# A Unified Approach to Cyber-Physical Testing

## Federated Advanced Cyber physical Test range project (FACT)

**Project Coordinator**: **Jon Leistad**

Kongsberg Defence & Aerospace

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# Cyber-Physical Systems of Systems (CPS)

Characteristics of Systems of Systems (SoS), e.g. Smart Cities

- **Cyber-physical Systems**, incl. Automation
- **Autonomy of Subsystems** & System Components
- **Interconnected Subsystems** & Communication, even without human interaction
- **Diverse Goals among Subsystems**, and Collaboration to **Support Overarching Goal**
- **Emergent Behaviors** where the Capability of an SoS are greater than the Sum of its Part
- **Evolutionary Development** where an SoS Evolves over time with Subsystems being added, modified, or removed.

# CPS: Unmanned Vehicle

- **Autonomy & Remote Control**
  - Controlled remotely by human who may adjust actions in real time
  - Operate autonomously using AIML for tasks like navigation, object detection, decision making
- **Sensors & Detection Systems**
  - Cameras for visual navigation
  - Radar/LiDAR of object detection, 3D mapping etc
  - Proximity Sensors for nearby objects
- **Data Processing & AI**
  - Real-time Data Processing & Data fusion
  - Machine Learning for Continuous Improvement
  - Computer Vision of Situational Awareness
- **Communication Systems**
  - GPS & Satellite Communication
  - Radio & Wi-Fi Systems for control and data transmission
  - Telemetry for Monitoring & Diagnostics
- **Power Supply & Energy Efficiency**
  - Battery Powered
  - Alternative Energy Sources
  - Energy Management
- **Safety & Redundancy**
  - Fail-Safe Mechanisms
  - Obstacle Detection & Avoidance
  - Redundancy Systems

# Cyber Resilience for CPS

- Cyber Resilience of Subsystems & System Components
- Cyber Resilience of Integrated & Interconnected System of Systems
- Cyber-physical Resilience in Hazardous & Adverse Environments
- Possible Self-defense
  - Integrated Threat Detection
  - Autonomous Response & Recovery
  - Risk-based / Multi-layers Security Architecture
  - Self-Healing Capabilities, i.e. software patching
  - Redundancy & Robust Backup Systems
  - Threat Prediction & Adaptive Security
  - Physical Security & Hardware Security
  - Environmental Awareness

