ELETTRONICA
MIND IS THE FIRST DEFENCE

A distributed joint mission simulator for validation and training

Claudio S. Malavenda, Ph.D., MBA
TP Manager – Elettronica Group

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A few words on the speaker

- BSc, MSc Electronic Eng.mcl; PhD in innovative WSN for battlefield. MBA 2008.

- He worked in STMicroelectronics, Bombardier, ElsagDatamat and Selex ES (actual Leonardo). His works activity deals with project and program management especially for first series articles. He worked in several FP6/FP7 projects and in the Italian FNEC programs: product lifecycle management, first series products, C4I systems for fire control and EW. Authored several publication on WSN and secure C&C systems for joint operations.

- In 2015, he joins Elettronica group to enlarge the company's product portfolio with C&C systems. After a period as NH90 Program and Area manager, he is currently in the Capability Marketing & Scientific Board group as corporate Product Portfolio Manager and Bid Manager.

Agenda

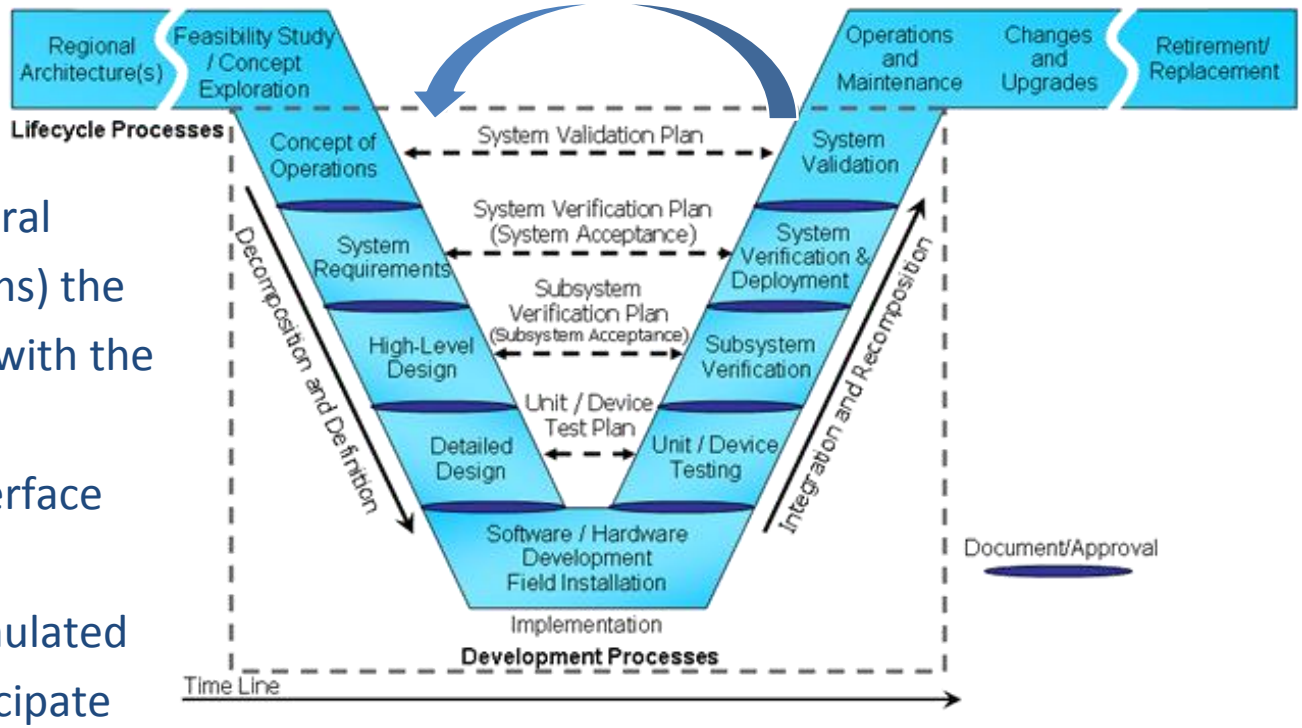
- Need
- Key Issues
- Solution overview
- Key Technology
- Configuration Examples

High Value Feedback Collection in a System development-

- High Value Feedback often happens at the end of the development

- Delivering complex system with several human in the loop (System of Systems) the main validation procedures is faced with the SoS interface that is a often a Command and Control Software interface

- We can use same interfaces with simulated platforms instead of real one to anticipate valuable feedback in earlier phases of the product development



Product Lifecycle – Phases Change

FROM

Phases: Offer → Design → Industrialization → Validation → Series Production

In charge to: Sales → Project Management → Manufacturing

TO

Introduce Valuable feedback from end customer at earlier stages of the project

Phases: Offer → Concept → Wargaming → Design → On Field Test → Industrialization → Validation → Series Production

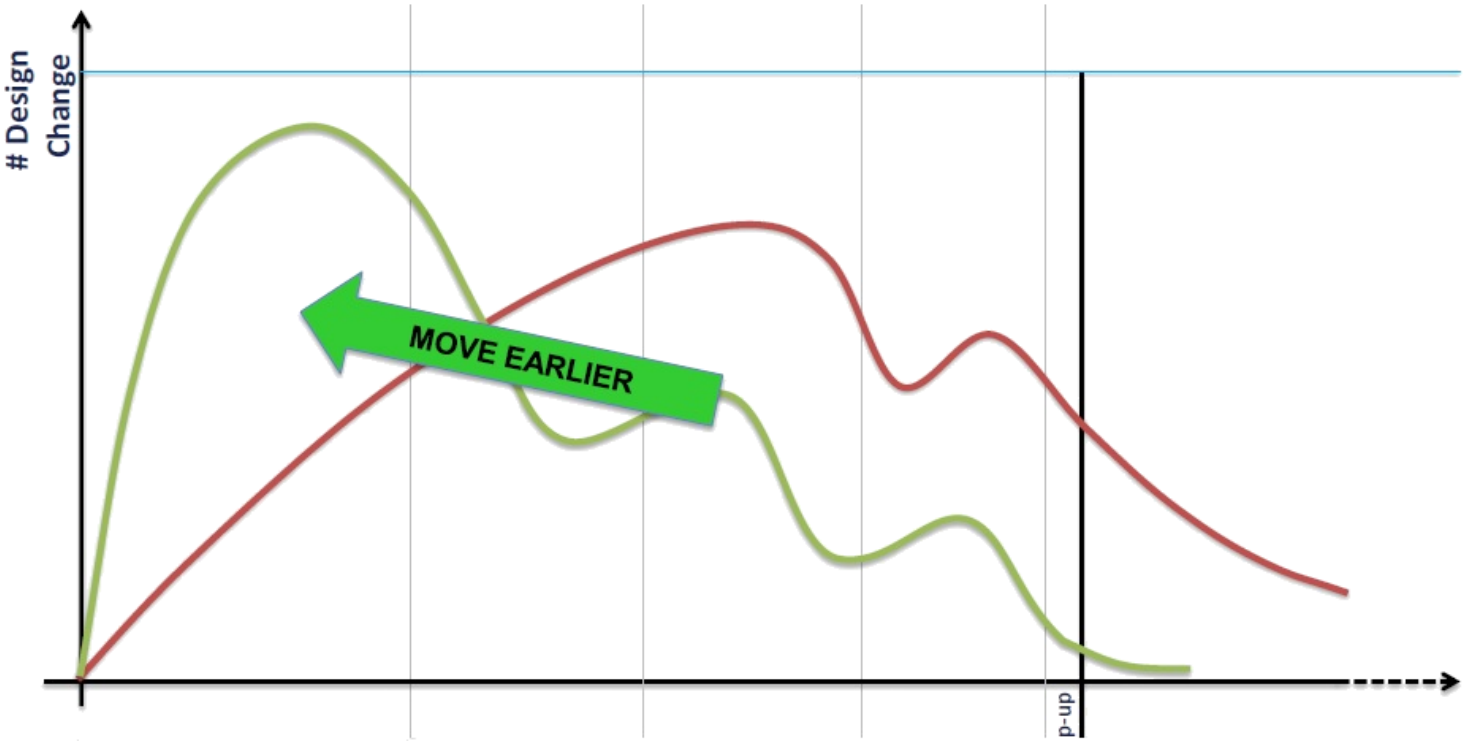
In charge to: Sales → Project Management → Manufacturing

