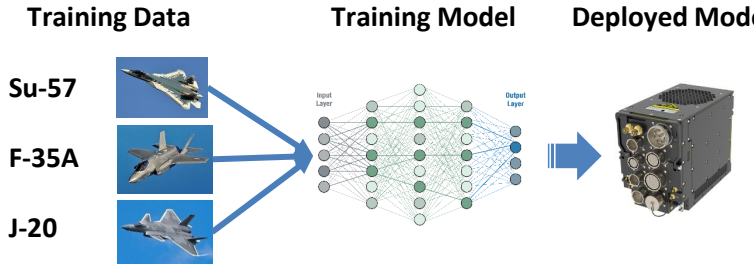


Problem: ML is Not Proven to be Safe or Trusted

Certification Challenges

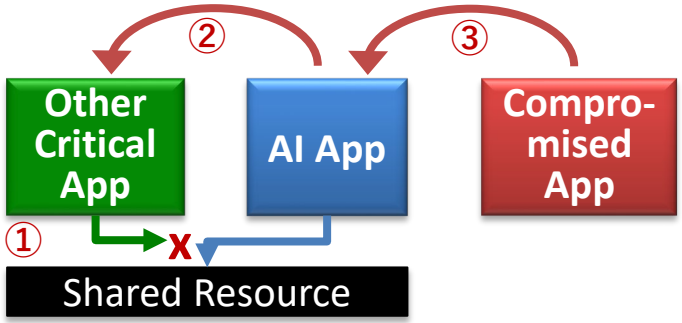
- AI is considered a "novel" technology that is unproven

- Need to worry about 3 parts of ML



Unintended Interactions

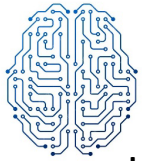
1. AI application hogs CPU resources
2. An error in the AI affects other applications
3. AI is manipulated from other apps



Certification Challenges and Solutions

Challenges

1. **Decomposing requirements to directly describe the AI implementation**
2. **Validating requirements by showing that they provide coverage to the next higher level**
3. **Difficulty assuring innocuity through Failure Mode and Effects Analysis (FMEA)**
4. **Ensuring the completeness and correctness of the knowledge bases and data sets**



Solutions

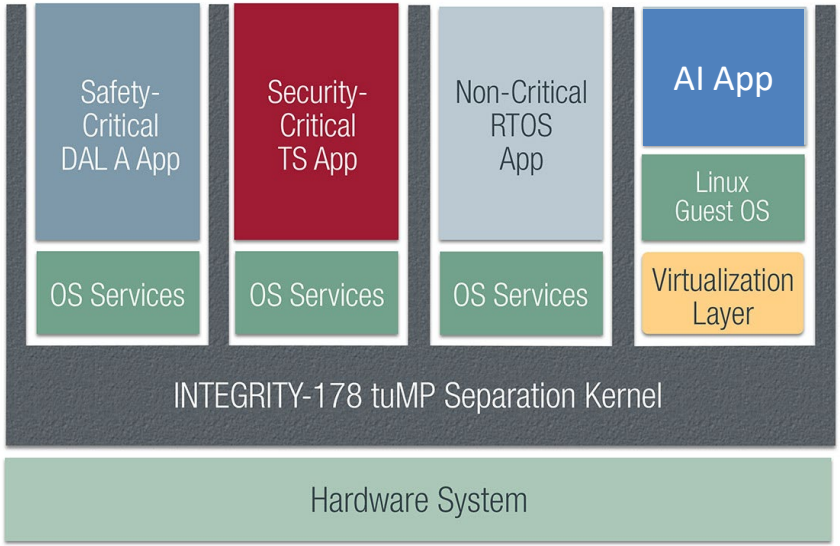
Long Term:

- **Learning Assurance**
  "confidence that the trained models can generalize "
- **AI Explainability**
  "capability to provide the human with understandable, reliable, and relevant information"

Short Term:

- **Extensive Stress Testing for FMEA**
- **Software Runtime Assurance**
  monitoring the output and reverting to a default safe mode

Prevent Unintended Interactions



Isolate AI Apps using a Separation Kernel

- Keeps AI errors from affecting other safety- and security critical functions
- Secures the AI from security threats