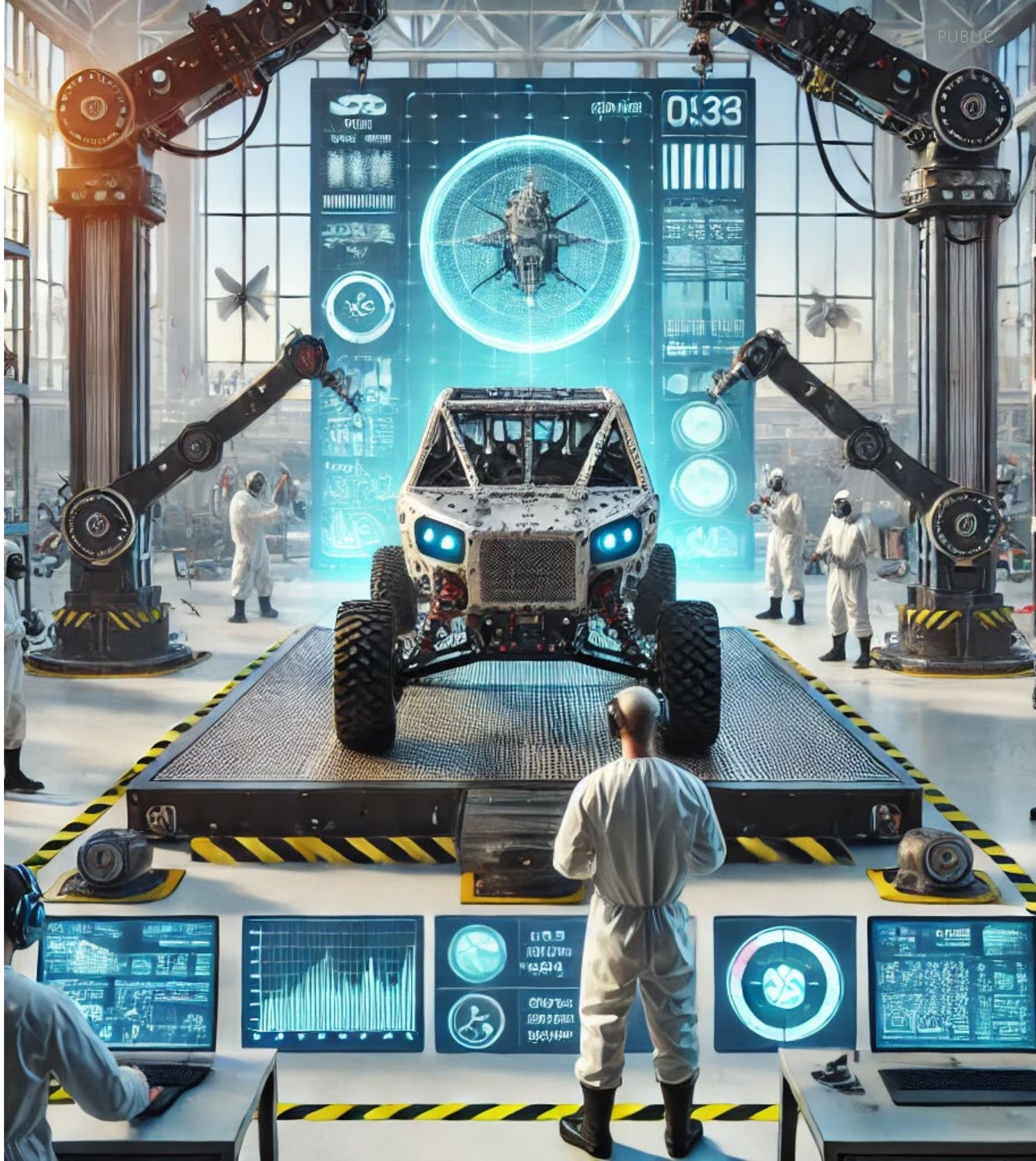
- Related EU Act & Directives
  - EU Cyber Resilience Act
  - EU Cybersecurity Certification framework
  - NIS2, and the EU Cyber Defence Policy.

# Cyber-Physical Testing

- Complex Cyber-physical Systems of Systems demand:
  - Prioritize & Mitigate Sub systems
  - Integration and End-to-end Testing

- Cyber-physical Test Range (CPTR)
  - Federated CPTR with Hardware & Software-based tools
  - Hybrid CPTR combined local & distributed components
  - Environment generates traffic, emulation & simulation in the network
  - Red team attacks CPS(s) dynamically, using AI/ML for ethical hacking
  - Blue team attacks CPS(s) dynamically, using AI/ML for cyber defense
  - Installed systems (OT) are subject to attack and are defended using hybrid intelligence
  - IT-system infrastructure are subject to attack and are defended
  - Federated service orchestration, and cyber-physical test-result aggregation using AI/ML

https://tinyurl.com/EDF-FACT-FactSheet



# What matters most?

- Assure **Cyber-Resilience** of equipment used
- Equipment is an arbitrary **Cyber-physical System**(-of-Systems)
- Perform **Cyber-Physical TESTING** *(semi-)automatic & manual*
- Overall **Testing Process** to validate cyber resilience
  - Testing Application (Purpose)
  - Testing Tools
  - Testing Methods
- Enabling **Federated** Testing

# FACT: A Solution through European Collaboration

The solutions lies in:

- A common European federated framework for cyber testing
- A common architecture
- A shared tool set for testing

Related PESCO Project:

- Cyber Threats and Incident Response Information Sharing Platform (CTIRISP)

- Integrate “hardware-in-the-loop” approaches and test (including reverse-engineering) platforms and systems in very comprehensive conditions
- Increase the overall level of cyber-resilience of platforms and systems while fostering interoperability.
- a significant improvement, given the high number of platforms and systems in service with EU and Norway