Product Lifecycle – Front Loading

Need

Front Loading: plan so that a large portion of activity occurs in an early period

The sooner valuable feedbacks are available the sooner ECNs (Engineering Change Notice) are identified and lower will be their impact and cost



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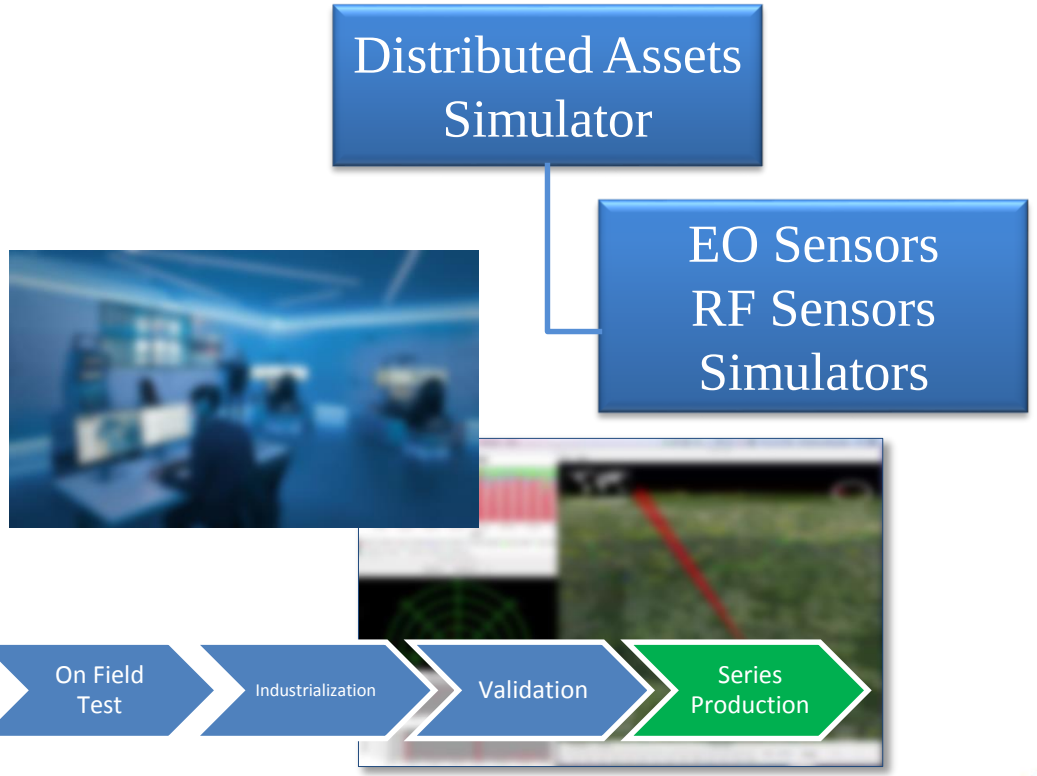
Product Lifecycle – Key Issues 1/3

Key Issue

How To Increase Front Loading in the delivery of a Electronic Warfare system

Integration with a **distributed** simulator with the real systems' HMI in the loop enhance the capability to have early **feedback** from end customer concerning the Operative Concepts and System performance and offer a integrated digital playground for V&V teams.



Product Lifecycle – Key Issues 2/3

Key Issue

How To Increase Front Loading in the delivery of a Electronic Warfare system

-**Create** a real RF/EO scenario in a designed area using a common configurable solution. Allows complex scenario validation in a real generated RF area.

-Tracking Capability

-EM reconstruction capability

RF Area Probes

RF /EO Stimulator

Situational Awareness & Tracking

EO Sensors RF Sensors

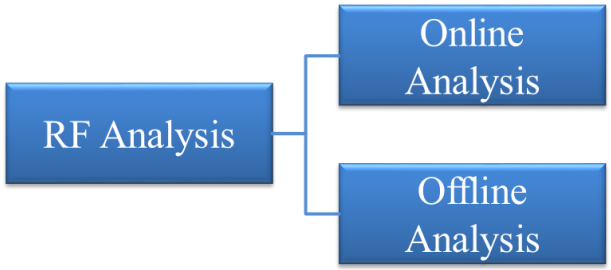
Offer | Concept | Wargaming | Design | On Field Test | Industrialization | Validation | Series Production

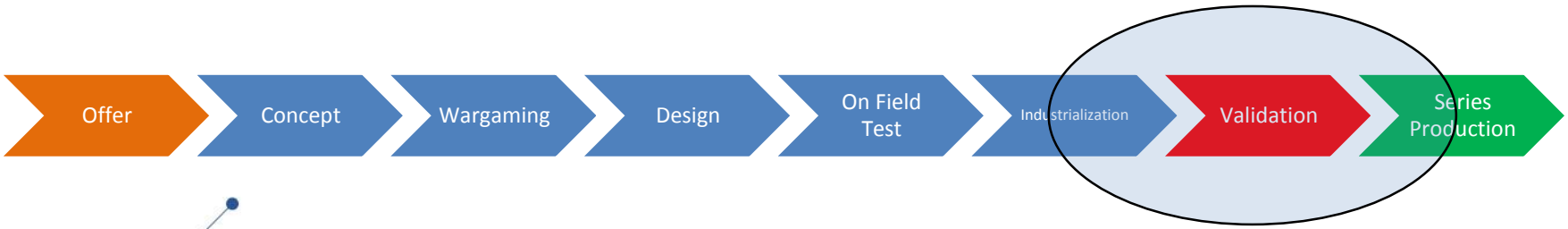
Product Lifecycle – Key Issues 3/3

Key Issue

How To Increase Front Loading in the delivery of a Electronic Warfare system

-**Analysis** and comparison of reconstructed RF scenario with simulated one





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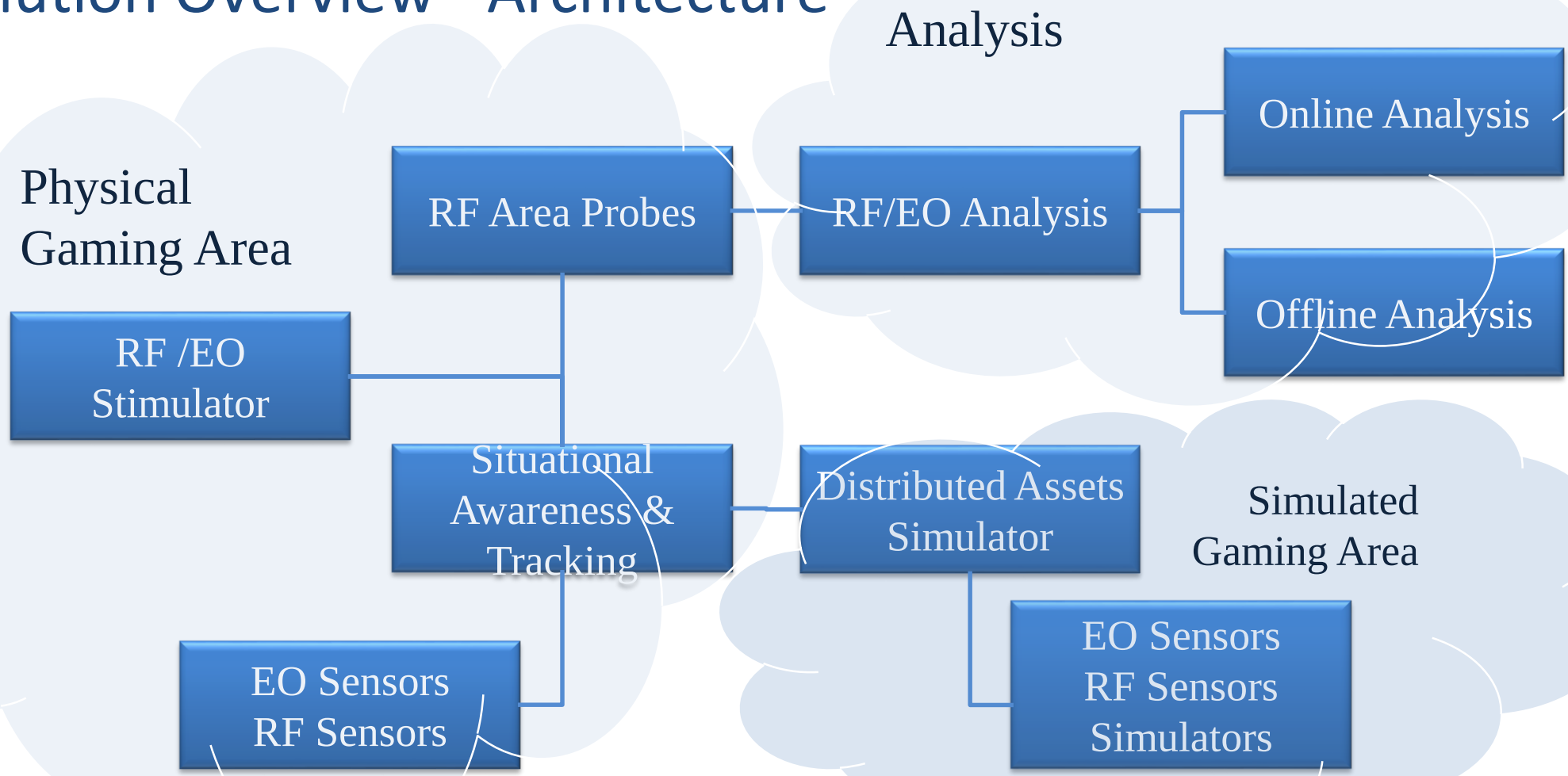
Solution Overview - Architecture



