

EMBEDDED SYSTEMS AND SMART MANUFACTURING WORKSHOP

ART – ADVANCED RESEARCH & TECHNOLOGY

DATE: 16-17/06/2022



OUTLINE

- Company overview
- Research interests
 - Model Based Systems Engineering
 - Digital Thread and Twin Technologies
 - Cybersecurity

 **Collins Aerospace**

NET SALES \$18.4 BILLION



 **Pratt & Whitney**

NET SALES \$18.2 BILLION



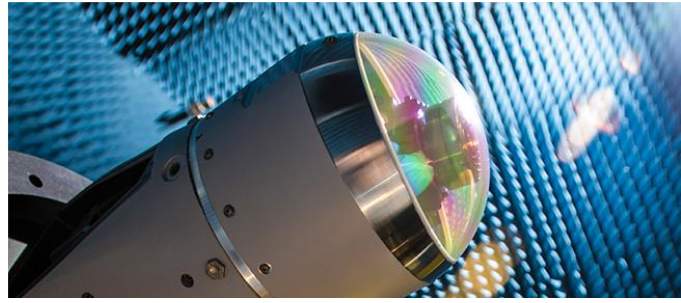
 **Raytheon Intelligence & Space**

NET SALES \$15.2 BILLION



 **Raytheon Missiles & Defense**

NET SALES \$15.5 BILLION



STRATEGIC BUSINESS UNITS

FORMED TO MEET CUSTOMER NEEDS AND REPRESENT THE BEST IN INNOVATION, TECHNOLOGY AND EXPERTISE.

Advanced Structures



Avionics



Connected Aviation Solutions



Interiors



Mission Systems



Power & Controls



BALANCED PORTFOLIO, GLOBAL FOOTPRINT

GLOBAL PRESENCE

67,000+
employees

17,000+
engineering
workforce

300+
sites globally

ANNUAL REVENUE

\$18.4 billion
net sales

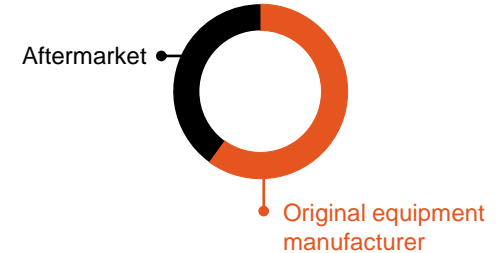
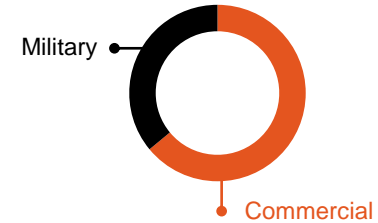
* 2020

INVESTED IN INNOVATION

\$3.1 billion
research and
development
investment*

* 2021, includes company-
and customer-funded

BROAD AVIATION AND MILITARY PORTFOLIO



LEGACY OF INNOVATION

AVIONICS AND COMMUNICATIONS



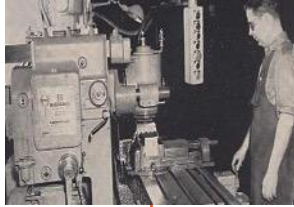
Arthur Collins



ELECTRIC SYSTEMS



David Sundstrand



ENVIRONMENTAL CONTROL SYSTEMS



Thomas Hamilton



LANDING SYSTEMS



Benjamin Goodrich



NACELLES



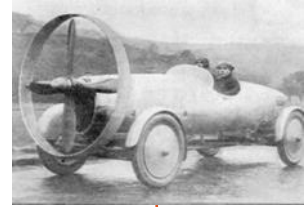
Fred Rohr



PROPELLER SYSTEMS



Paulin Ratier



APPLIED RESEARCH & TECHNOLOGY

ORGANIZATIONAL DESIGN



APPLIED RESEARCH
& TECHNOLOGY

Skilled & Diverse Workforce

- ~180 employees
- ~50% Ph.D.
- >20 Nationalities
- Sites in IA, CT, Ireland, Italy