INTEGRITY-178 tuMP Separation Kernel

- Certified safety isolation to DAL A
- Certified security isolation to NSA's "Raise the BAR" and Common Criteria EAL6+

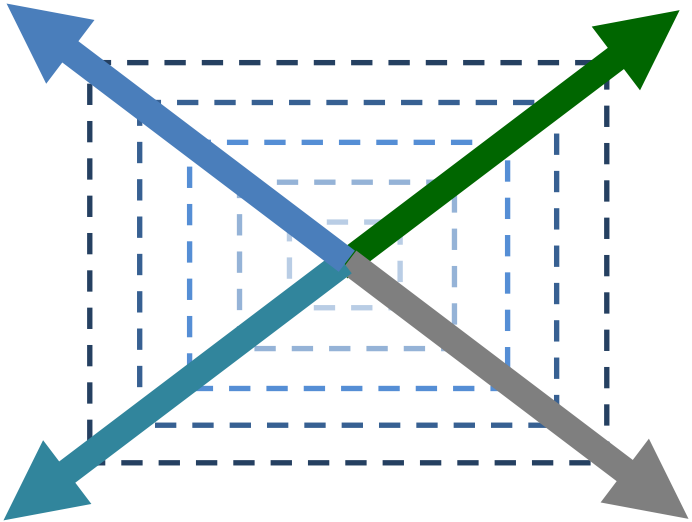
ED-12C
DO-178C
DAL A

RAISE-THE-BAR
NCDSMO
Assessed & Authorized

The Path toward Autonomous AI: Incremental Steps in 4 Dimensions