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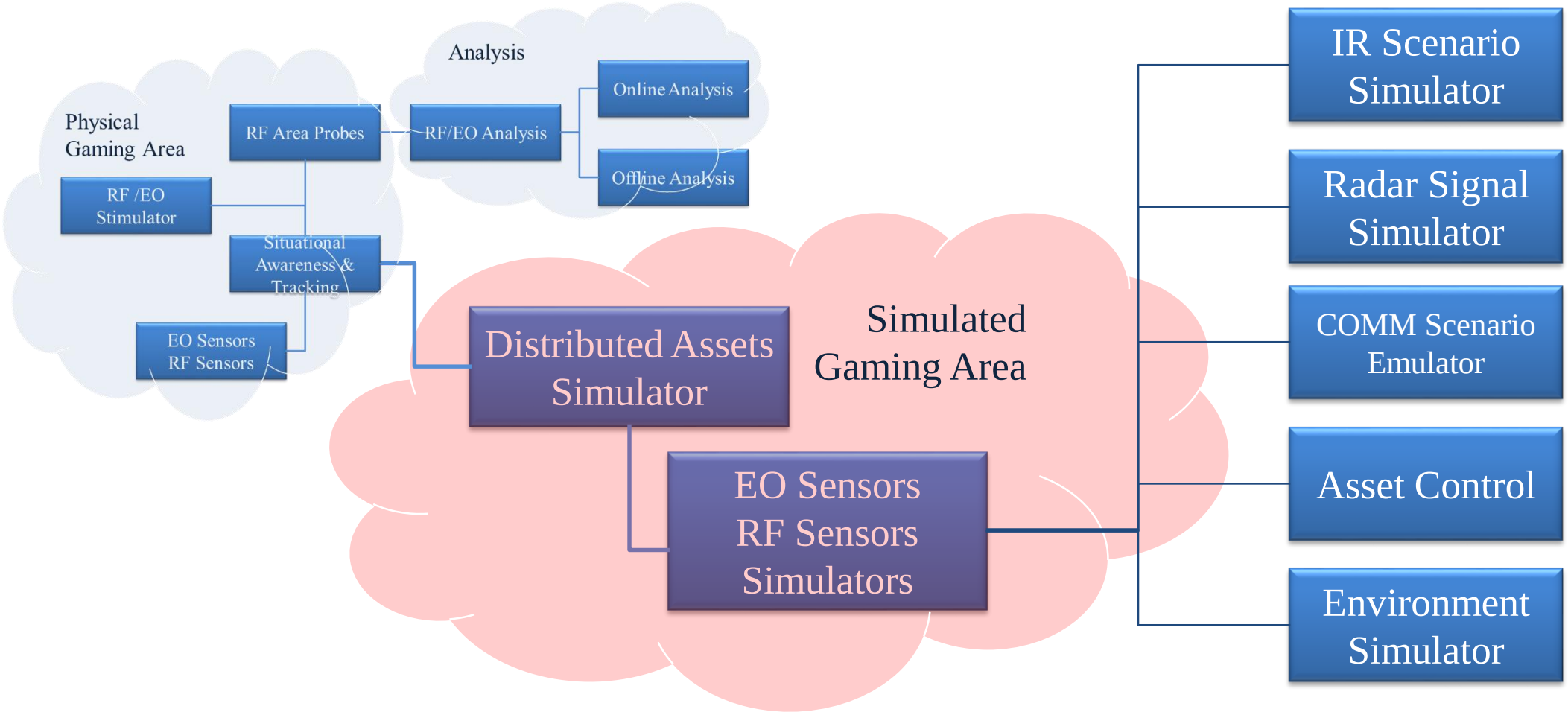
Distributed SIMULATION

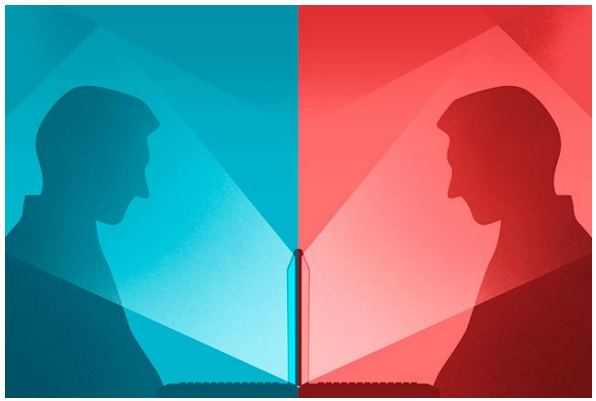


Enabled Simulation

Key Tech

Simulation is the key enabler for

- Effective preparation of a mission
- Preparation of realistic tests



Multi level simulation allow

-a level with behavioral modelling of actors (platforms, sensors, countermeasures, humans)

-a deep and emulation level for specific platforms creating the corresponding signals received or seen by the “observer”

Blue Team and Red Team can play the same ‘game’

- Electronic Attack
- Electronic Protection
- Electronic Support

- Set the *observer* according to your current mission
- Enlarge your simulation capability easily with new models (behavior & signature) as your tactical capability grows