Technology Management

Architectures



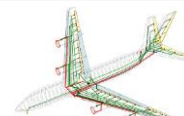
Integrated Mechanical Solutions



Advanced Propulsion Systems



Cabin Systems



Electric Architectures & Controls



Non-A/C Applications

Advanced Systems & Demonstrators



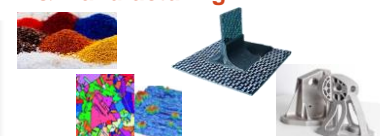
Networks & Emerging Technology



Advanced MBSE Methods



Advanced Materials & Manufacturing



A.R.T. Accelerator



Data Analysis



Tool & Methods Scaling



Material Testing



AR/VR

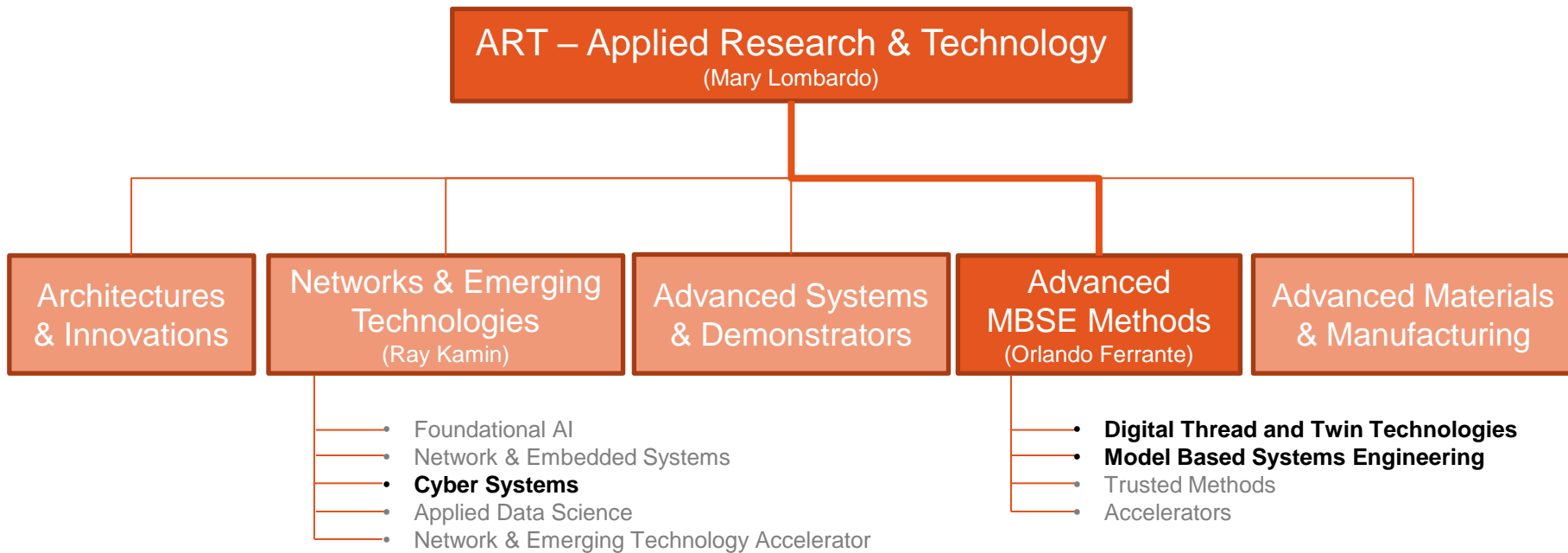


Data Visualization



APPLIED RESEARCH & TECHNOLOGY

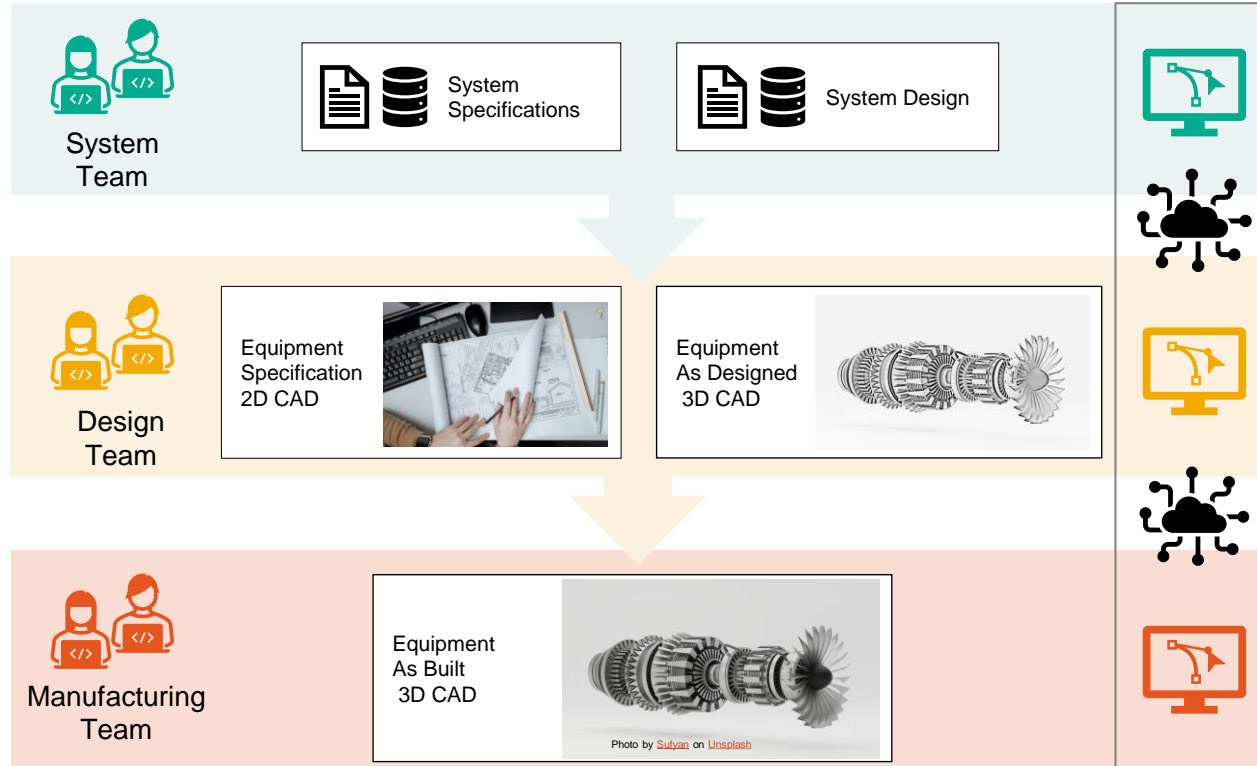
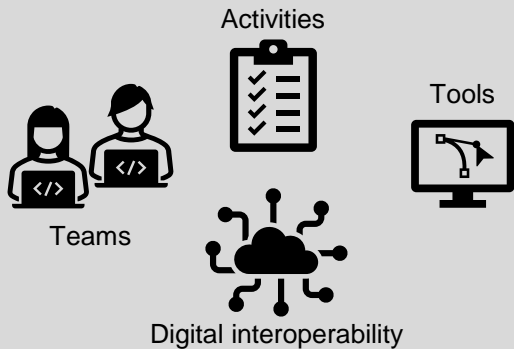
Accelerating Transformative Aerospace Technologies for
a Safer More Connected and Sustainable World



MBSE RESEARCH INTERESTS

Model-Based Systems Engineering for Mechanical Systems

- Cross-team and cross-domain (up-stream and down-stream) information exchange
- End-2-End Informed Design Decisions