*End User Conference, Oslo, March 2024*

FACT

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY TOMORROW TODAY
APPROACH CYBER
BPTI BALTIJOS PAŽANGIŲ TECHNOLOGIJŲ INSTITUTAS
bianor
C&V CONSULTING
certSIGN
crosshill SECURING EMBEDDED SYSTEMS
emproof embedded security
CR14
KONGSBERG
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NOKIA
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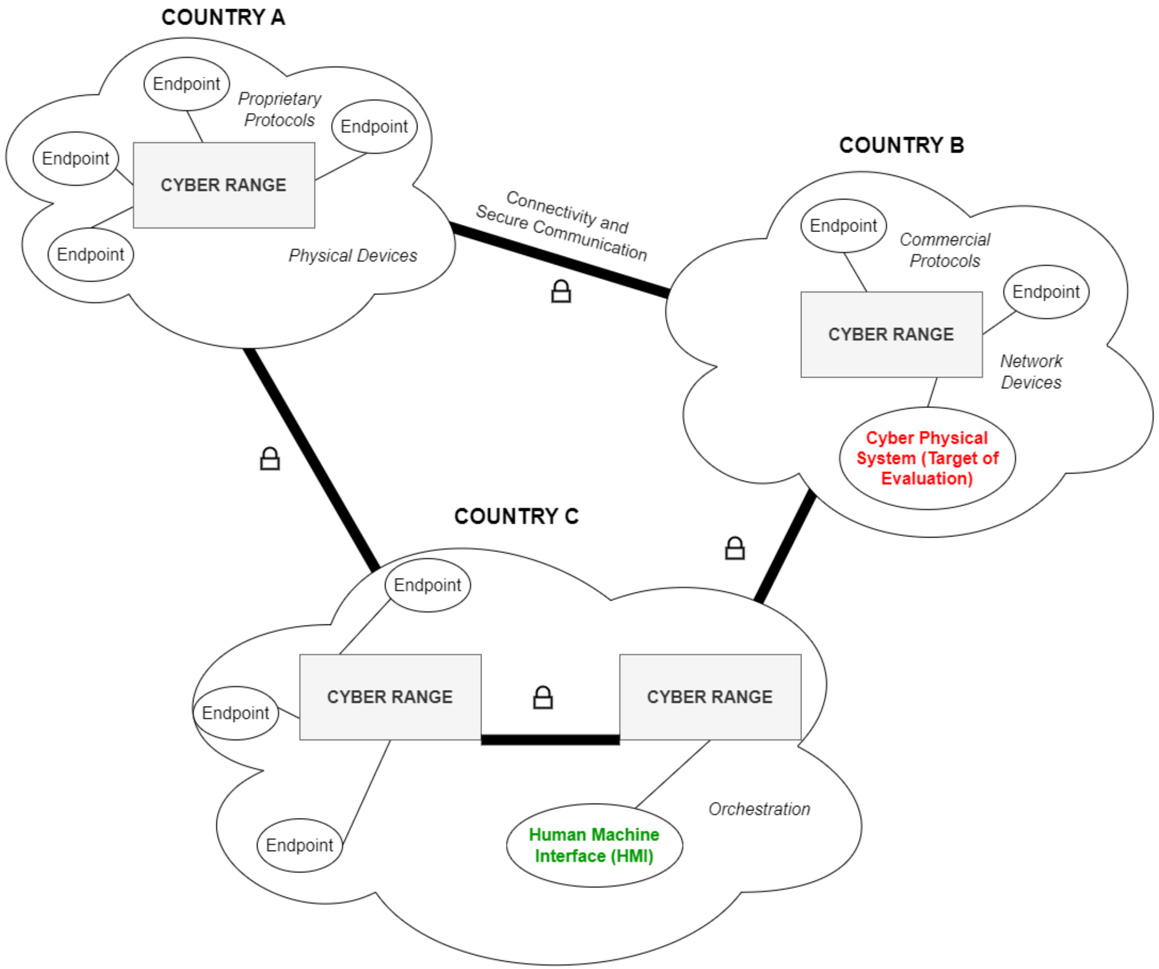
THALES
Università di Genova

