LEONARDO ELECTRONICS

MODELLING & SIMULATION CAPABILITIES

LEONARDO

Leonardo leverages extensive expertise to deliver advanced modelling and simulation capabilities that serve as key enablers for the development, integration, and validation of Force systems across multiple operational domains.

These multi-domain simulation technologies support not only training and operational readiness, but also system testing, integration, and the development and assessment of new operational concepts.
By minimising risk, reducing costs, and enhancing the safety, efficiency, and effectiveness of national Forces platforms—whether in reconnaissance, support, or combat scenarios—these technologies help optimise in-service performance and improve human–machine interaction.
The adoption of these solutions, implemented through the software suites described below, ensures full control over the Modelling and Simulation pipeline, fully tailored to specific mission and customer requirements.

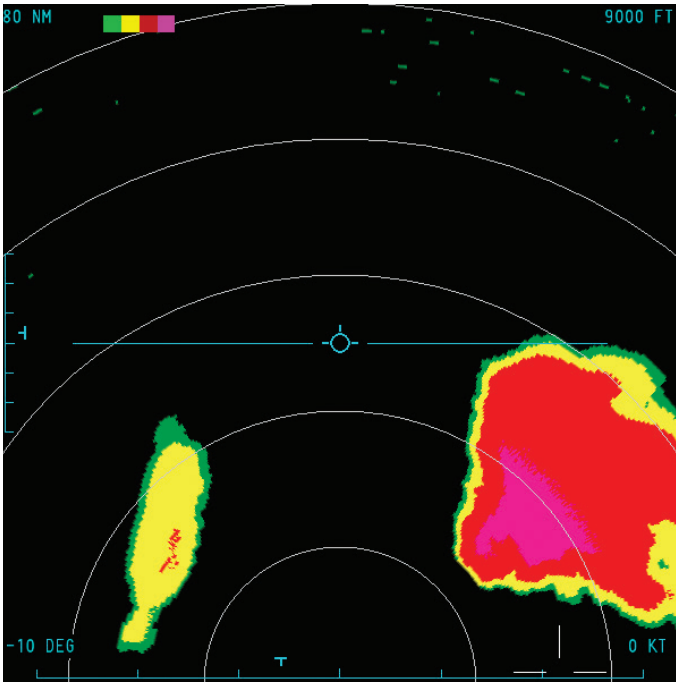
MODULAR SOFTWARE PACKAGES COMPONENTS

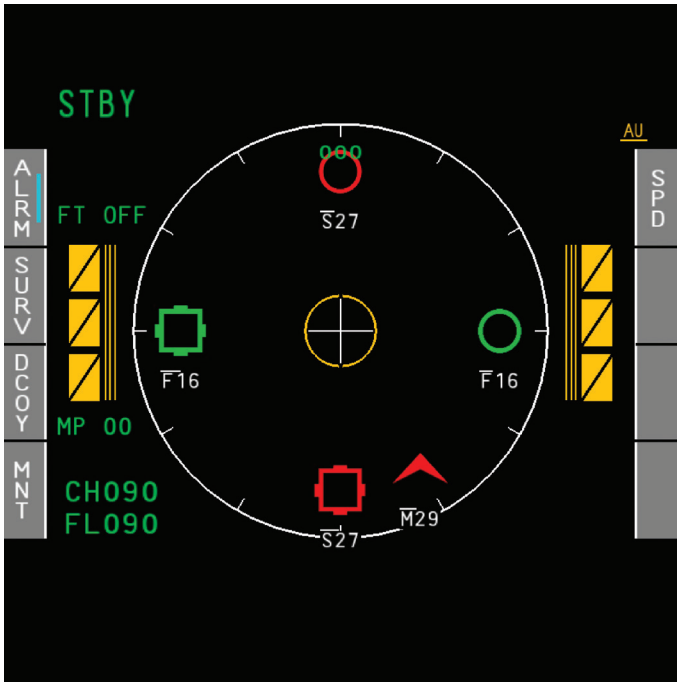
- → **MARS** is a comprehensive simulation Sensor Suite that delivers immersive, real-time RF/EW/EO/Acoustic modelling and simulation capabilities for multi-domain operational environments.
- → **RIACE** is a proprietary synthetic environment solution designed to deliver an optimal multi-domain, distributed battle environment at individual, team, and collective level for CONOPS development and training, as well as Combat Ready and Operational Conversion Units (OCU) Training.
- → **VIR3X** is a proprietary image generator, fully developed in-house from the ground up, ensuring complete independence from Commercial Off-The-Shelf (COTS) engines.
- → **OCEAN** is a self-service automated platform, based on virtualisation and cloud technologies, for the creation and no-code modelling of complex infrastructures composed of virtual and physical machines, supporting the MSaaS paradigm.