- Co-Engineering with Manufacturing
- Open-Standards for digital and data interoperability



DT3 RESEARCH INTERESTS

Digital thread and digital twin for manufacturing sustainability and the circular economy

Connected Digital Supply Chain

- [Digital Twin System Interoperability Framework](#)

System-Centric	
Model-Based	Federated
Holistic	Actionable
State-Based	Scalable

Digital Twin Consortium

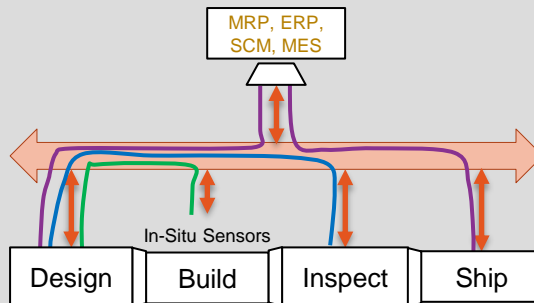
Product and Material Tracking

- Trace products through-out their life cycle
 - Part material footprint
 - Performance degradation and RUL
 - Maintenance history
 - Contaminant exposure



Digital Thread for Additive Manufacturing

- Close feedback between in-situ monitoring and process design to improve process robustness
- Close feedback loop from inspection to design
- Big data management and processing
- Seamless integration with production management tools (MRP, ERP, SCM, MES)