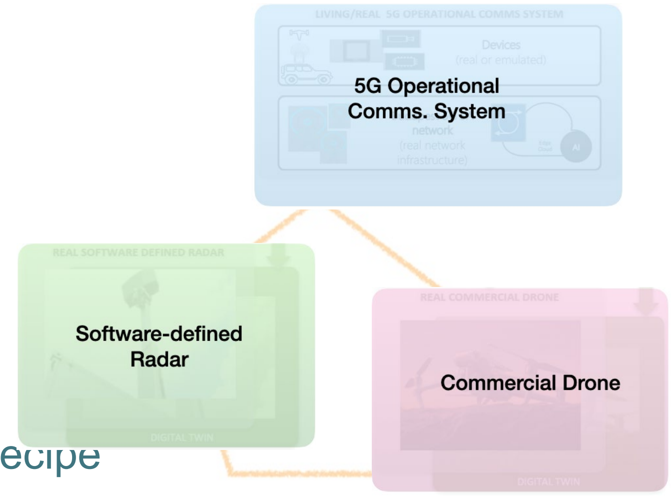
The Federated Advanced Cyber physical Test range (FACT) project will provide an unprecedented new European capability to test and verify the cyber vulnerability of equipment.


COUNTRY A
Endpoint
Proprietary Protocols
Endpoint
Endpoint
CYBER RANGE
Endpoint
Physical Devices
Connectivity and Secure Communication
COUNTRY B
Endpoint
Commercial Protocols
Endpoint
CYBER RANGE
Network Devices
Cyber Physical System (Target of Evaluation)
COUNTRY C
Endpoint
CYBER RANGE
CYBER RANGE
Endpoint
Endpoint
Human Machine Interface (HMI)
Orchestration

# FACT Deliverable & Demonstration

**Project Outcomes**

- Federated Test Range
- Adaptive on Demand
- Open API & Expandable
- Cyber Physical Testing
- Real-world Scenarios



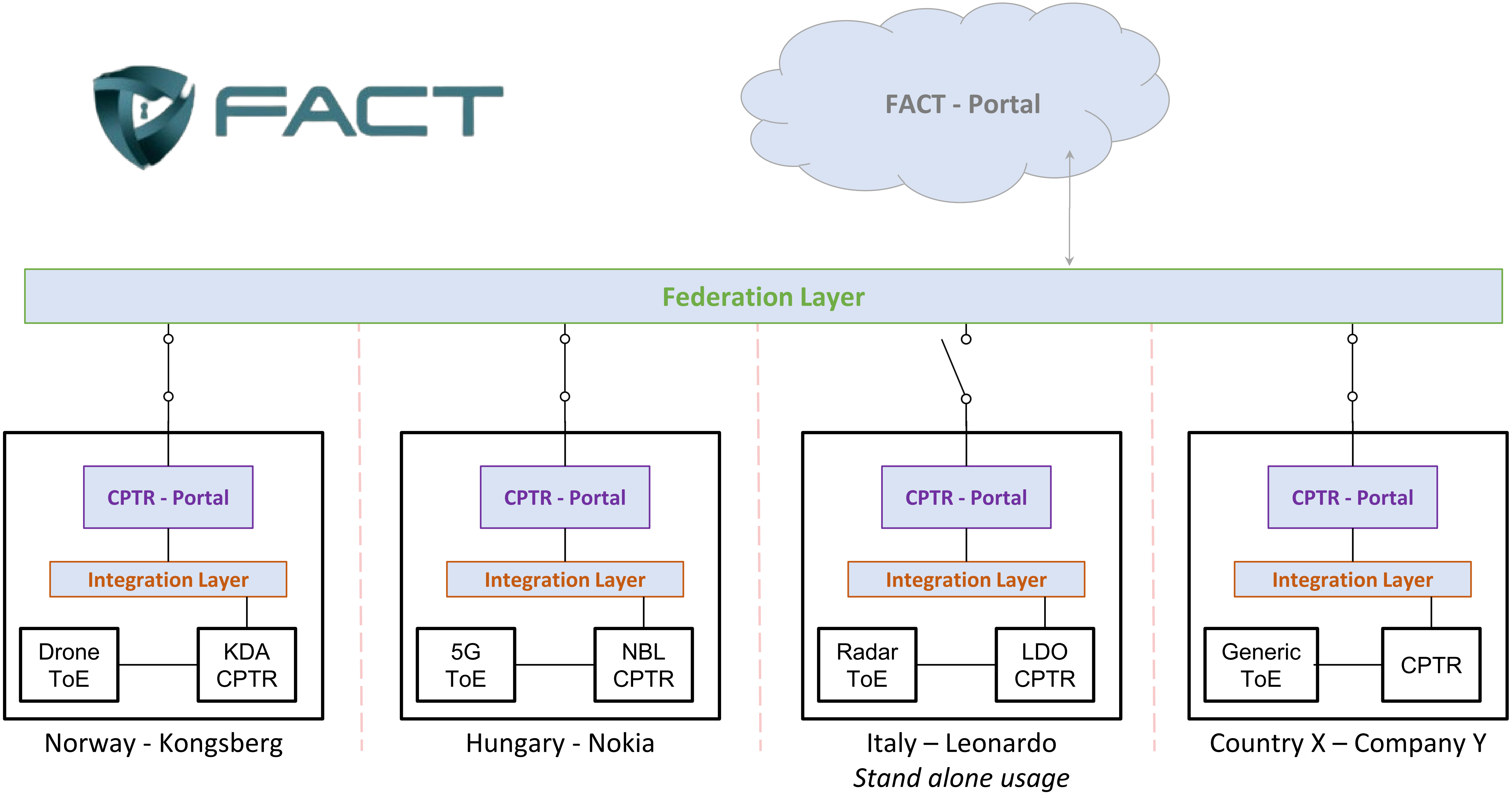
**FACT Blue print *(theory)*** - the cooking recipe