MARS

MODELLING & SIMULATION SENSORS SUITE

MARS Sensors Suite implements immersive and real-time RF/EW/EO/Acoustic simulation capabilities that provide Armed Forces unrivalled battlefield advantages in electronic surveillance, protection, and attack. These capabilities are applied to platforms where Leonardo integrates real sensors, re-hosted source code, mission data, or hardware-in-the-loop solutions - all interfaced with the MARS Sensors Suite models.





MAIN FEATURES

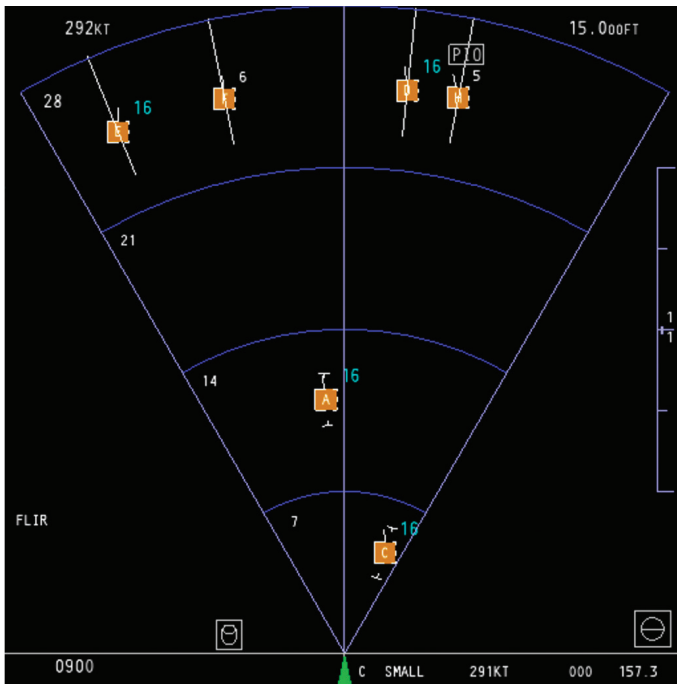
→ **RADAR:** The system simulates high-resolution Radar in complex operational modes, such as SAR and DBS, reproducing the base-band IQ signals of the received echoes and the FFT processing. MARS-RADAR integrates physical and mathematical models that emulate real radar devices and the interaction between radar electromagnetic waves and the external environment