Enabled Platform-Simulation

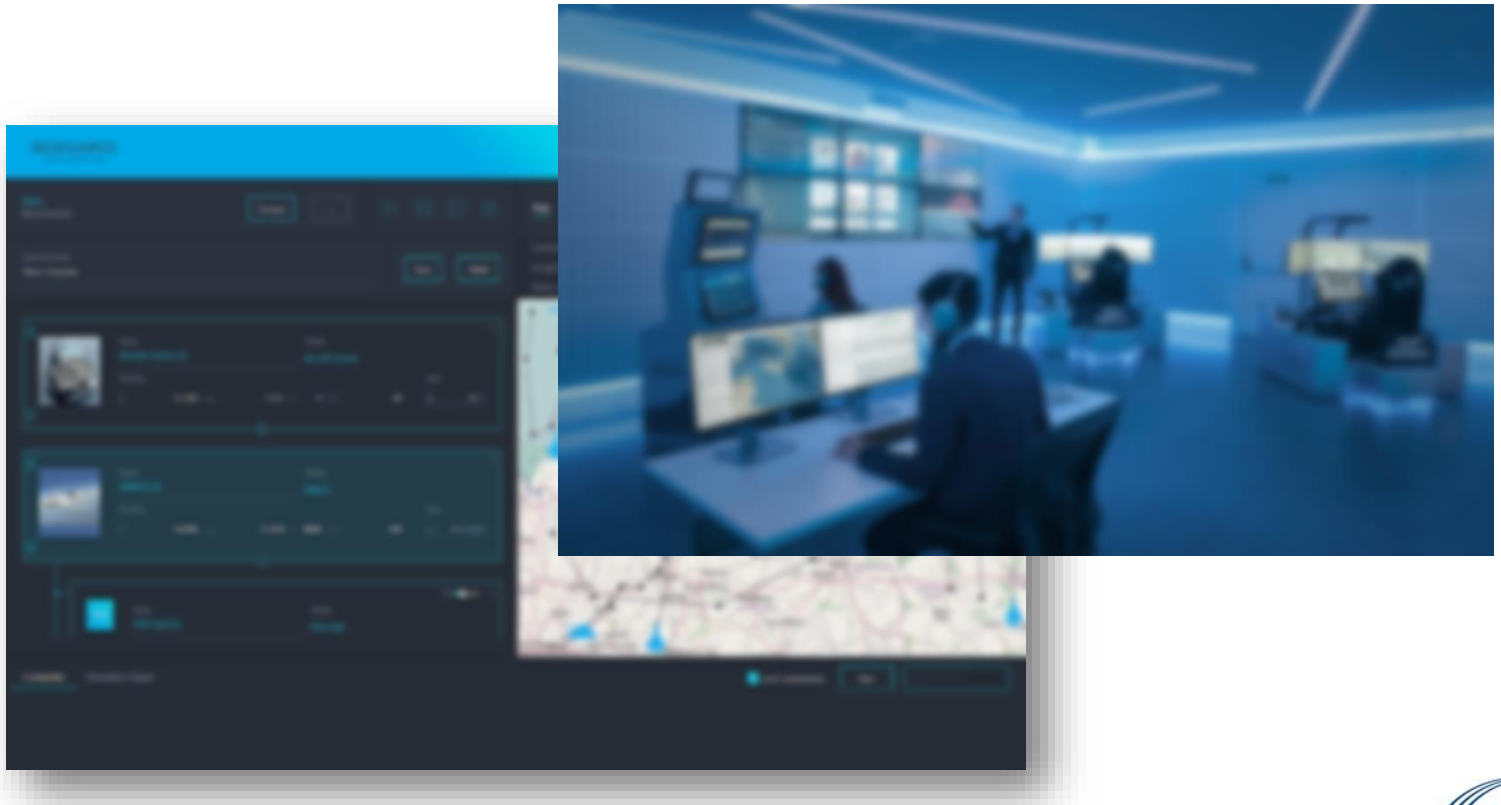
Key Tech

Simulating

- Aircraft & Heli
- UAV
- Missile
- Ships
- Ground Vehicles

Including

- Trajectory
- Kinematics
- Attitude
- Antennae Position
- 3D-Models

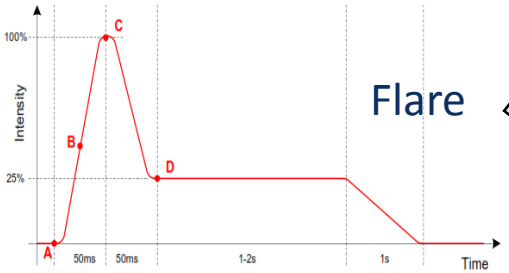


Enabled Infrared-Simulation

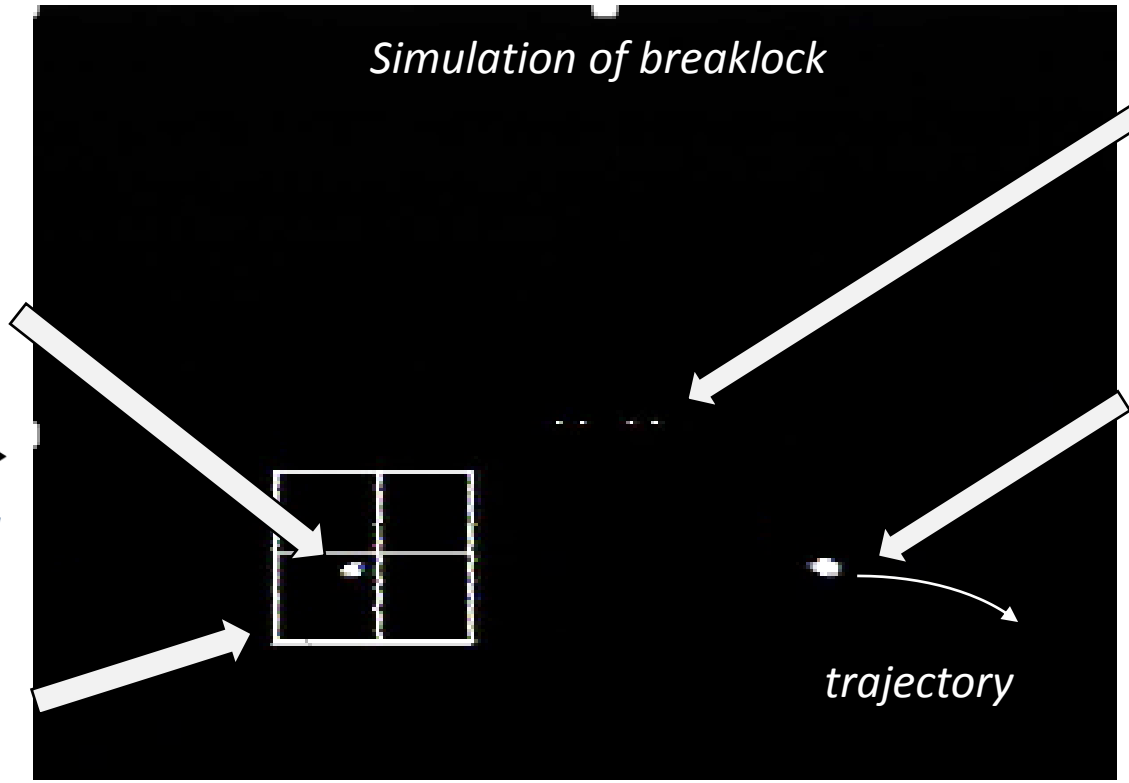
Key Tech

Simulating

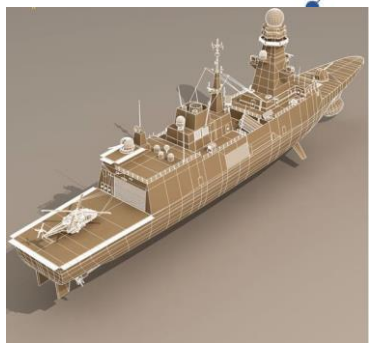
- Infrared signature and radiant intensity of the platform
- Flares
- DIRCM



Flare Time profile [mW/cm2]



Enabled E.M. Simulation 1/2



Key Tech

Simulating

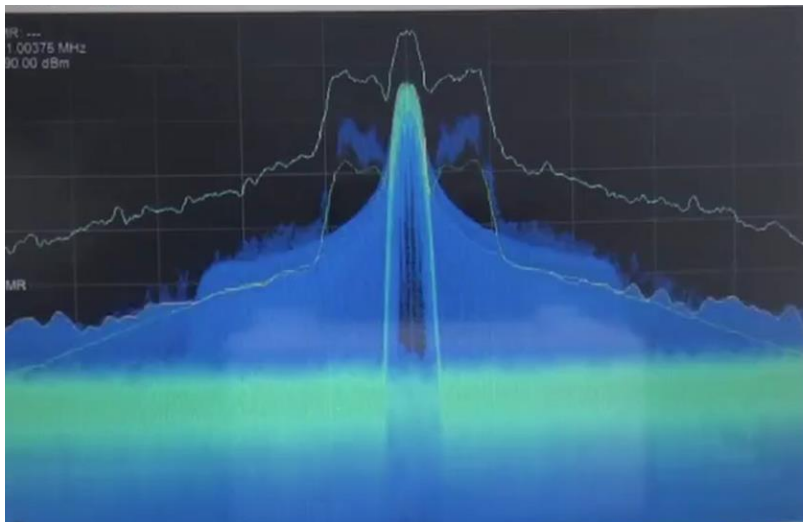
- E.M. signature of the platform (RCS)
- Land based radars
  - long range search, fire control, Battlefield surveillance, Battlefield early warning, Mortar detection, Surface to air missile system surveillance, Surface to air missile system target tracking, Surface to air missile system target missile guidance
- Naval based radars
  - Long range search, Short range defence, Collision avoidance and weather, Navigation, Surface to air missile system surveillance, Surface to air missile system target tracking, Surface to air missile system target missile guidance
- Airborne radars
  - Air to Ground Surveillance, imaging radars (SAR/ISAR), HRR, Air to Air Surveillance, Radar Seekers (active, semi-active)
- RWR/ESM/ELINT
  - Wide open, Digital receiver, rotating antennae, fixed antennae