- Perform integrated cyber-resilience testing
- Design  the cyber-physical test range (military grade)
- Facilitate continuous update & extend testing

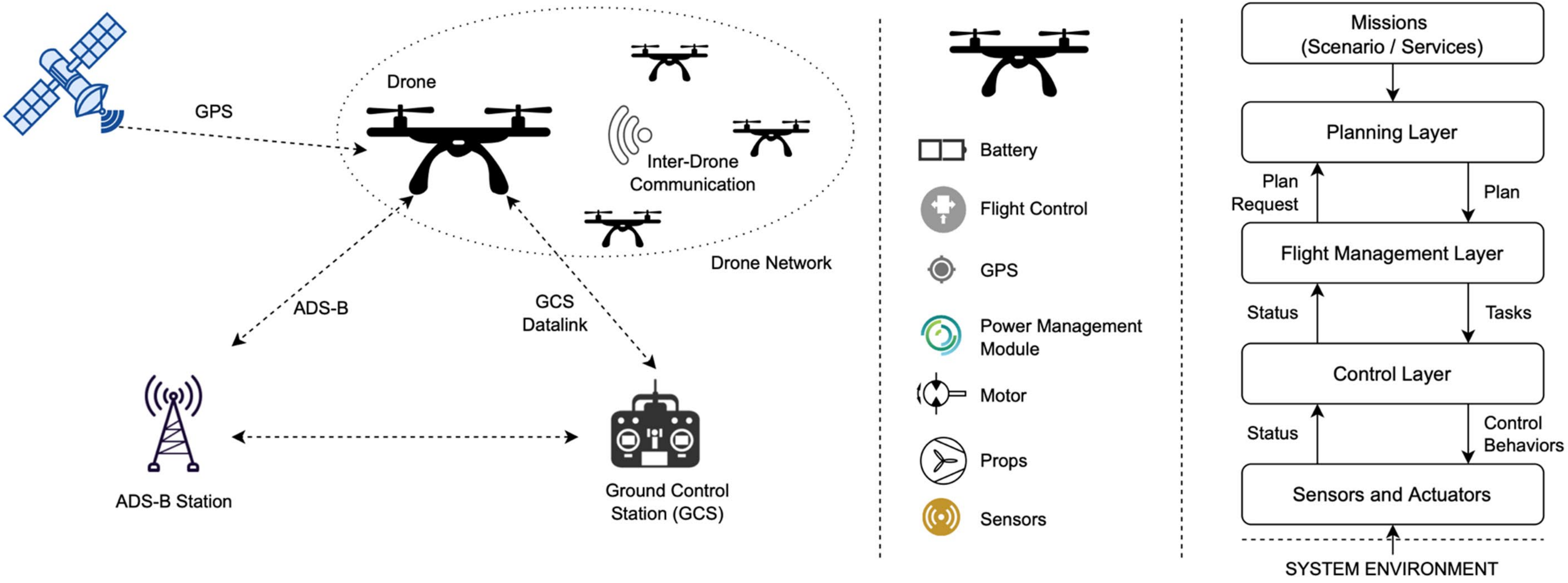
**Demonstrate the Testing *(practice)*** - three specific use cases