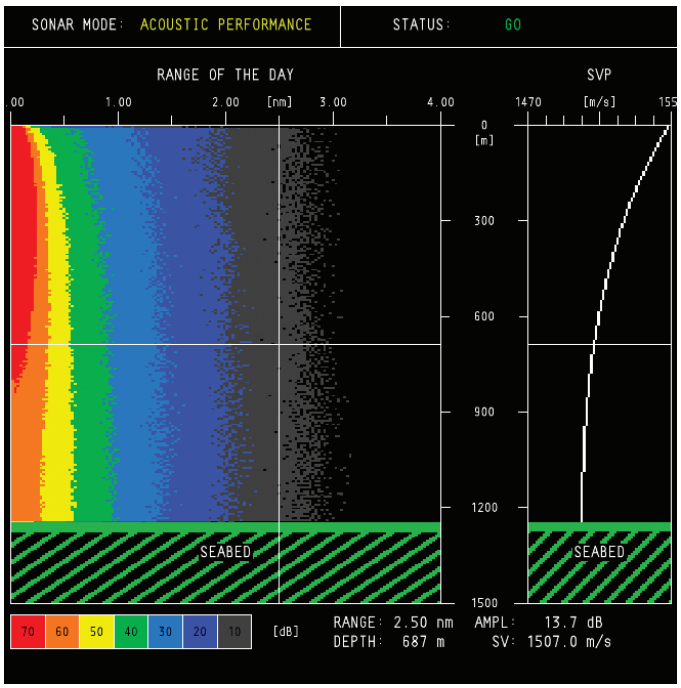
→ **EW:** MARS-EW provides an advanced solution for reproducing high-fidelity, real-time Electronic Warfare systems across multiple simulation environments. Real-world algorithms and code are re-hosted to ensure authentic performance and behaviour in detection and countermeasure actions

→ **OPTRONICS:** MARS-EO leverages physical models of real devices to support multidisciplinary optronic systems in complex scenarios. These include FLIR Systems for navigation, Surveillance Turrets (PODs) for observation and reconnaissance, Targeting Turrets for target designation, and IRST Systems for threat detection and real-time acquisition.

The suite implements advanced algorithms for target detection, tracking and recognition based on simulated data. Simulated systems can operate in both air-to-surface and air-to-air modes

→ **SONAR:** MARS-SONICS enables underwater detection, localisation, tracking, and classification of potential maritime threats. The system integrates both active and passive acoustic interfaces through the simulation of Dipping Sonar Subsystem (DSS) and Sonobuoys Subsystem (SBS)





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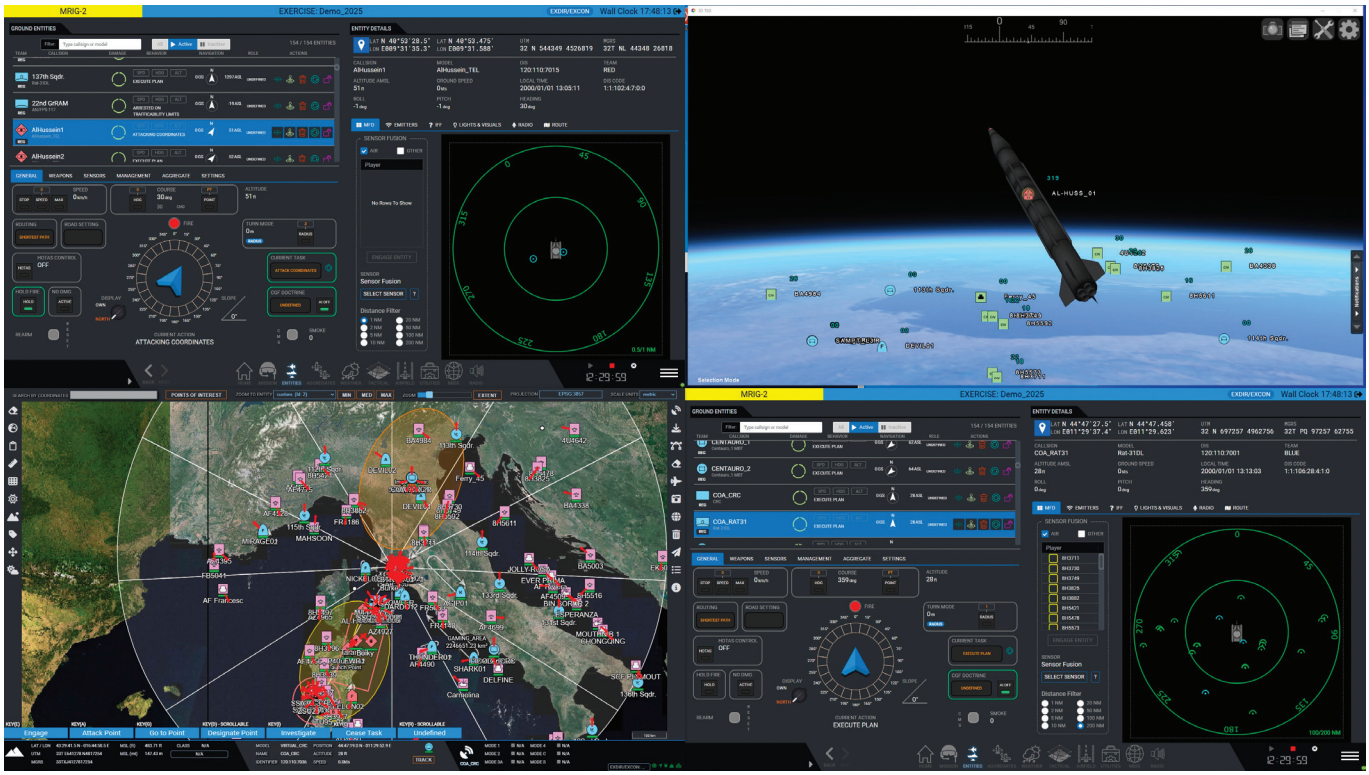
RIACE

