LEONARDO

NATO OTAN

S&T organization

Electronics

Helicopters

Aircraft

Cyber & Security

Space

Unmanned Systems

Aerostructures

Digitalization, Cloud, Extended Reality and Connectivity for Remote Training and Support

SAS-165 on Assessing the Implications of Emerging Technologies for Military Logistics
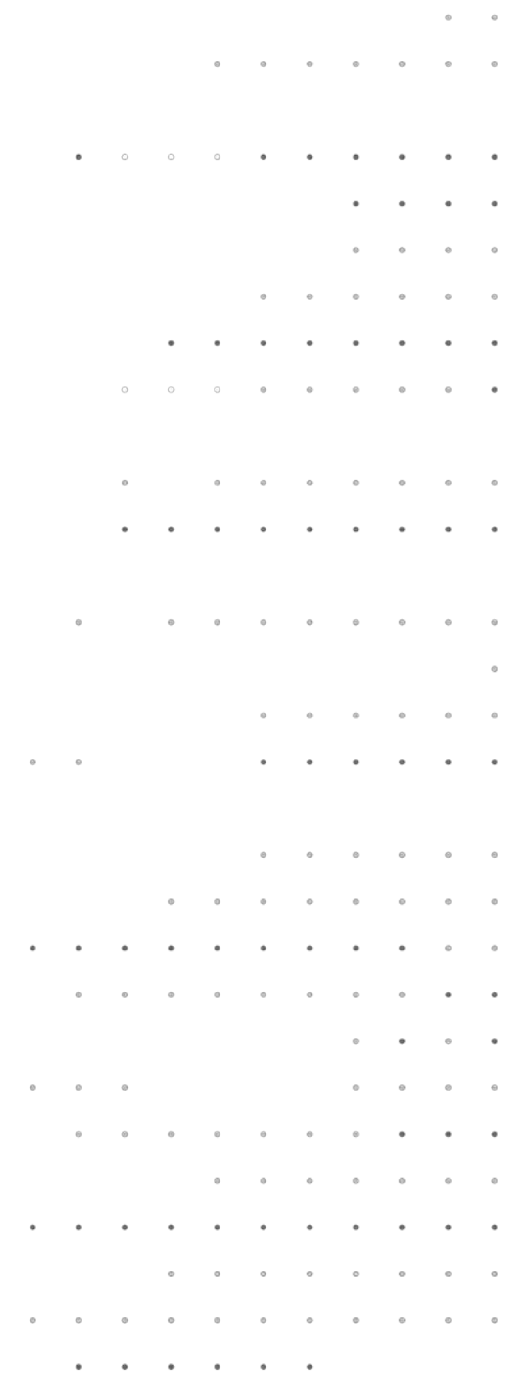
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SUMMARY

- A selection of **products** and **services** designed and developed by Leonardo to support the **digitalization of Customer Support and Training** is presented.

- Leonardo developed a complete suite of *digital* solutions:

    - A **Cloud platform** for MSaaS: OCEAN;

    - A **Synthetic Environment** for simulations: RIAce;

    - A permanent **Network**: SHORE;

    - A series of **Extended Reality** products for Training: VMT, Morpheus XR;

    - A platform for **Remote Support**: Collaborative Digital Platform.

- Emerging technologies for digital Customer Support and Training presents benefits and challenges:

    - **Benefits**: reduce costs, time and effort; maximize safety; enhance capabilities;

    - **Challenges**: cybersecurity; connectivity; perception and health issues;
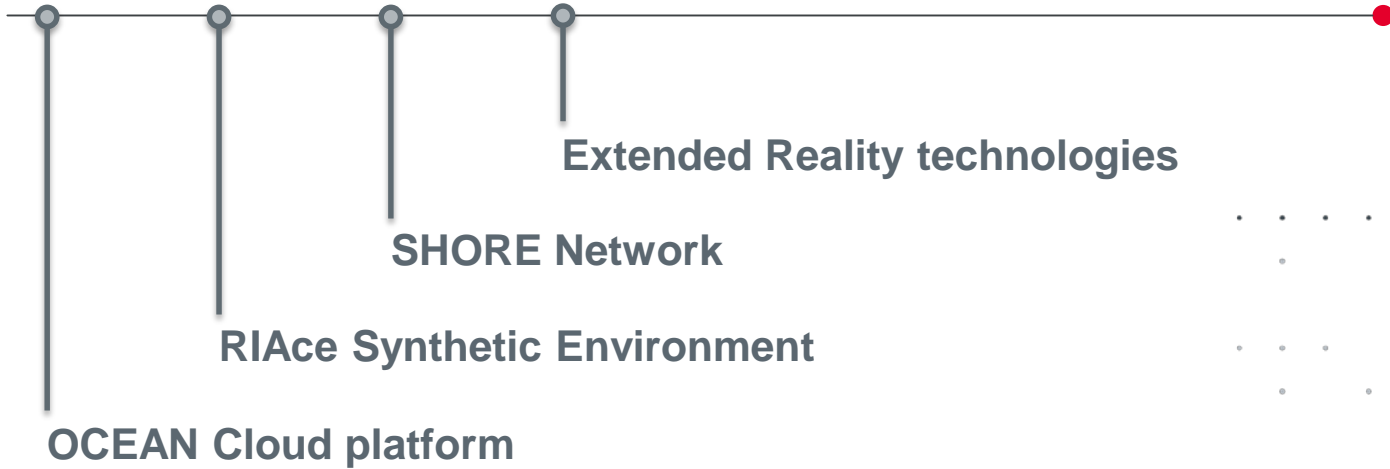
The Military in the era of Digital Transformation

- The Army requires the **capability to prepare units** in **complex realistic environments**, including **flexible scenarios** where threats and Operational Environment (OE) change continuously, so as to ensure **well-trained and ready personnel** capable of conducting missions across the whole range of military operations.