- Selected cyber-resilient testing
- Limit capability of the test infrastructure
- Technology-readiness level 6-8

Created with mapchart.net


FACT - Portal
Federation Layer
CPTR - Portal
Integration Layer
Drone ToE
KDA CPTR
Norway - Kongsberg
CPTR - Portal
Integration Layer
5G ToE
NBL CPTR
Hungary - Nokia
CPTR - Portal
Integration Layer
Radar ToE
LDO CPTR
Italy – Leonardo
*Stand alone usage*
CPTR - Portal
Integration Layer
Generic ToE
CPTR
Country X – Company Y

# Demonstration Use-Case: Drone



GPS

Drone

Inter-Drone Communication

Drone Network

ADS-B

GCS Datalink

ADS-B Station

Ground Control Station (GCS)

Battery

Flight Control

GPS

Power Management Module

Motor

Props

Sensors

Missions (Scenario / Services)

Planning Layer

Plan Request

Plan

Flight Management Layer

Status

Tasks

Control Layer

Status

Control Behaviors

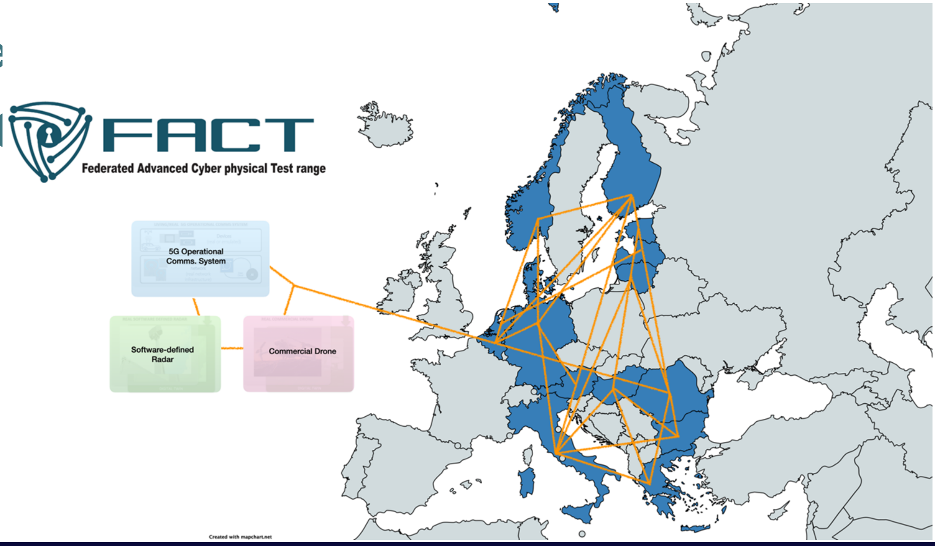
Sensors and Actuators

SYSTEM ENVIRONMENT

# Security Objectives

- Strategic Objective (overall) for Federated CPTR capability:
    - Advanced security resilience testing of Target of Evaluation (ToE) Cyber Physical Systems (CPS) – both military (and commercial)

- Security Objectives (overall) for Federated CPTR capability:
    - high level of security and trust - and be resilient against Cybe
    - able to handle and protect Information about ToE with discret and according to ToE System Owner security policy
    - able to handle and protect Classified Information (e.g. EUCI) military grade ToEs
    - comply with relevant Security Laws and Regulations


FACT
Federated Advanced Cyber physical Test range
5G Operational Comms. System
Software-defined Radar
Commercial Drone
Created with mapchart.net

# CPS Testing in NO

- FACT born in the SFI NORCICS realm
- Cooperation between KDA & NTNU
- CPS testing demanded everywhere

- Nordic Model of cooperation
- Cooperation & sharing across critical sectors
- Towards Norwegian Total Defence Approach

- From NORCICS to Europe & back again

# Contact information

## Project Coordinator

Jon Leistad
jon.leistad@kongsberg.com

## Technical Manager

Prof. Katrin Franke
katrin.franke@kongsberg.com

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