REALISTIC INTELLIGENT AGENT FOR COMPUTER ENVIRONMENTS

RIACE is an integrated system of systems for Distributed Simulation, providing an immersive, high-fidelity experience designed to meet a wide range of training, testing, and experimentation needs.
It serves as the core system of several distributed simulation initiatives within the Italian Armed Forces, and has also been employed in SPARTAN WARRIOR and SPARTAN ALLIANCE Exercises within the NATO distributed simulation Community.

MAIN FEATURES

- → RIACE Distributed Mission Training (DMT) System (including the RIACE Synthetic Environment)
- → RIACE Mission Trainer (MT) System
- → RIACE Ownship Related Module (ORM) Sub-System



DISTRIBUTED MISSION TRAINING SYSTEM

The Distributed Mission Training (DMT) is a turnkey solution that enables users to conduct immediate tactical and C2-level training through the distributed simulation of complex, multi-domain military operations. The RIACE DMT System includes one or more RIACE Synthetic Environment servers, enabling:

→ Preparation of worldwide scenarios and planning of complex, multi-domain, large-scale excercises, as well as simple training vignettes.

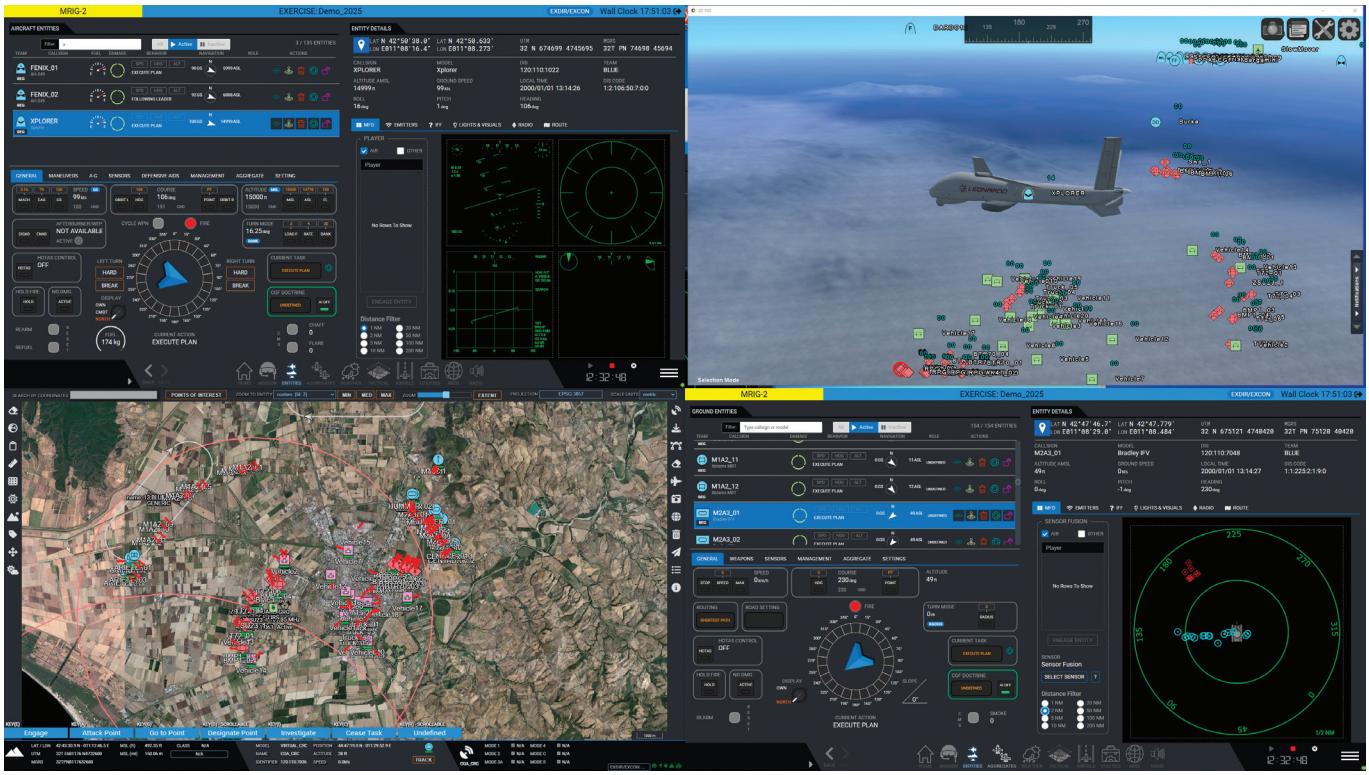
→ Real-time simulation of planned scenarios and exercises in a networked environment.
RIACE Synthetic Environment enables simultaneous, interactive, real-time simulation of Air, Land, Surface, Sub-surface, and Space operations (including Tactical Ballistic Missile Defence - TBMD). RIACE Human Machine Interface (HMI), as a component of DTM, provides a single control station (one module) for managing an entire simulation session, covering both the Synthetic Environment and the networked Mission Trainers.

MISSION TRAINER SYSTEM