Enabled E.M. Simulation 2/2

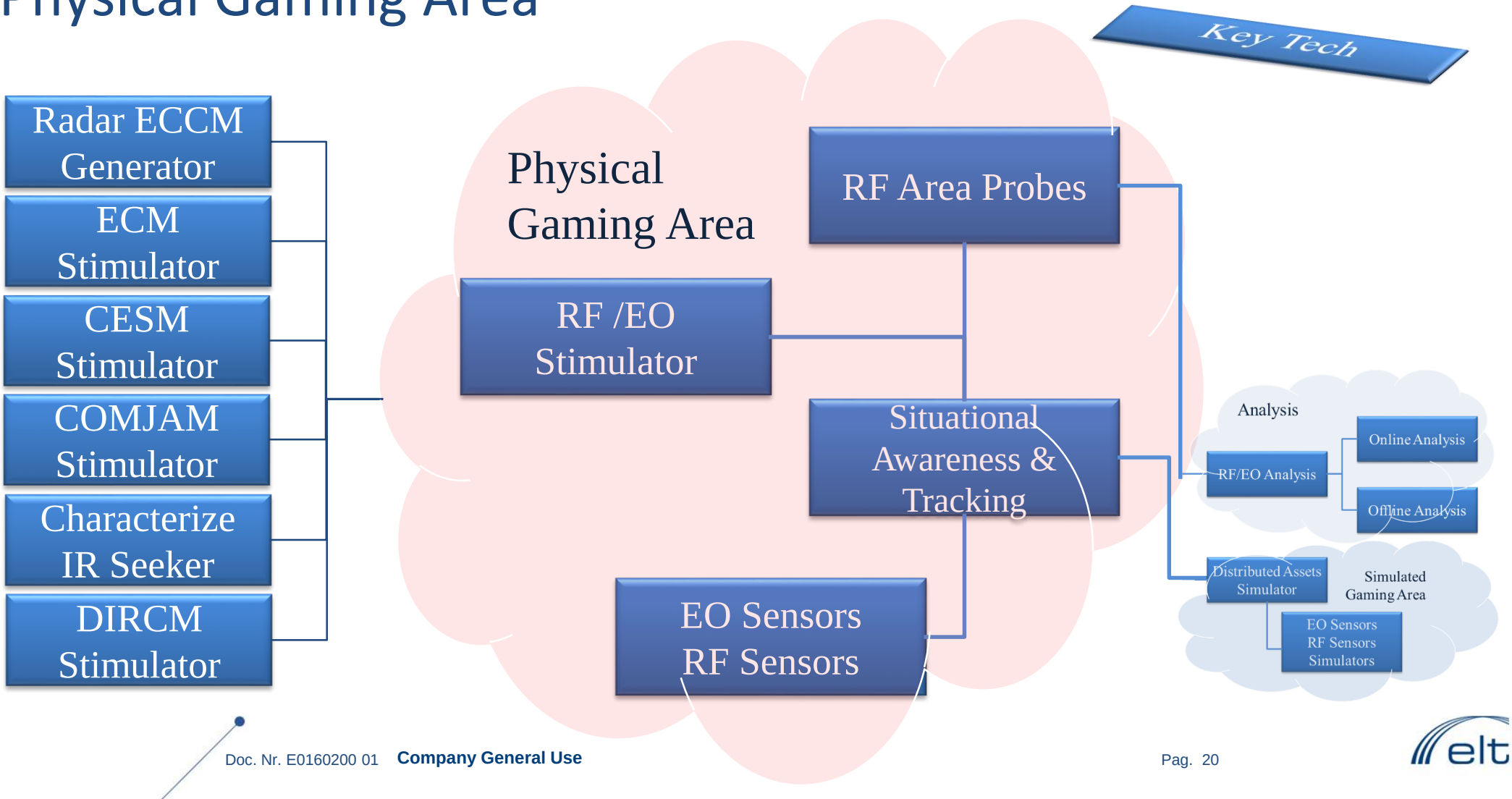
Key Tech

Simulating

- CESM/ COMINT
  - Frequency Switching/Scanning, Direction Finding, etc.
- EO/IR
- R-ECM
  - Continuous Noise (Spot and Barrage), Synthetic CW, Fast Set-on Spot Noise, Swept Spot Noise, Range Gate Pull Off / In (RGPO/I), Coordinated and Non-coordinated R/VGPO/I, Multiple False Range Targets, Independent False Range/Doppler Targets, Dependent False Range/Doppler Targets, Multiple False Doppler Target, Range/Velocity Bin Masking, Velocity Noise, Cover Pulse, Keeper Pulses, etc.
- DIRCM
- C-ECM
  - Reactive, Spot-on, Barrage Noise, Follower, etc..



Physical Gaming Area



Reconstructing The EM Scenario

Key Tech

The simulated EM environment can be used to transmit RF/EO towards a tracked platform.

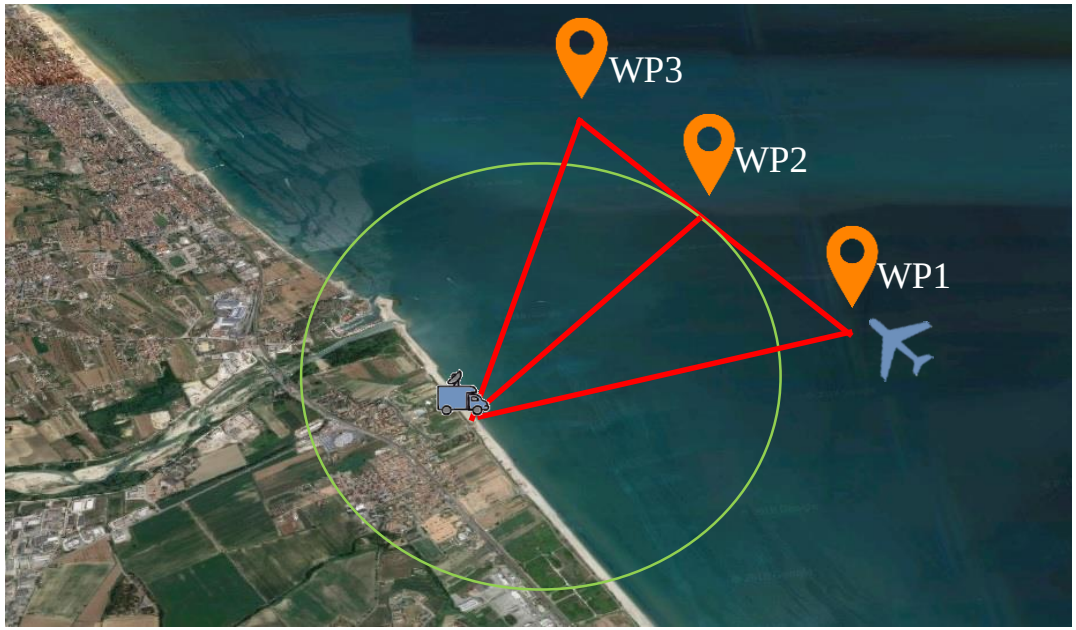
This creates a real EM environment around the platform reconstructed according to the simulated scenario. Several trackers and RF emitters can be installed in different sites or used to reconstruct different scenarios for different tracked platforms

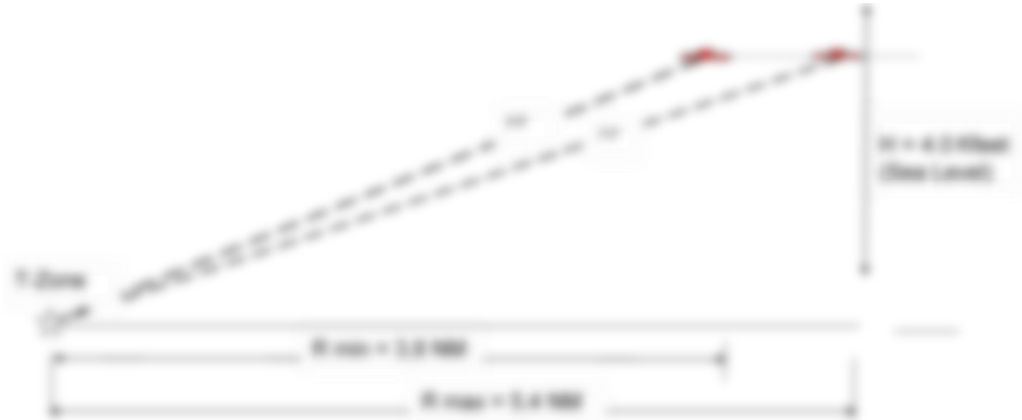
Land-to-Air Use Case

Key Tech

The system has the capability to track and test systems on board of flying planes from ground stations (e.g., SIGINT aircrafts). Measurement can be conducted in both ‘Long range’ and ‘ Short range’ mode, according to the target plane distance.