Industrial DataOps for product and production digital twins

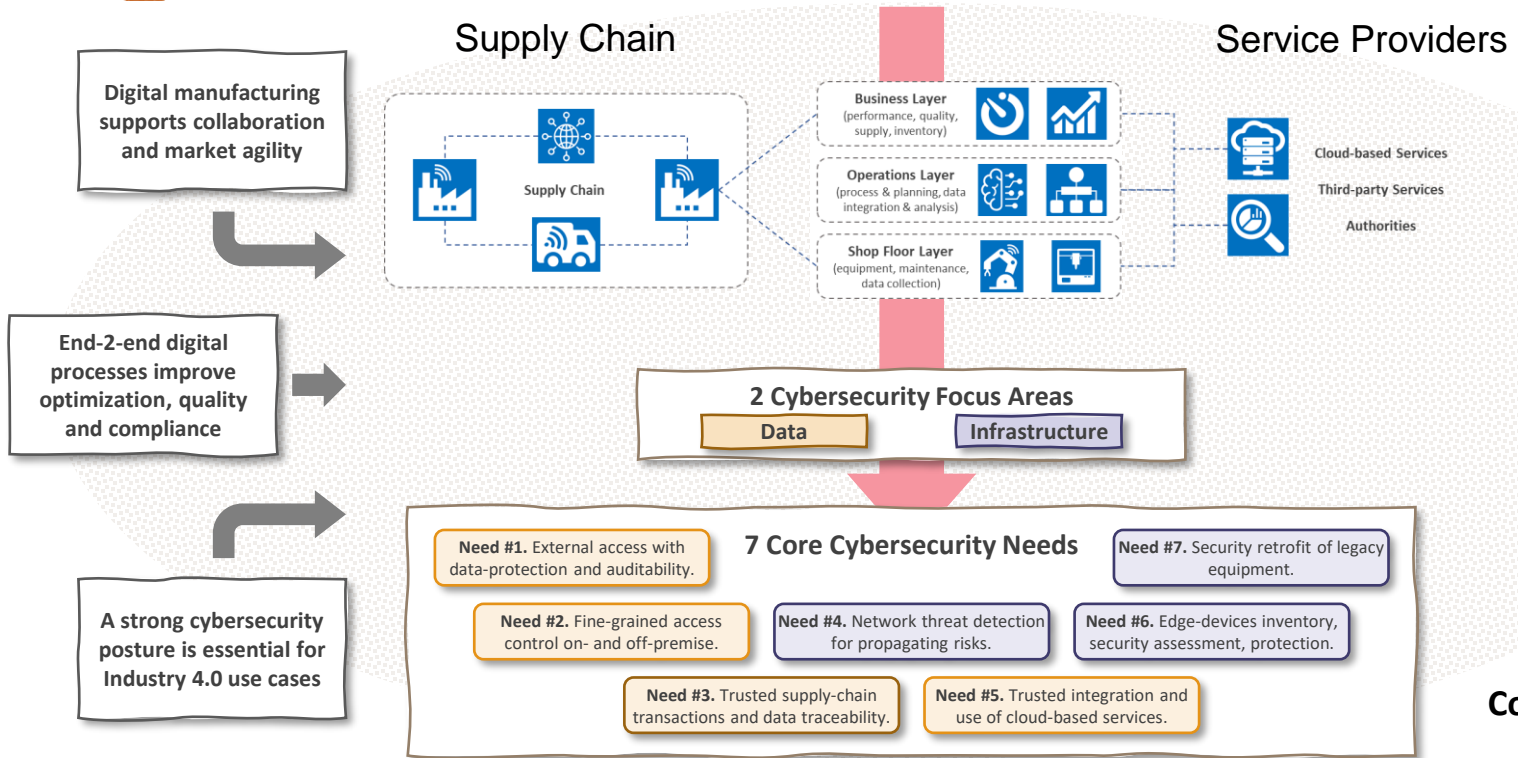
- Collaborative frameworks for data management
- Integration and automation of data pipelines
- Monitor and inspect time-series, structured and unstructured data
- Deliver big data to business analytics and physics-based digital twins