RIACE Mission Trainer is an operational desktop training solution customised to simulate specific RIACE High-Fidelity assets, offering a higher level of user interaction. Its primary application is the RIACE Typhoon Mission Trainer (TMT) specifically designed for mission-oriented training. The simulator complements the higher-level EF2000 Full Mission Simulator, and also provides the capability to simulate High Fidelity manned opponents (e.g. MiG-29, SU-27) for realistic force-on-force training.

OWNSHIP RELATED MODULES

To ensure seamless integration with legacy or custom simulation systems, RIACE includes Ownship Related Modules (ORMs). These application-specific modules provide the interfaced simulation system with extensive data support packages and functional tools to ensure compatibility and interoperability.



VIR3X

HIGH-PERFORMANCE MULTI-DOMAIN IMAGE GENERATOR

VIR3X (Virtual Immersive Reality 3D eXperience) guarantees independence, flexibility, and technical robustness, through a rendering engine designed to meet the most demanding simulation requirements - today and in the future.
Whether used for immersive virtual environments, sensor emulation, or tactical visualisations, VIR3X ensures exceptional realism, scalability, and adaptability across all domains. The system automatically enhances image quality, even in scenarios where high-fidelity features are unavailable, unnecessary, or where time constraints prevent the development of ultra-detailed models. It dynamically adjusts scene detail levels according to the field of view (FOV) and application requirements, rendering static objects, textures, vegetation, and geographical features in real-time. The rendering engine, optimised for both flexibility and performance, leverages advanced ray tracing techniques on multi-GPU workstations.