- This requires especially the **availability and readiness** of training personnel and resources, **interoperability** across all fields, **flexibility** in the complex management of training scenario. This has been notably **challenging in terms of logistics**.

- One of the most drastic shift in the way people used to operate and cooperate is the **rise of platform technologies** enabled in particular by digitalization.

- In recent years, the emergence of **innovative technologies** leveraging in particular on **Modelling & Simulation** as well as **Remote Connectivity** have significantly **enhanced capabilities for Training and Support** of armed force.

- The increasing maturity of such solutions enables most significantly:

  - **Availability** of resources **on-demand** and **at all time** thanks to the immateriality of these resources;
  - **Ease of management** as well as **acute flexibility and complexity** of training activities thanks to **appropriate user interface**;
  - Significant **reduction of logistics costs, time and effort** thanks to transportation of **data rather than people or things**;
  - Considerable **increase of capabilities** thanks to the rise of **Services taking over Products**.

- As new capabilities emerge, **new challenges** arise as a result of this change of paradigm: **perception**, **connectivity**, **cybersecurity** and **certification/standardization**.
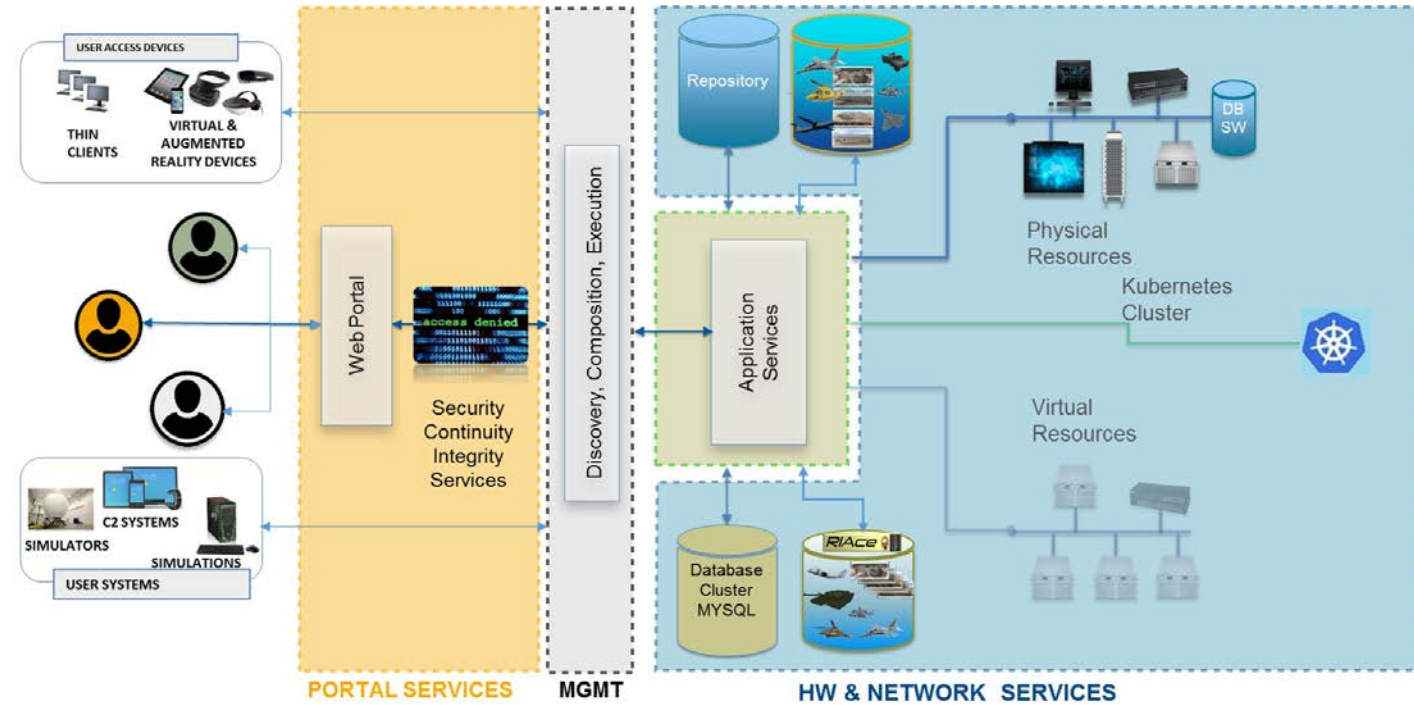
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Modelling & Simulation

Extended Reality technologies

SHORE Network

RIAce Synthetic Environment

OCEAN Cloud platform

Modelling & Simulation as a Service: OCEAN

- OCEAN (Open Cloud Environmental ApplicatioN) is a **Cloud platform** for **orchestrating both physical and virtual applications and networks**, equipped with a **graphical and intuitive web interface** (drag & drop), capable of **creating and managing dynamic deployment of environments** for products and services.

- OCEAN is essentially a "container of services", used primarily by Leonardo as a platform for delivering **Training as a Service**, adhering to the **MSaaS** paradigm.

- The system is structured on 4 levels:

  - External Users and Assets layer;
  - Web portal to access the services layer;
  - Management layer;
  - Application Service and Resources (HW & Network Services) layer.