1. Design Assurance Level

2. Level of Automation



3. Percentage of Systems Automated

4. Type of Aircraft and Operation

The Path toward Autonomous AI: Incremental Steps in 4 Dimensions

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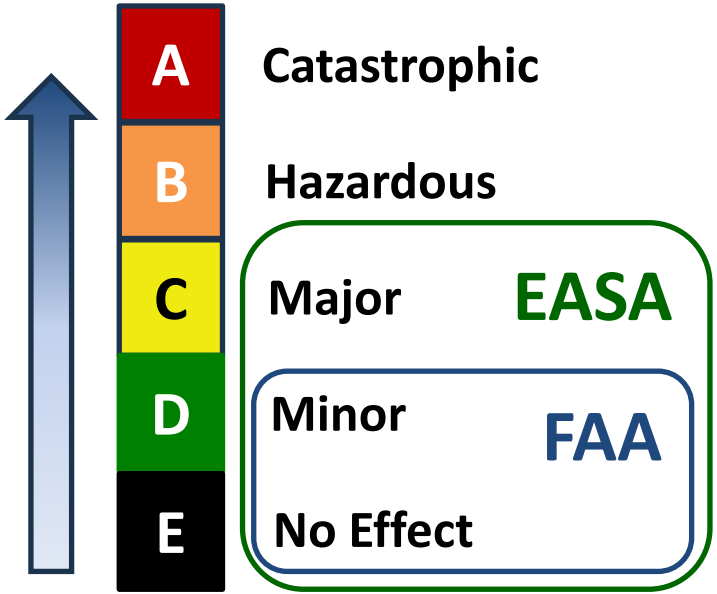
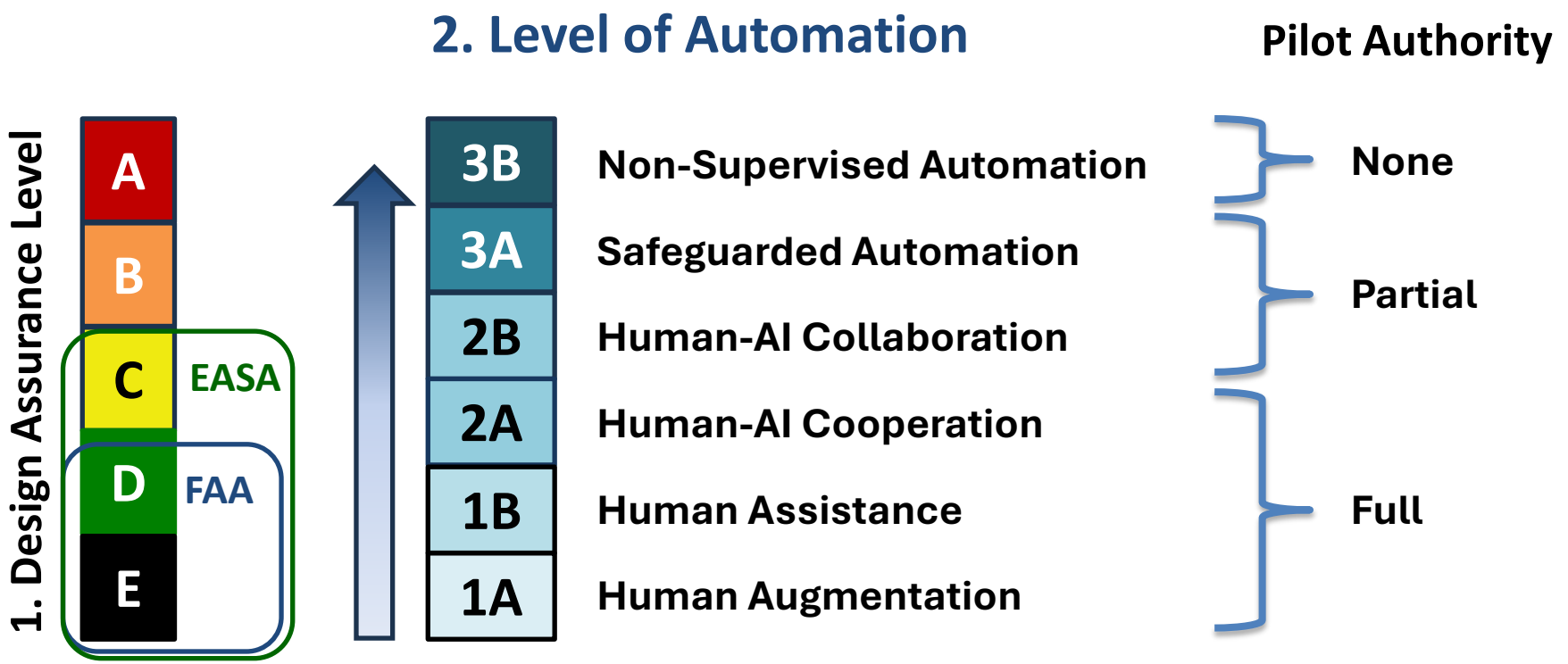