Tracking outputs is used in order to direct the test system antennas in in the proper 3D cone.

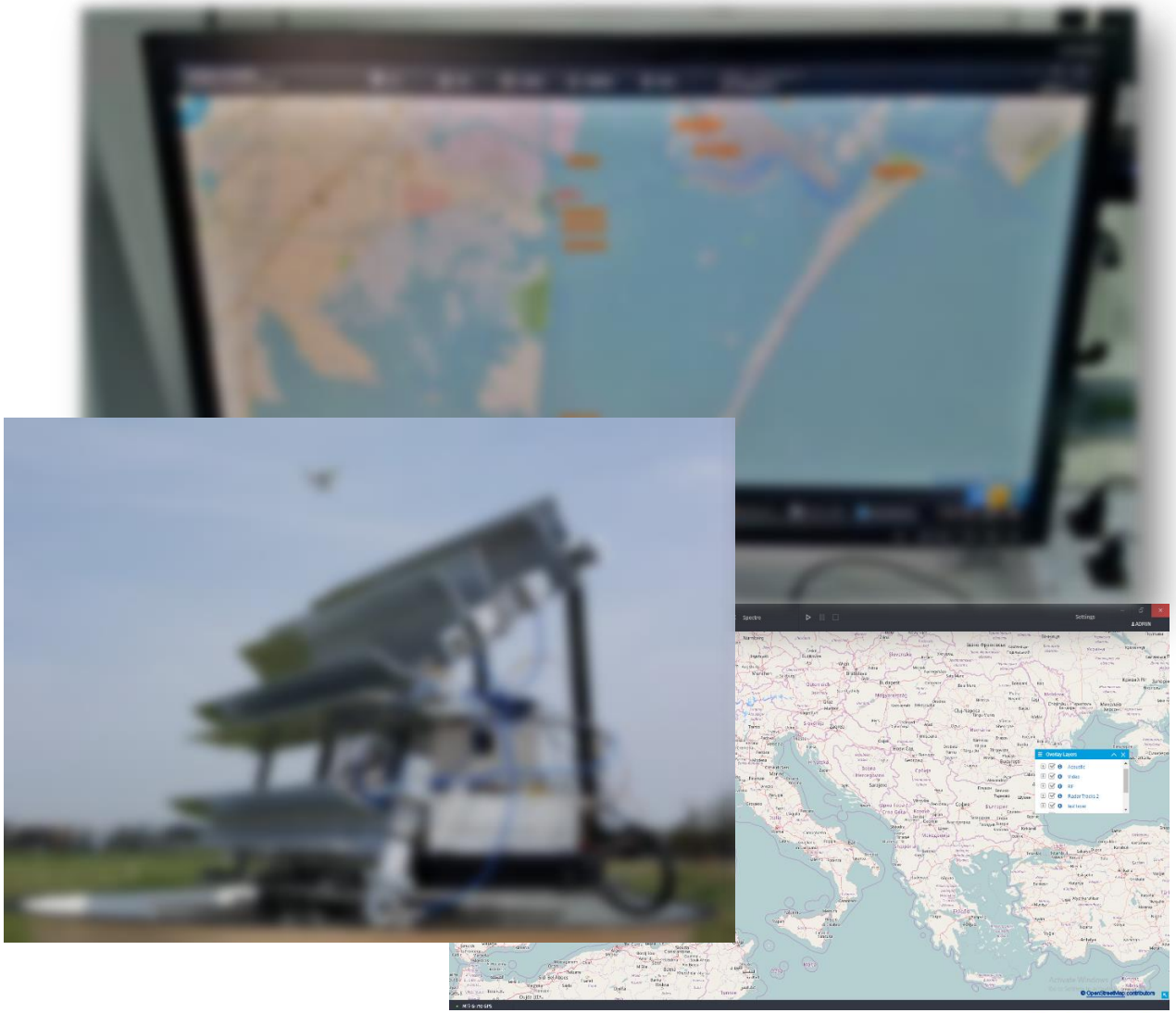




Tracking Capability

Main features

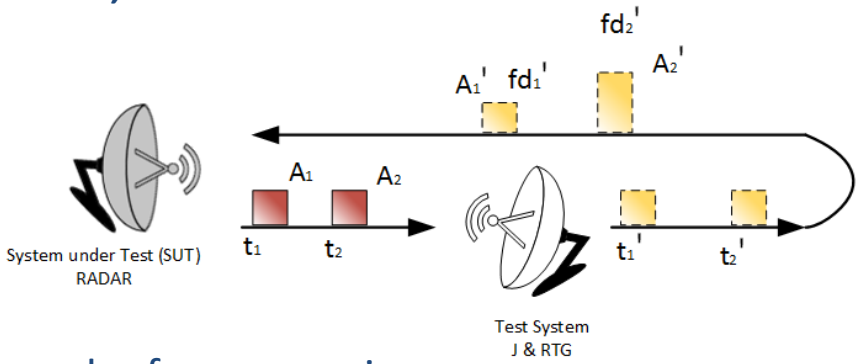
- Situational Awareness on cooperative and non cooperative platforms and actors in the exercise area
- Real time display of Operational Picture
- Manual and automatic antenna tracking for fast moving PUTs (up to 20 deg/s rotation rate)
- Joint tracking with EO/IR sensors and radar sensors
- Display of geo-reference information (areas, borders, no-TX zone, etc.)



Jammer & Radar Target Generator

Key Tech

The unit is able to acquire, modify and retransmit **pulsed, CW and FMCW** signals in order to simulate:



The RTG is able to modify:

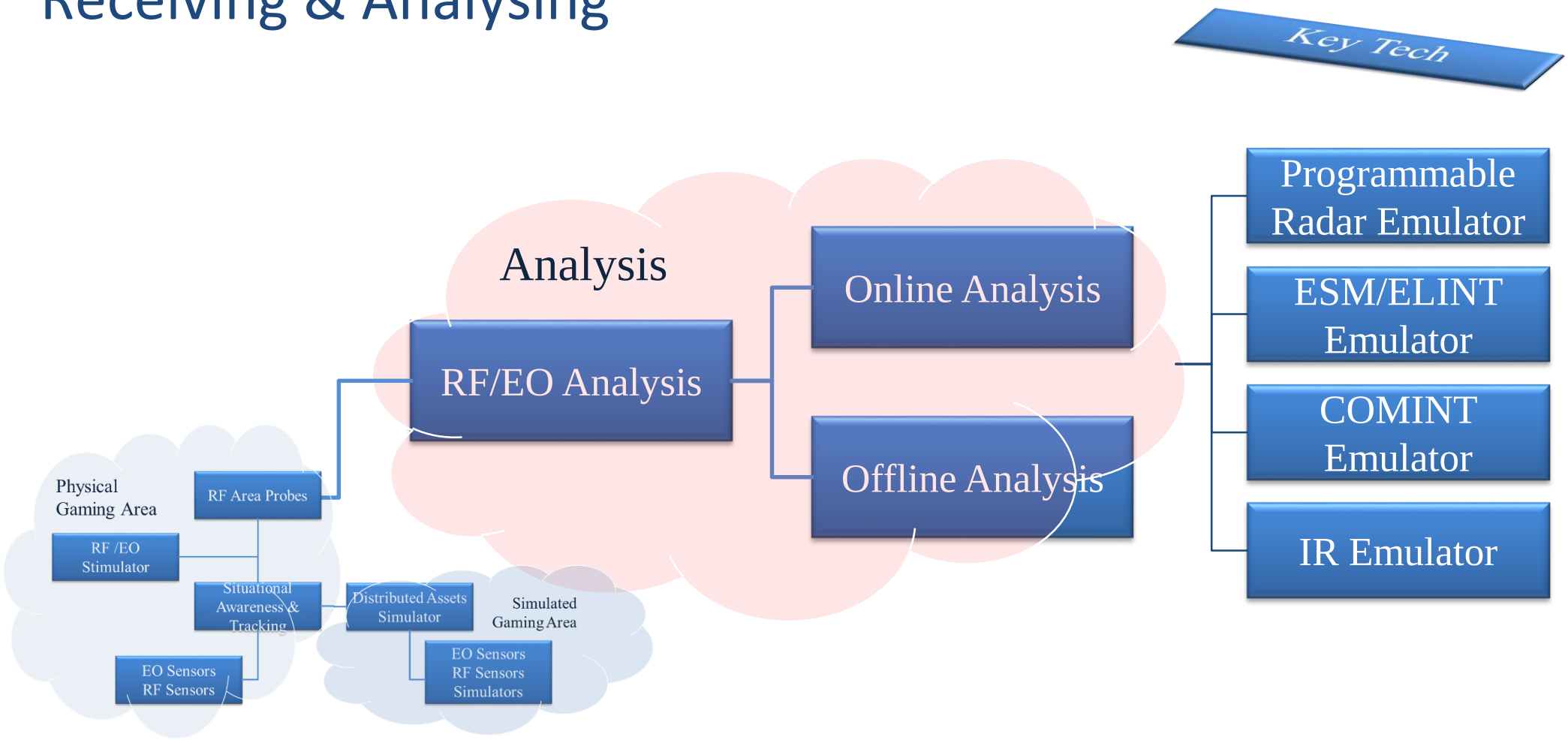
- Amplitude
- Delay
- Doppler

of the incoming signals in order to reproduce a radar echo from a moving target (point-like or distributed) and from clutter

In addition, it is capable of generating noise-like interferences (incoherent jammer)

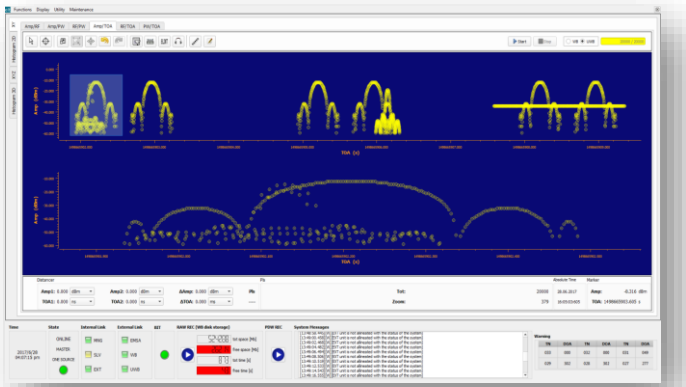
The J&RTG is able to emulate also coherent ECM techniques that are used by the radar-illuminated platform (eg, RGPO, VGPO, etc.)

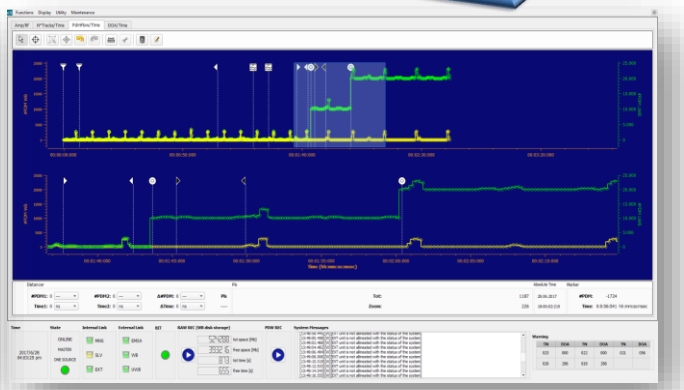
Receiving & Analysing



Receiving & Analysis Capability

Key Tech





Main features

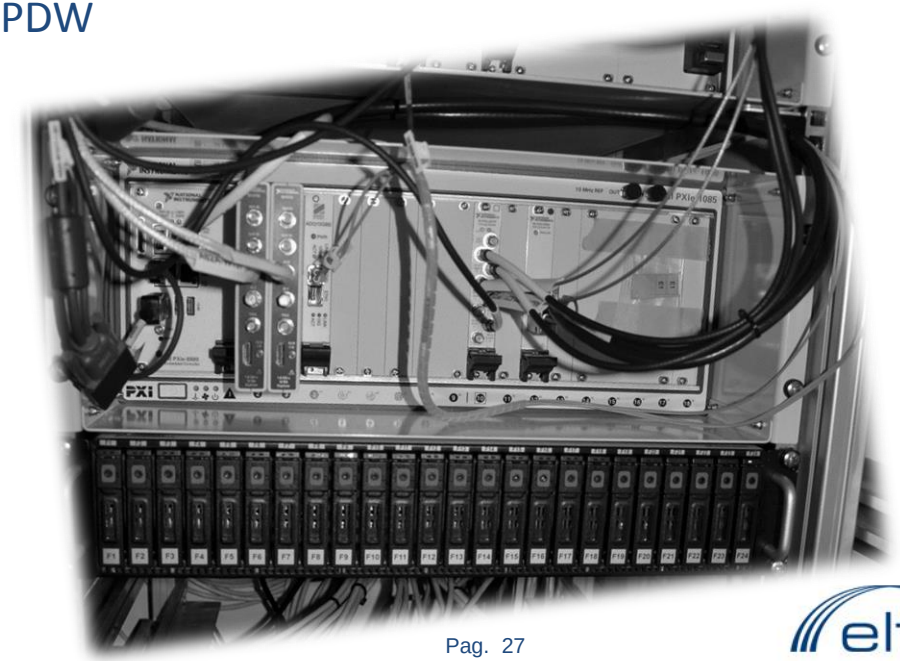
- Wideband (500 MHz – 2 GHz) receiving system
- Real-time reception and analysis of signals coming from the system under test
- Generation of PDW / Tracks in dense environment
- Wideband recording and off-line analysis
- Statistical tools and library-based comparison

Digital Recording and Radar Signal Analysis

Key Tech

Analyser and Recorder of Radar Signals, fully designed for test applications

- IF recording bandwidth >500 MHz
- Continuous recording with BW_max and simultaneously PDW generation out of the IF-Signal
- Integrated online signal analysis functionalities
- Extended offline signal analysis capabilities
- Data via 10-Gigabit LAN interface
- COTS-based design



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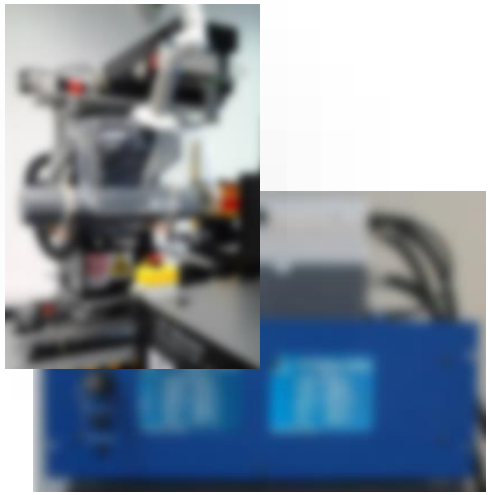
E.G. DIRCM Test (IR Countermeasure) 1/2