- The core of the system, the HW & Network Services layer, consists of the **services federated** by OCEAN and all the physical and virtual resources used to provide **complex distributed scenarios**.
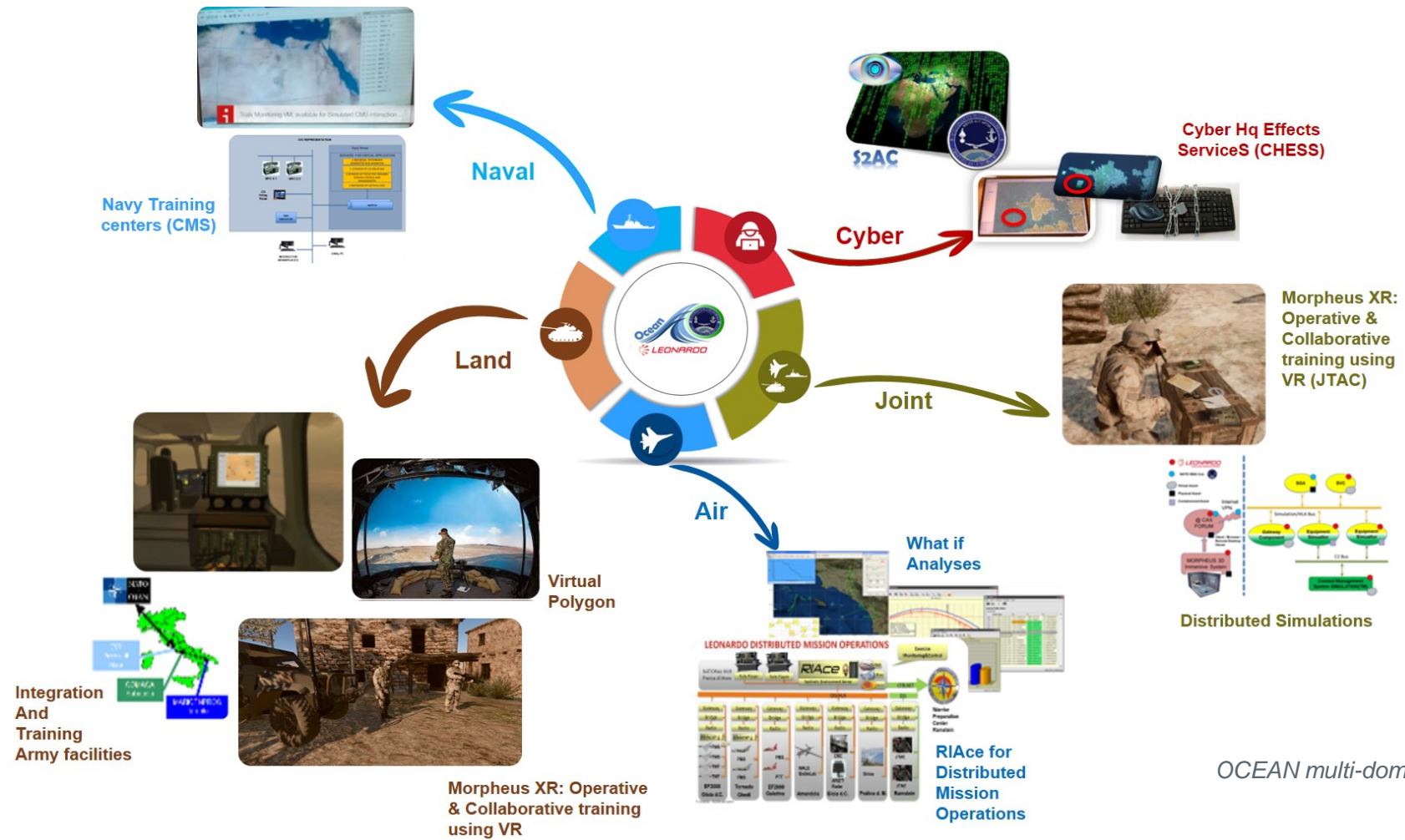

OCEAN working principles

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Modelling & Simulation as a Service: OCEAN

- OCEAN has been upgraded over the years with a number of features that make it **extremely flexible** and **easy to use**, managing hardware, software, simulators, simulations, didactic material, and all other resources needed to create any **complex scenario for training** in any domain of application.

OCEAN multi-domain application

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Modelling & Simulation as a Service: OCEAN

Benefits

- **Easy to use** thanks to web-portal access, user-friendly interface, set up with APIs, simple navigation and access management, hidden low-levels instructions, etc.

- **Easy management** and **integration** over LAN/WAN of both **Virtual and Physical resources**: classrooms/laboratories (i.e. any place and asset used for training), real/virtual test benches, Synthetic Environment, simulators and simulations, etc.

- **Easy management** of **training sessions**: access, configuration, execution and termination.

- **Concept Development and Experimentation** (CD&E) to study in a simulated environment the adoption of new operational concepts (CONOPS) and existing resources or new acquisitions (CONUSE).

- **Advanced Training** in **complex and realistic scenarios**, including critical situations (environmental disasters, terrorist attacks, military operations, etc.), focused in particular on procedures, strategies and decisions making.

- **Availability**, **repeatability**, **rapid adaptation** and **automation** by virtue of models and simulations available **on demand**, **at all time** and **from anywhere**, as well as **sharing** and/or **reusing** of resources (models, services, data).