IEC-62443
UNECE WP.29
NIST 800.171

Factory Management



Source: unsplash.com

Civil Aviation



Source: unsplash.com

Automotive



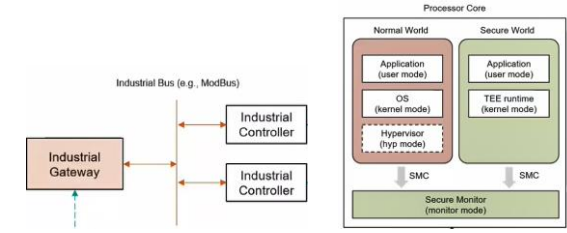
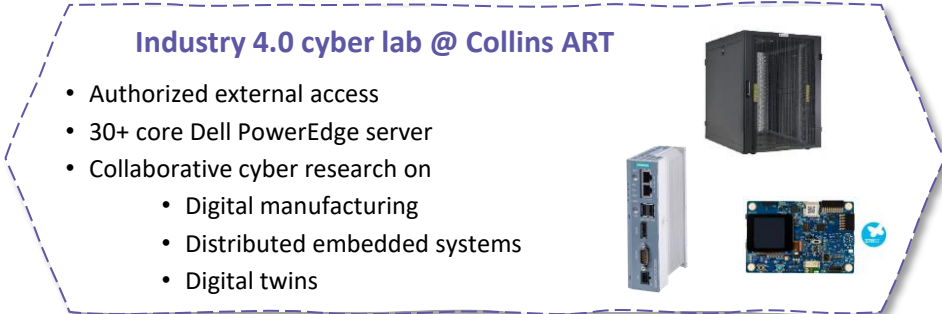
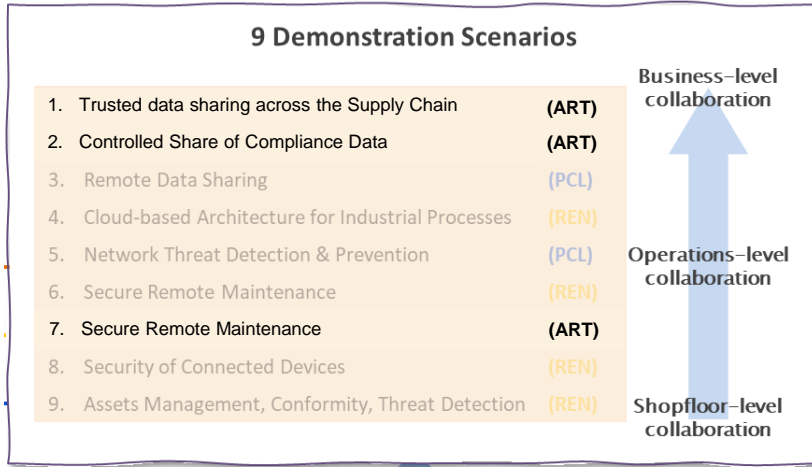
Source: pexels.com

Consumer Electronics

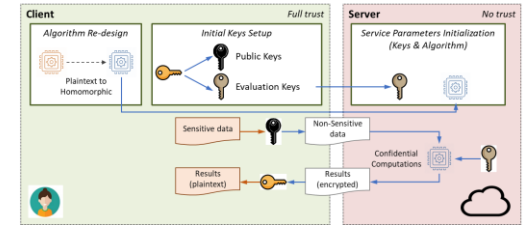


Source: unsplash.com

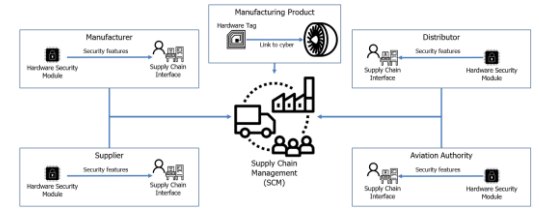
Civil Aviation



Trusted Computing at the edge and legacy retrofit



Confidential Computing in Multi-tenant & Cloud-based Env.



Interledgers for Supply Chain Protection



THANK YOU

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COLLABS – Specific demonstration scenarios

Civil Aviation



Source: unsplash.com



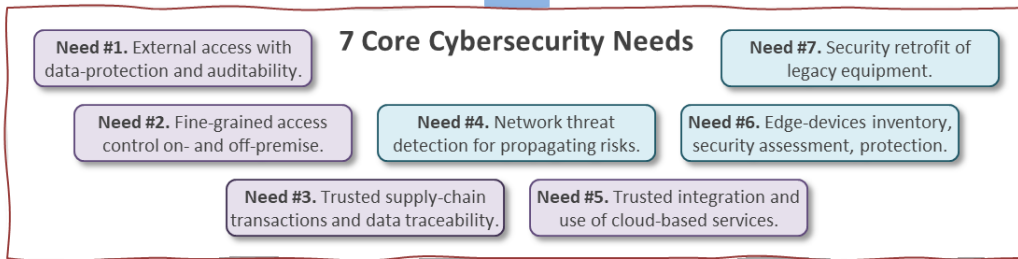
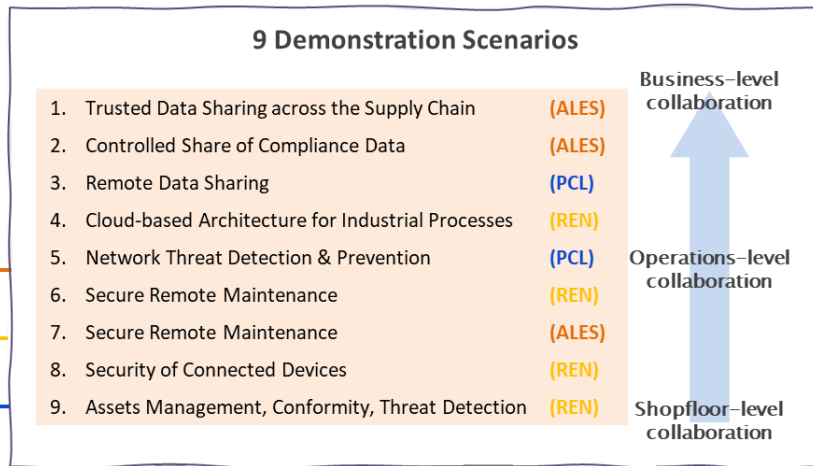
Source: unsplash.com