MAIN FEATURES

Enhanced Ambient and Weather Effects

- → **Volumetric Clouds:** Simulates multi-layered cloud formations with customisable parameters - from simple coverage indices to detailed density profiles
- → **Dynamic Ambient Lighting:** Accurately renders light transitions based on sun, moon, and star positions, synchronised with geographic and temporal data
- → **Atmospheric Realism:** Integrates optical path effects for fog and visibility, delivering unparalleled natural colour and high visual fidelity

NATURAL SHADOWS AND SELF-SHADOWING

Real-time computation of complex, physically accurate shadows for all static and dynamic objects, including advanced ambient occlusion calculations.

ADVANCED LIGHT EFFECTS

Supports highly realistic rendering of glows, volumetric light cones, motion blur, water reflections, and dynamic shadow volumes, adapting seamlessly to environmental conditions such as humidity.

CUSTOM PARTICLE SYSTEM

A dedicated particle animation engine reproduces real-world phenomena with precision, including heat distortion, muzzle flashes, torpedo launches, splash effects, missile trails, explosions, fire, smoke and more.

CORRELATED SENSOR SIMULATION

Simultaneous, physically accurate rendering for multiple sensor types, including:

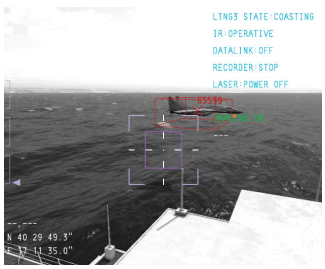
- → Electro-Optic (EO) cameras (visible spectrum)
- → Infrared (IR) cameras: Near-, Short-, Medium-, Long-, and Far-Wave IR (0.75 μm to 1000 μm)
- → Night Vision Goggles (NVG) compatibility

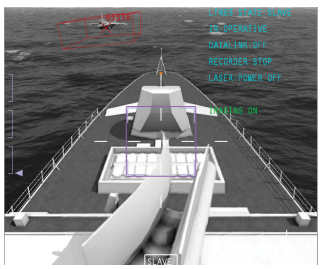
MULTICHANNEL SCALABILITY

Engineered for full scalability, VIR3X supports configurations ranging from single-sensor channels to fully synchronised, multi-channel mission simulators.
The proprietary rendering engine exploits state-of-the-art hardware to deliver optimal performance and visual fidelity.

SEAMLESS INTEGRATION AND DEPLOYMENT

Already fully integrated within the RIACE Synthetic Environment and the MARS Sensor Suite, VIR3X ensures perfect interoperability. It can also be adapted to third-party systems, whether developed by Leonardo or other partners.