- Significant **reduction of cost**, **time** and **effort.**
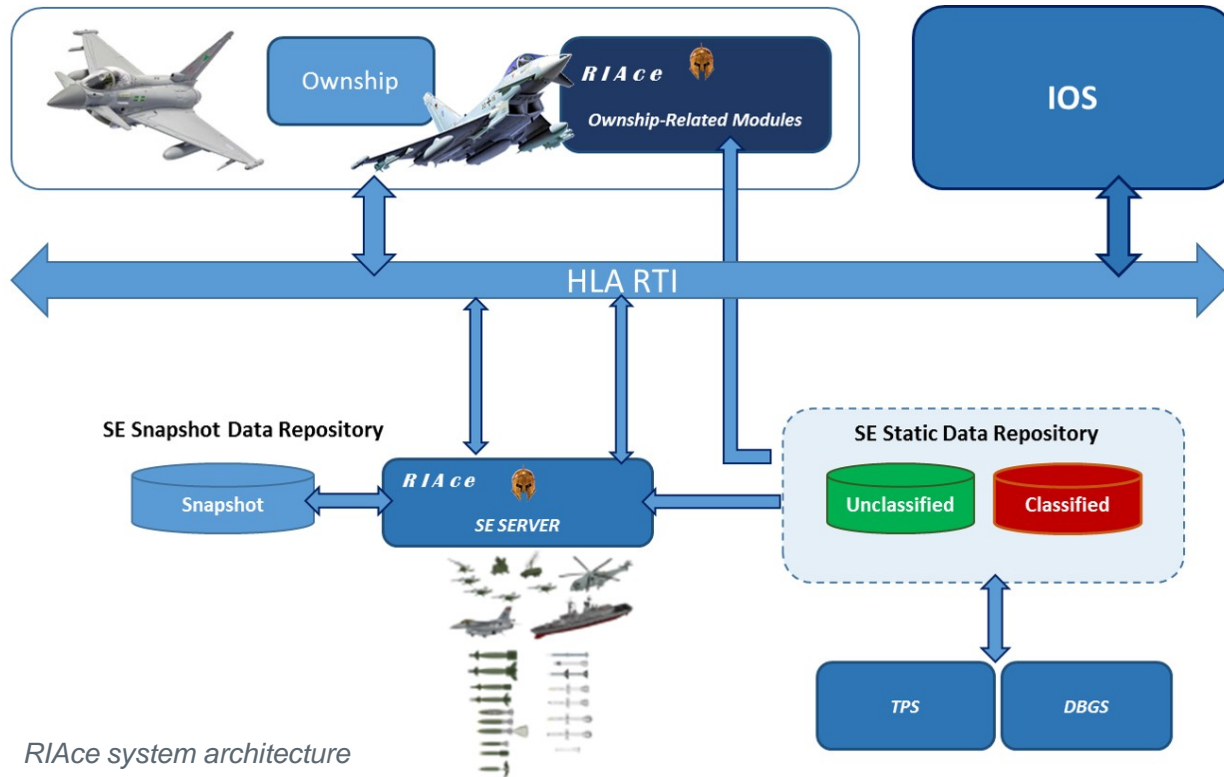
Challenges

- **Certification/validation** of training activities.

- **Interface Standardization** to guarantee full compatibility with services.

- **Multi-cloud Interoperability**.

- **RTI/HLA:** to support federated simulation services and coordinate their operations and data exchange during a runtime execution.

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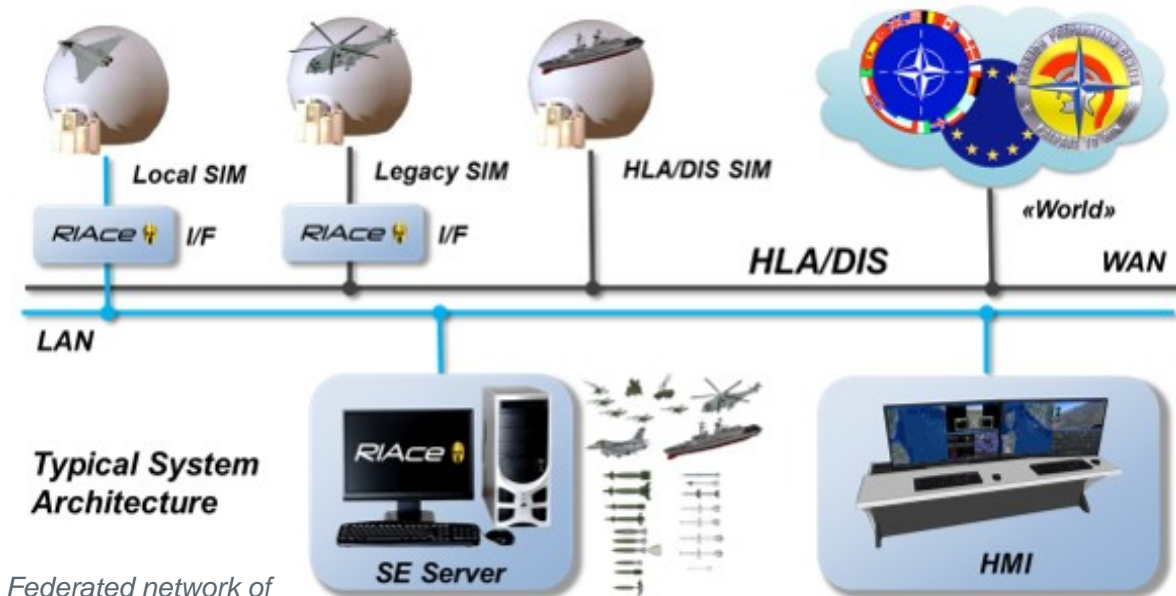
Synthetic Environment: RIAce

- RIAce (Realistic Intelligent Agents for Computer Environments) is a **Synthetic Environment**, able to **simulate** and **provide** either **single events** (e.g. "one-to-one" air-to-air engagements) or **complex missions** (e.g. COMAO: Composite Air Operation).

- It is based on a client-server architecture: the core component is the **SE Server**, client applications consist in a series of **Ownship-Related Modules** (ORMs) including **simulation models** (e.g. flight model) hosted on the same Ownship processing system to allow for different **simulators to be federated** on the network to participate in a joint distributed exercise.

- A typical **distributed simulation system architecture** includes elements connected via LAN (e.g. local simulators on the same Operating Base) and other components connected via WAN supporting HLA/DIS interface or via a proper gateway.


RIAce system architecture

Federated network of simulators over LAN/WAN

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Synthetic Environment: RIAce

- RIAce allows the simulation of **low and high intensity war scenarios** (including self-generated civil air traffic, merchant and fishing vessels, pedestrians and vehicle traffic on urban and country roads) with possibly **specific associated profiles** (e.g. smugglers and traffickers of immigrants, rebels and many other types of actor of interest) for a **realistic** and **engaging** production of a particular **training scenario** for military or emergency management purposes.