Automotive



Source: pexels.com

Consumer Electronics

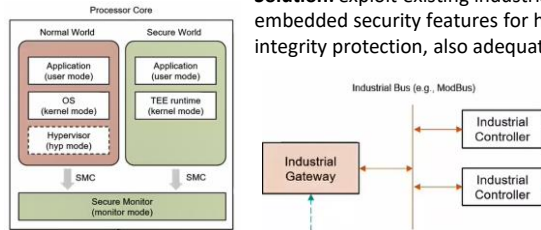


COLLABS – Collins Aerospace contributions

Trusted Computing at the edge and legacy retrofit

Need: guarantee segregation of IP-sensitive product data from data with less stringent controls (e.g., required for PHM, quality, auditing, ...); support legacy with minimal impact

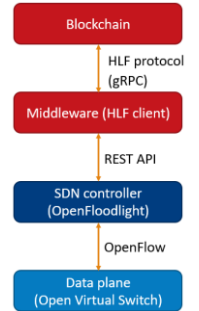
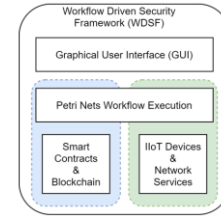
Solution: exploit existing industrial gateways (used for interoper.) embedded security features for highly-trusted data separation and integrity protection, also adequate for legacy equipment



Need: Guarantee remote access for maintenance to an industrial equipment located in a specific subnet of a complex, multi-organization distributed network, managing coordination of the different stakeholders, reducing human errors, and with least-privilege, minimal time, and lateral-movement protection guarantees.

Solution: enforce an authorization workflow, leveraging blockchain contracts to coordinate stakeholders, realign automated network security reconfigurations through a software defined network layer establishing a secure link.

Secure Remote Maintenance



Industry 4.0 cyber lab

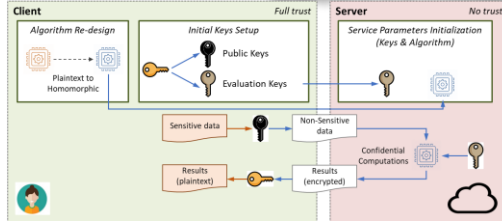
- Located in a dedicated and protected sub-network, allowing authorized external access
- Equipped with several industrial embedded devices and a 30+ core Dell PowerEdge server enabling complex networks virtualization.
- Supporting collaborative cyber research on digital manufacturing, critical infrastructures, distributed embedded systems, digital twins



Need: guarantee a high-confidentiality solution to transfer to cloud-based infrastructures computationally expensive tasks required for product compliance checks on manufactured parts to reduce costs of expensive in-house computing facilities

Solution: in a multi-tenant/multi-user environment the risk of IP-sensitive information leakage is very high; to ensure data protection under all circumstances we used homomorphic encryption to enable direct processing of encrypted sensitive data without providing a decryption key to the cloud service provider.

Confidential Computing in Multi-tenant & Cloud-based Env.



Need: increase trust in transition to digital supply chain transactions considering also the specific responsibilities arising in production of safety-critical systems, such as in the civil aviation manufacturing sector.

Solution: extending existing research using interledgers for supply chain transactions, we introduced trusted security modules deployed on manufacturing equipment to provide high-assurance tracking of single manufacturing steps, used active tags for parte recognition, and leveraged «channels» for enabling auditability with sensitive data protection guarantees

Interledgers for Supply Chain Protection