OCEAN

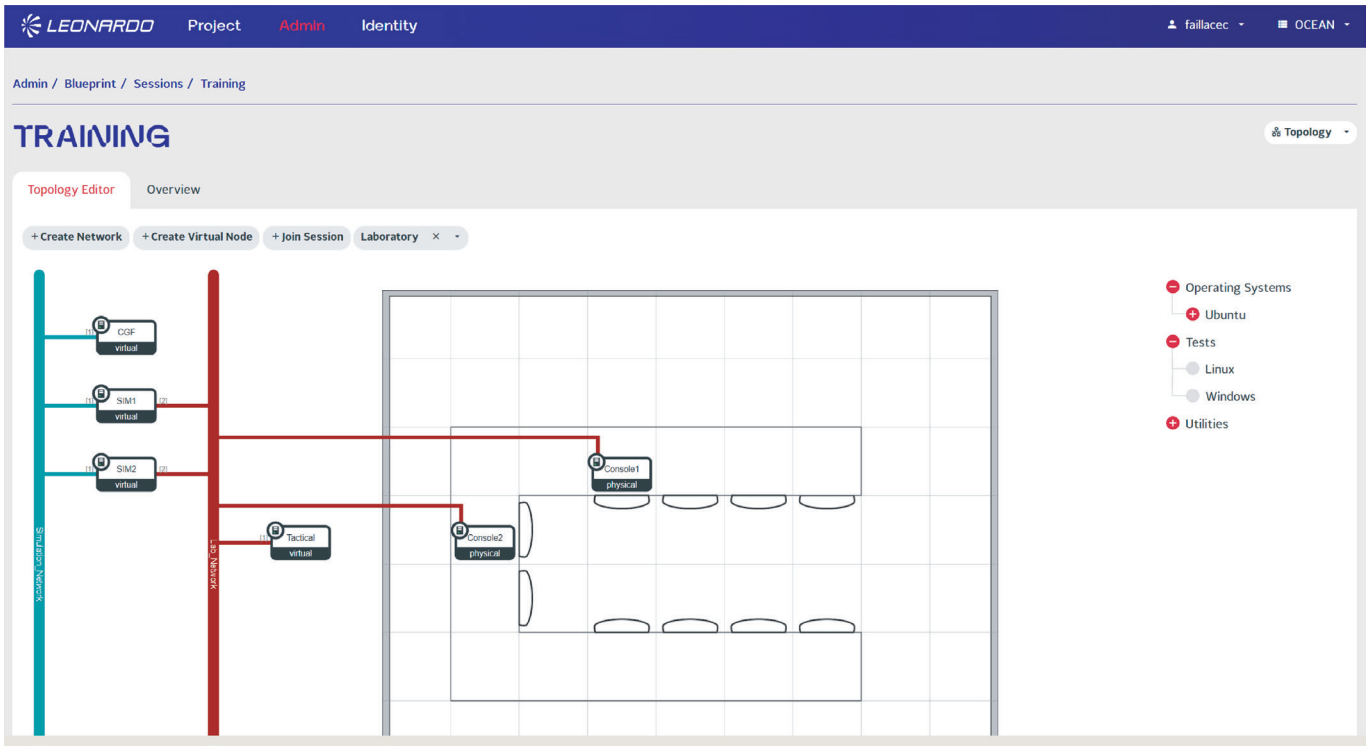
SELF-SERVICE AUTOMATED INFRASTRUCTURES GENERATOR PLATFORM

OCEAN was developed to transform traditional static hardware architectures - often characterised by inefficient resource usage and costly manual set-ups into a new generation of cloud-based infrastructure generation approach. With OCEAN, configuring network devices, workstations, and software is no longer required: all operations are managed graphically through an intuitive drag-and-drop interface , optimising hardware utilisation and ensuring continuous 24/7 service availability.
This approach makes advanced configurations accessible even to non-expert users.
OCEAN's versatility enables the rapid and repeatable creation of collaborative private environments, allowing users - wherever they are - to securely share resources, software, and applications. This makes it an ideal solution for a wide range of workgroups and operational contexts.
OCEAN also supports the MSaaS (Modelling&Simulation as a Service) paradigm, the architecture for providing simulation services promoted by NATO Modelling&Simulation Group.

KEY BENEFITS

- → Full Availability and Automation: OCEAN provides 24/7 access to environments through a cloud computing-based architecture, delivering a new, permanently available, flexible and location-independent solution. Users can access environments from anywhere - labs, classrooms, etc.- and from any device, including PCs, laptops, tablets, smartphones, etc
- → Increased Capacity through Resource Sharing and Reuse: Once a service is added to the catalogue, it can be distributed and accessed by multiple users, maximising resource utilisation and generating cost savings
- → Rapid Adaptation to Changing Needs: OCEAN's flexibility allows users to easily modify environment configurations. The same environment can be duplicated and adjusted to create multiple configurations quickly, supporting evolving operational or training requirements
- → Easy Automation and Repeatability. OCEAN enables multiple environments to run simultaneously and be repeated countless times with a single click, ensuring consistency and efficiency

Reduction of Complexity and Errors: OCEAN minimises typical challenges associated with configuring complex systems (installation, set-up, maintenance) while significantly reducing the risk of human error.
Its intuitive, user-friendly interface guides operators step by step, and role-based access control ensures users access only the functions relevant to their permissions.



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