- Leveraging on HLA/DIS, the network architecture can include a hub hosting Computer Generated Forces (CGF) servers. This was used for the **Spartan Distributed Simulations Exercises** in which several flight simulators were connected via HLA/DIS to RIAce platforms that generated and distributed a **complex scenario** in which all **connected simulators cooperated**.
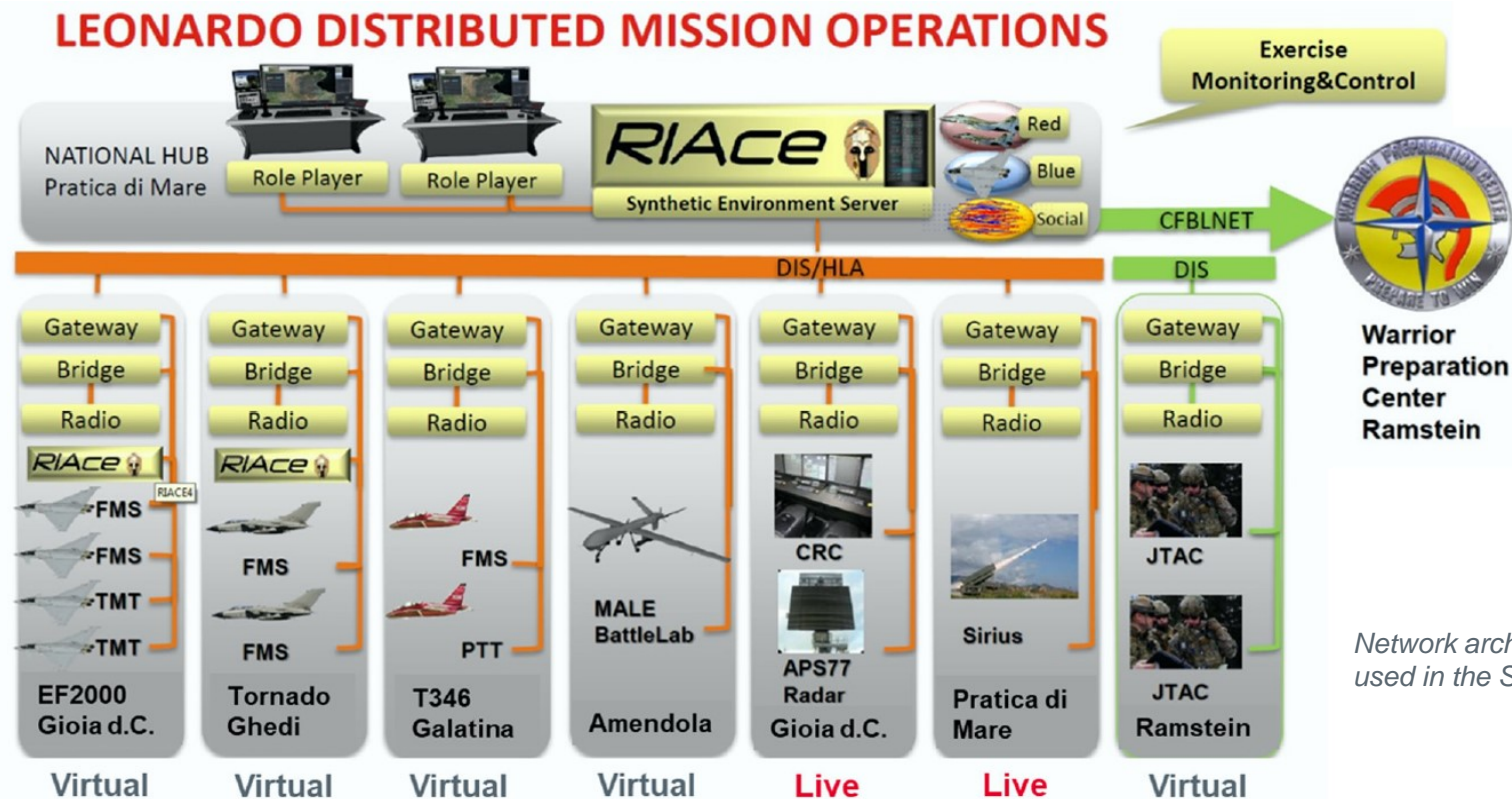
Network architecture with a central HUB used in the SPARTAN Alliance exercise

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Synthetic Environment: RIAce

Benefits

- **Highly realistic** with **accurate modelling and simulation** of terrain, weather, Computer Generated Forces (CGFs), physics (for aerial, land and sea platforms and weapons), etc.

- HLA/DIS interface allows for a large number of resources (e.g. several flight simulators) to **collaborate** in **complex Training simulations**.

- Integration with MSaaS platform (**OCEAN**) in order to provide **Training as a Service** solutions.

Challenges

- **Full Interoperability**.

- **Full adherence to MSaaS paradigm**.