Configuration Examples

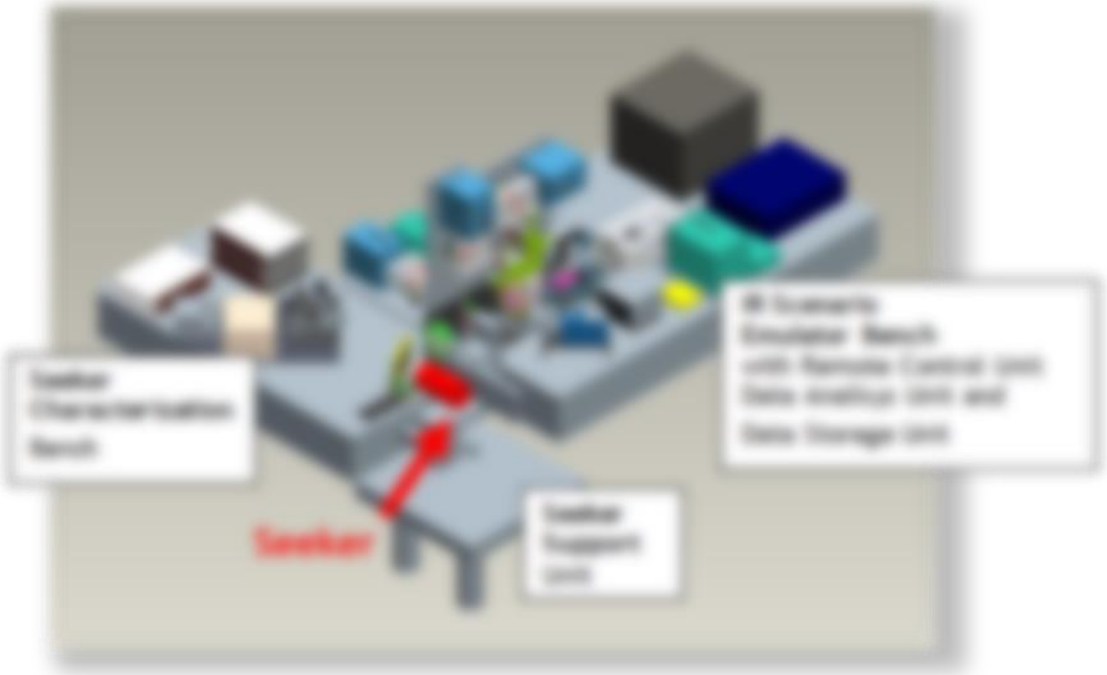
Electro-Optical Bench that offers the following functionalities:

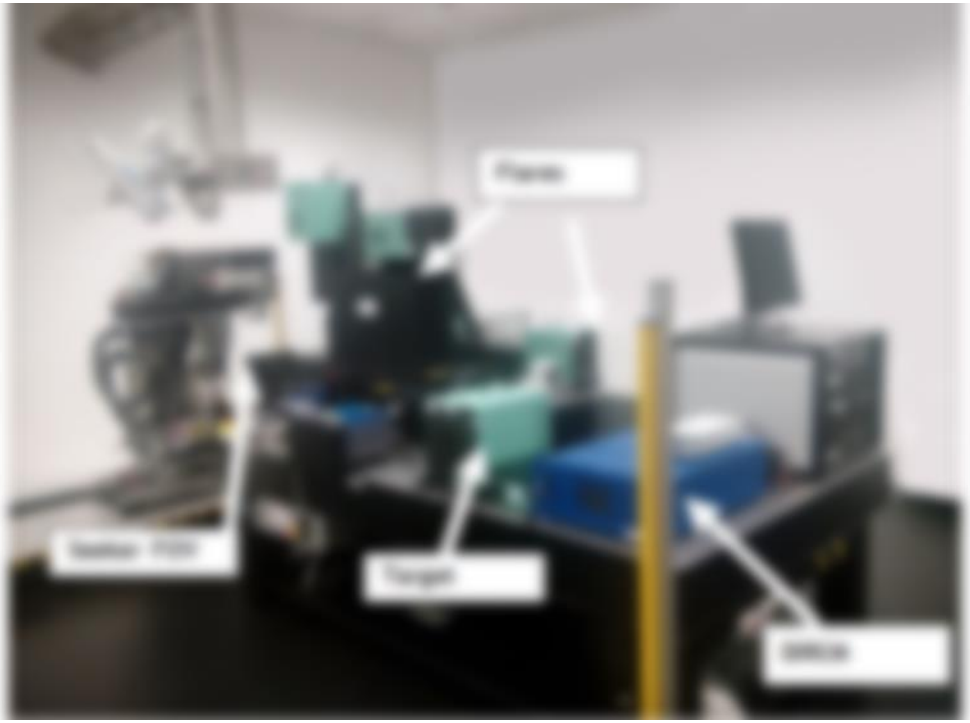
- **IR Seeker Characterization**: which allows a full characterization of seekers in terms of Spectral Responsivity, FOV dynamics, Spectral Discrimination and Break-Lock Limit.
- Scenario Definition and Emulation which allows to emulate an IR scenario, giving the possibility of:
  - Pre-setting Field Test,
  - Generating and Testing New Jamming Sequences,
  - Verifying Counter-Measures Effectiveness,
  - Upgrading Counter Measure Libraries,
  - Generating and Testing new Flare/DICM Combined Strategies, and
  - Personnel Training.



E.G. DIRCM Test (IR Countermeasure) 2/2

Configuration Examples





E.g.MWS Test (IR Scenario)

Solution Features

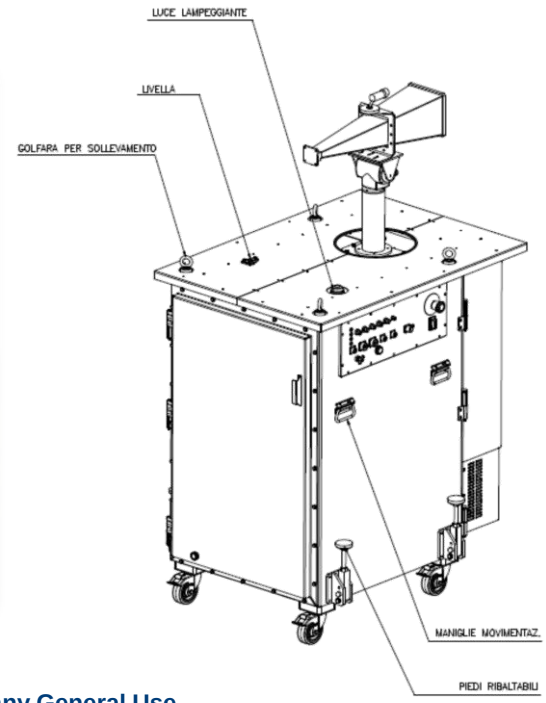
- **In Field MWS stimulation** by UV spikes
- On the MWS stimulators the user can select UV profile and range.
- Main features
  - Up to 8 missile profiles
  - Up to 5km stimulation range
  - Possible use of Classified UV profiles under MoD control

IR sources to support DIRCM thermal camera acquisition and tracking

E.g. ESM test (Radar Scenario) 1/2

Solution Features

Field-Test-Equipment (FTE) used to generate and transmit RF electromagnetic emissions that simulate complex radar signals. It is aimed at simulating and validating operational ESM Systems in lab or in operational environment



E.g. ESM Test (Radar Scenario) 2/2

Solution Features

Power amplification and antennae are selected based on testing ranges

E.g. ECM Test (ECM Countermeasure)

Solution Features

- Study, analyse, and develop ECM technique against radar modes and its ECCM;
- Validate the ECM Library in a dynamic scenario and evaluate the improvement of platform self-protection and survivability.

By means of

- Closed-loop of Radar-Jammer-Radar able to test the effectiveness of the jammer under test against a given radar scenario
- Use of customer's jamming algorithms
- Generation and transmission of radar pulses to the customer's Jammer and receiving jamming (J) and Signal (S) outputs

Conclusions

- Introducing Test systems Anticipate valuable feedback by means of intermediate validation phases with the end customer
- This allow the facing of non-conformity or Engineering Change Request earlier than the typical final ATP phase
- The final product delivered is more compliant with user's real need
- One single test bed can test several EW equipment in different phases of the product cycle
- Number of ECN in final phases of the product development decreases

- The effort for the simulation activities and the test equipment setup activities must be considered together with the design /Production of the equipment

Questions