The Path toward Autonomous AI: Incremental Steps in 4 Dimensions



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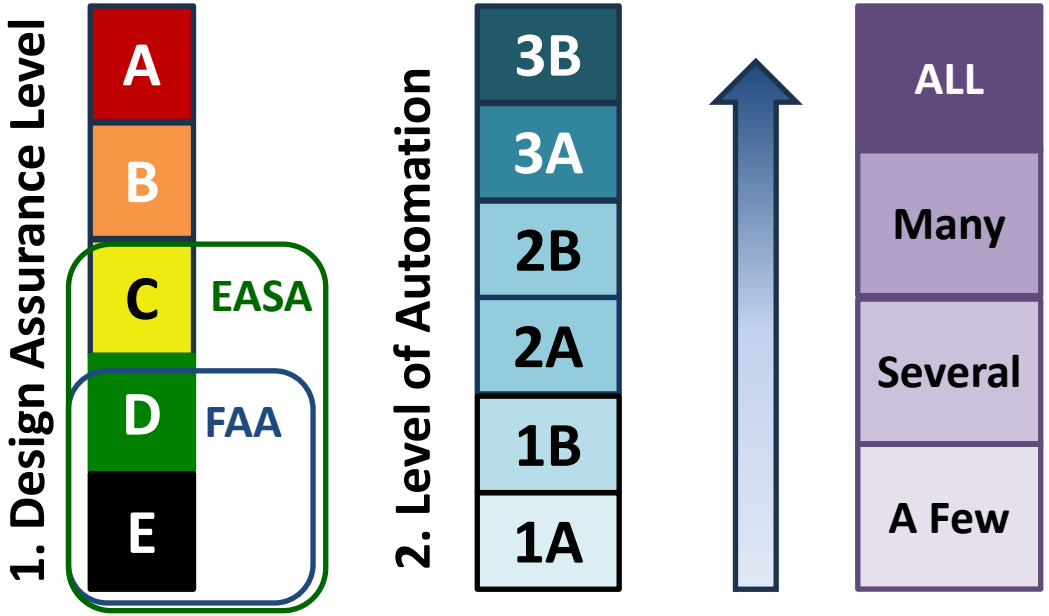
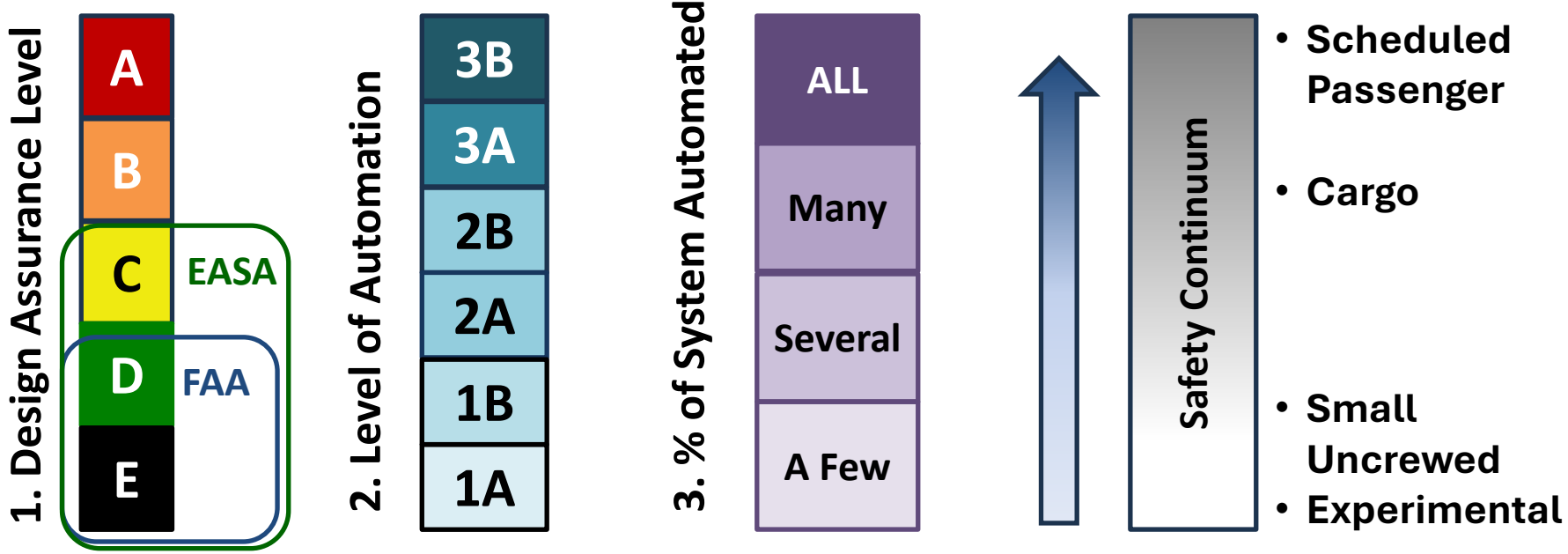


Examples Functions to Start:

1. Executing checklists before/during/after flight
2. Continually identifying suitable emergency landing areas

The Path toward Autonomous AI: Incremental Steps in 4 Dimensions



INTEGRITY-178 tuMP RTOS Already Used in AI Avionics

- **Merlin Pilot from Merlin Labs**
  - **Example Apps: Automated checklists, emergency landing, autonomous navigation**
  - **Selected INTEGRITY-178 tuMP for DAL A approval on multicore processor, which is needed to run power-hungry AI applications**
  - **Contacted by USAF to reduce crew on C-130J and KC-135**
- **One of the CCA/"Loyal Wingman" offerings from a prime contractor**

CMC's PU-3000 Avionics Computer