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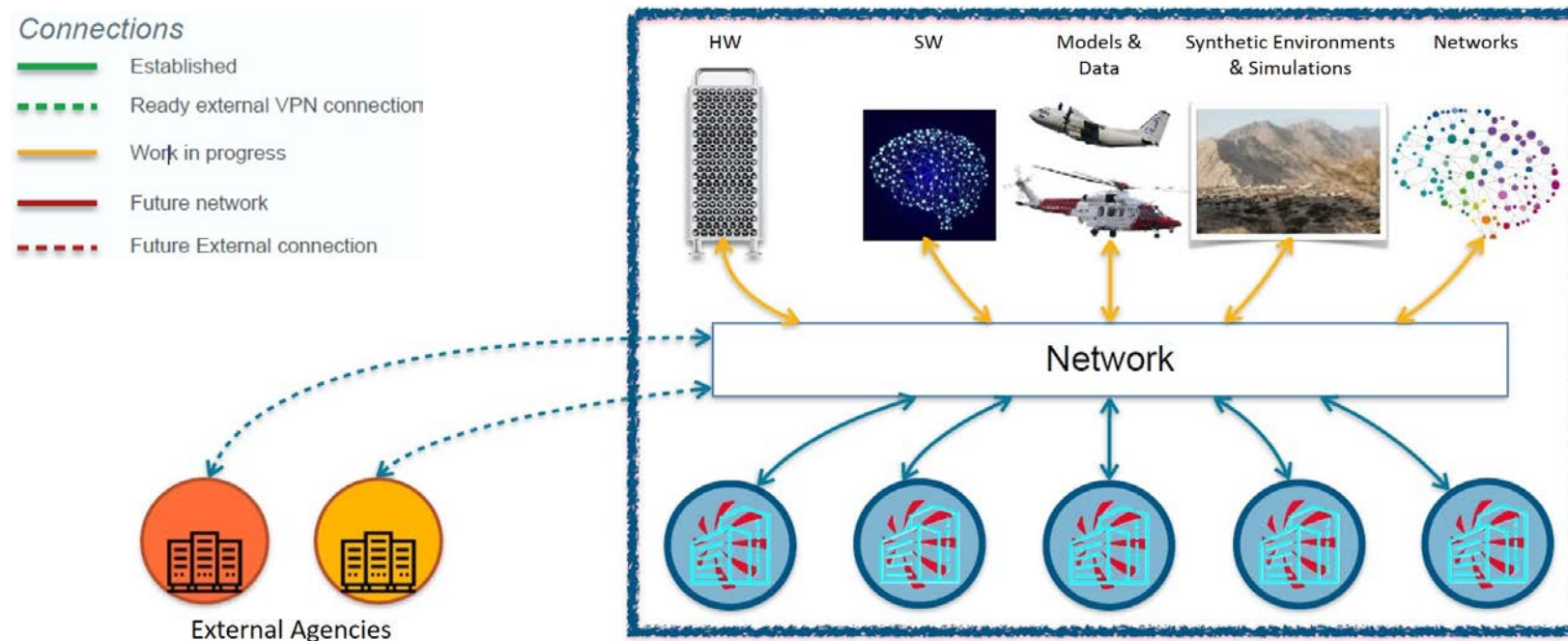
Integrated Network: SHORE

- SHORE (Simulation Hands-On, Review & Experimentation spaces) is Leonardo Network solution establish a **permanent network between M&S centres** across the Leonardo Group also establishing **bridges towards external agencies**.

- Shore transforms the current separated centres (engineering facilities, integration rooms, simulation laboratories, etc.) into a **single structure** to allow a seamless **interoperability across the various simulation systems** developed and running at different sites, without the need to move or duplicate them.

Implementation of SHORE network between Leonardo's M&S centres (2021)

Permanent network between M&S centres across the Group and bridges towards external Agencies

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Integrated Network: SHORE

Benefits

- **Interoperability** among facilities enables sharing resources, experience, infrastructures and simulated environments to achieve capabilities that go far beyond those of each individual centre.

- **Reducing costs** and **optimization of time** by virtue of sharing common resources (savings in assets acquisition), reduction of staff movements (distributed knowledge) and optimization of investments.

- Increasing the capacity to **share** and more importantly **reuse resources** (HW and SW, models, Synthetic Environments, simulations, data, etc.).

- **Rapid adaptation** to changing needs: new HW & SW, different Models and Environments, Service network improvements.

- Increasing **Cyber Security** of applications, deployed in a closed and private Company network.

Challenges

- **Extend** the capability of the network integrating OCEAN;

- **Ensure the integrity, safety, security** of data on the network;

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Extended Reality: Virtual Maintenance Trainer

- Leonardo Aircraft Division (LAD) and Leonardo Helicopters Division (LHD) have worked together to develop a common framework for an advanced **Virtual Maintenance Trainer** (VMT) system with **HD realistic environment**.

- Trainees practice **troubleshooting**, **routine maintenance** and **repair of faults** (even the most complex, critical or dangerous) in a virtual immersive world and leverages on **simulation models replicating the behaviour of the aircraft** main systems.

M345 Trainer VMT

AW101 VMT

M345 virtual cockpit

Trainee wearing VR equipment

Extended Reality: Morpheus XR

- Morpheus XR, developed by Leonardo Electronics Division (LED) supports the **practical phase of maintenance training of electronic equipment**.

- The system adopts a Virtual Reality Environment global approach where it allows users to perform a number of activities in a synthetic and photorealistic environment including **system familiarization** and execution of exercises following **operative and maintenance procedures**.

- Morpheus XR can be **integrated with OCEAN**, which guarantees **efficient management of network resources** and the **synchronous distribution of virtual contents** provided by Morpheus XR.

Avatar of a technician in Morpheus XR
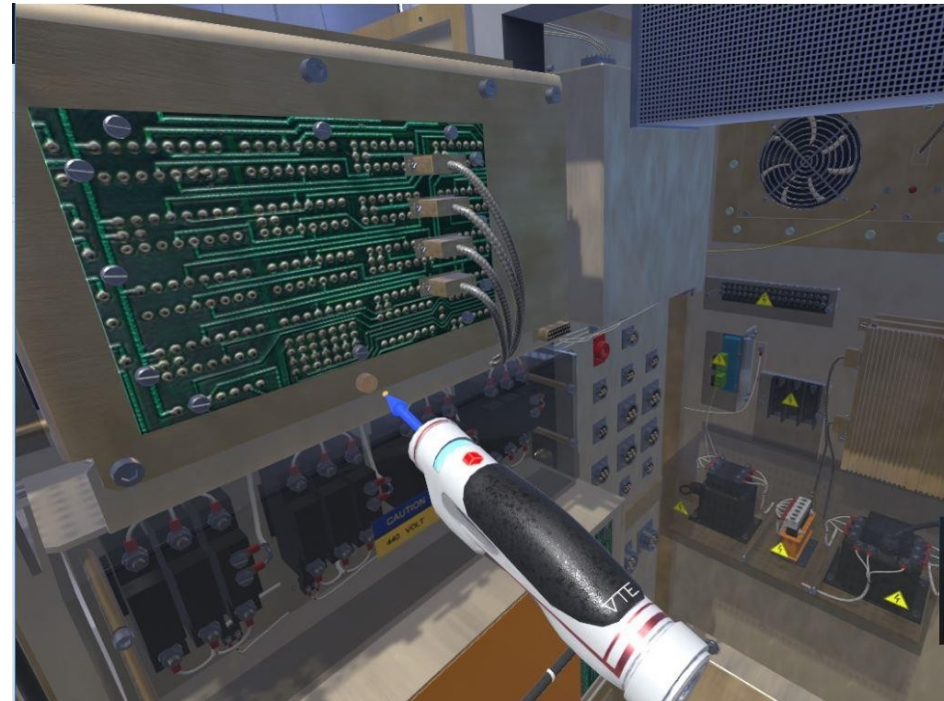
Interaction with a virtual asset using a tool

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Extended Reality: Virtual Training

Benefits

- **Real System unnecessary**: increase availability and reduce costs.

- **Gamification of Training**: Engage trainees using a fun, interactive and safe way of game-based learning.

- **Share virtual training experience** possibly from different locations, at the same time and in cooperation.

- **Reduce** significantly inconvenience associated to **transportation** (personnel and/or training assets): costs, time, pollution, health & safety protocols, etc.

- **Contain** commissioning and operating **costs** associated to Hands-On Training activities on real platforms.

- **Maximize safety** by preventing risks of injury to personnel or damage to assets.

- **"Unlimited" availability** on demand and on time, and reusable, of operational procedures (updated, integrated, paused, repeated).

- Enhance **memory retention** and **skills acquisition** thanks to full immersion.

Challenges

- **Certification/validation** of training activities operations.

- Only **as real as it can be** (touch, weight, feeling, environmental conditions, etc.).

- Possible issues with regards to **perception** and **cybersickness**.

- Extensive use **on cloud** to share models and environments to be exploited in immersive mode.
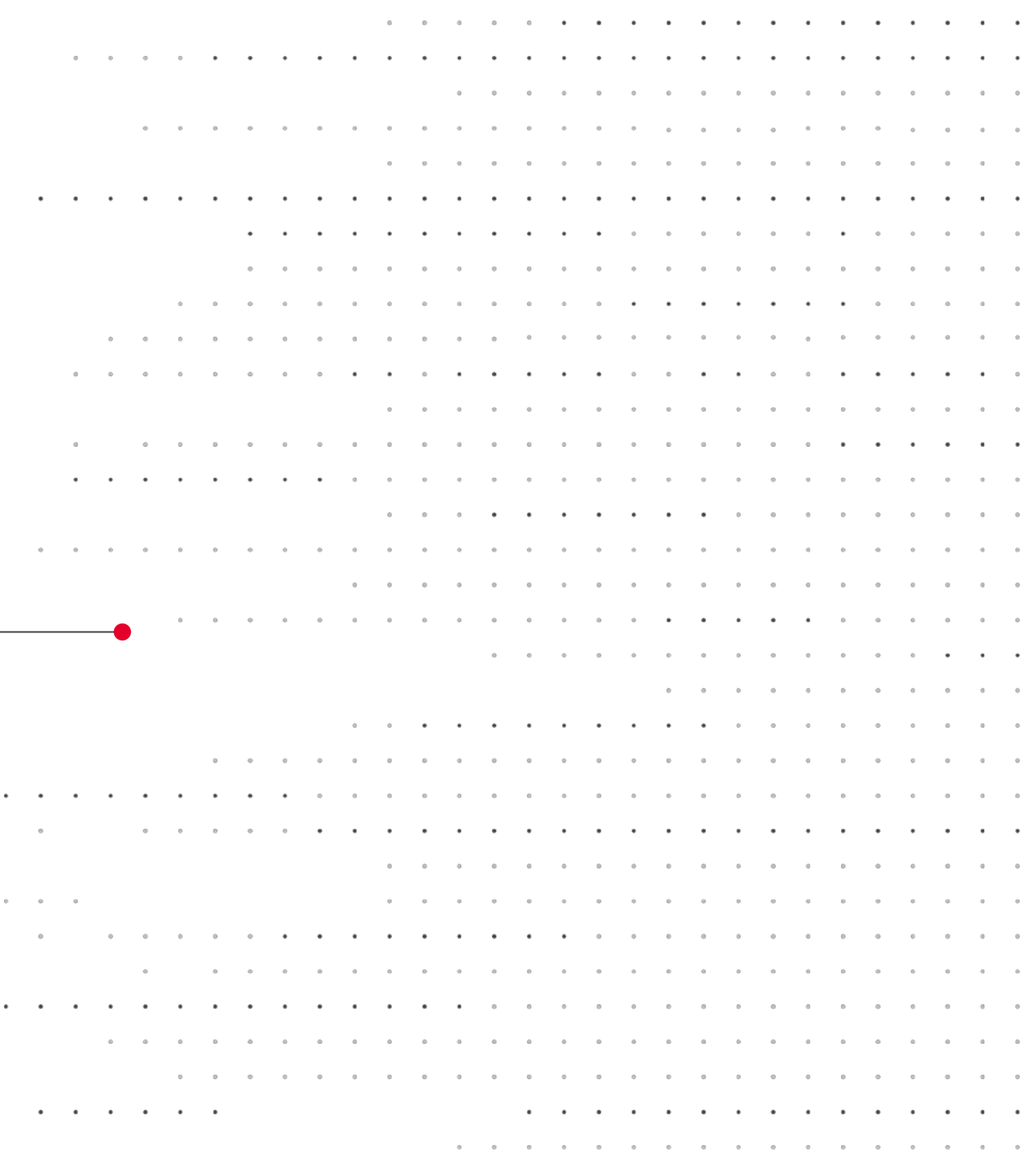
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Remote Support
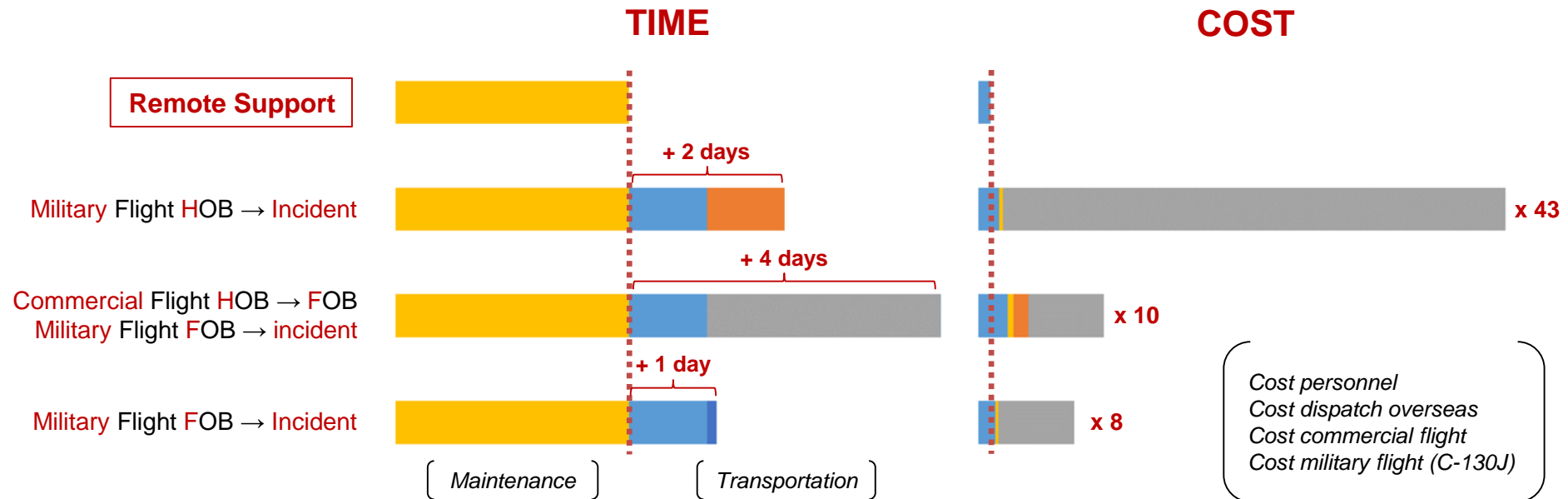
Collaborative Digital Platform

Remote Support: Collaborative Digital Platform

- A Customer Air Force faced a **critical incident** on a C-27J aircraft deployed **in operation abroad**. This real incident required the **urgent dispatch** of a dedicated **contact team of experts**.

- The **Collaborative Digital Platform** aims to accelerate the **"digital transformation"** of technical and logistical processes.

- One element is the **remote support application** which allows in particular to **connect remotely operators/technicians to experts** in order to accelerate workflows and decision-making processes by exploiting **live video communication**, **augmented reality** and **sharing of digital content**.

- **Different scenarios** have been simulated and compared to the use of remote support.

Operator wearing HMD and connected to experts for support

TIME

COST

Remote Support

Military Flight HOB → Incident — **+ 2 days** — **x 43**

Commercial Flight HOB → FOB / Military Flight FOB → incident — **+ 4 days** — **x 10**

Military Flight FOB → Incident — **+ 1 day** — **x 8**

Maintenance — Transportation

Cost personnel
Cost dispatch overseas
Cost commercial flight
Cost military flight (C-130J)

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Remote Support: Collaborative Digital Platform

Benefits

- Significant **reduction of time** and **cost** associated to:
  - Initiating the unscheduled maintenance activity;
  - Exchanging information;
  - Dispatch of a contact team of experts.

- Significantly enhancement of the **availability of support** (Logistics and Expertise).

- Enhanced **capabilities of support** activities.

- **Monitoring** and **record** of maintenance activities.

Challenges

- Availability and consistency of **safe and secured connection**.

- Availability of **spare parts**, **tools** and **maintenance equipment** on the field.

- **Certification/validation** of maintenance operations.

- Solution not applicable to all possible events.

Digitalization, Cloud, Extended Reality and Connectivity for Remote Training and Support

CONCLUSION

- A selection of mature solutions leveraging on **emerging technologies** to enable MSaaS, Extended Reality and Remote Connectivity to support **innovative approaches to Training and Support** was presented.

- Traditionally, training and support activities present challenges not only in terms of **logistics (costs, time** and **availability)** but also with regards to **efficiency**, **workload** and **safety**. **Transportation of personnel and materials** has often been needed. Capabilities have been limited to ensure the **safety of people** (both mental and physical) and the **security of assets**.

- The use of **digital resources**, **simulations** and **platform technologies** significantly disrupts – enhances – capabilities for training and support.

- For **training**, it enables access to products and services **on-demand**, **at all time** and **as many times** as needed. Furthermore, it allows training for **emergency and dangerous situations** without any risk of harm to either the trainee or the asset.

- For **support**, it significantly reduces **time** and **costs** related to **urgent interventions** as well as enabling interventions integrated with potentially **unlimited digital resources**.

- However, accessing these "connected" capabilities necessitates careful considerations on **connectivity**, **security**, **standards** and **certification**.

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THANK **YOU**
FOR YOUR ATTENTION