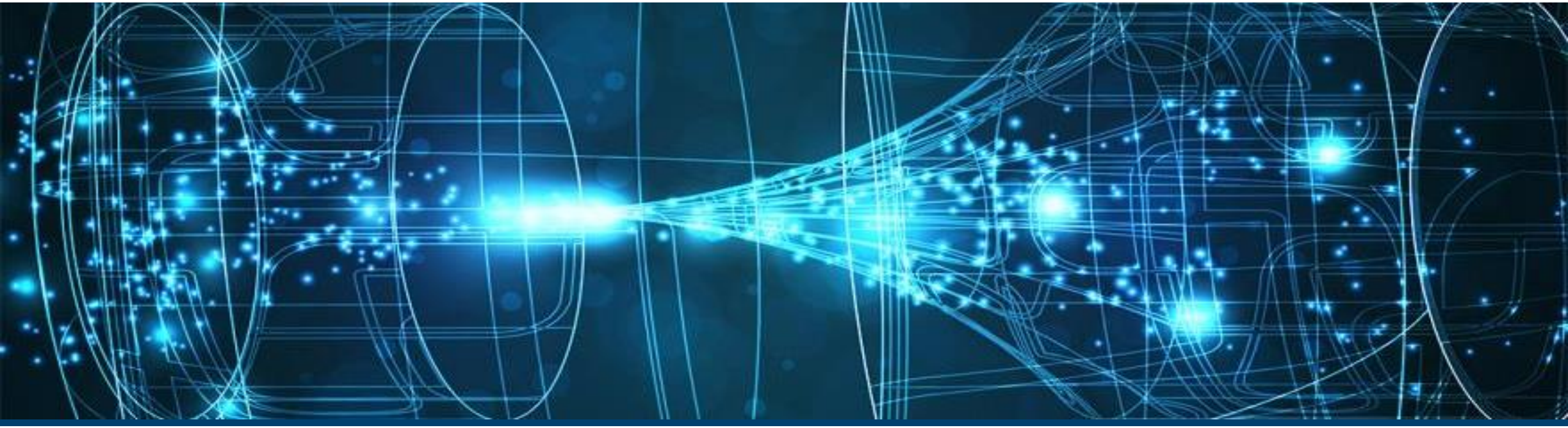


Constructive Simulation with a Higher Automation Level for Training and Decision Support

OSIRIS / 2018-05-17 / ITEC

Agenda

Agenda

Challenges of today’s Training and Decision Support

- Complexity of possible scenarios and the multi-variant situations
- Changing of capabilities brought into the real battlefield
- Multiple simulation systems
- Increasing demand for interoperability and integration
- Problems of aggregation and disaggregation

Approaches to these challenges

Manual Control

Scenario depends upon operator capabilities

- Simple approach for realistic scenarios
- High costs and personnel effort
- Reproducing the simulation is a problem due to the high involvement of human interaction
- Man-in-the-loop during simulation is no possible approach for decision support

Small Scenario Extracts

Separate simulations covers a part of the domain

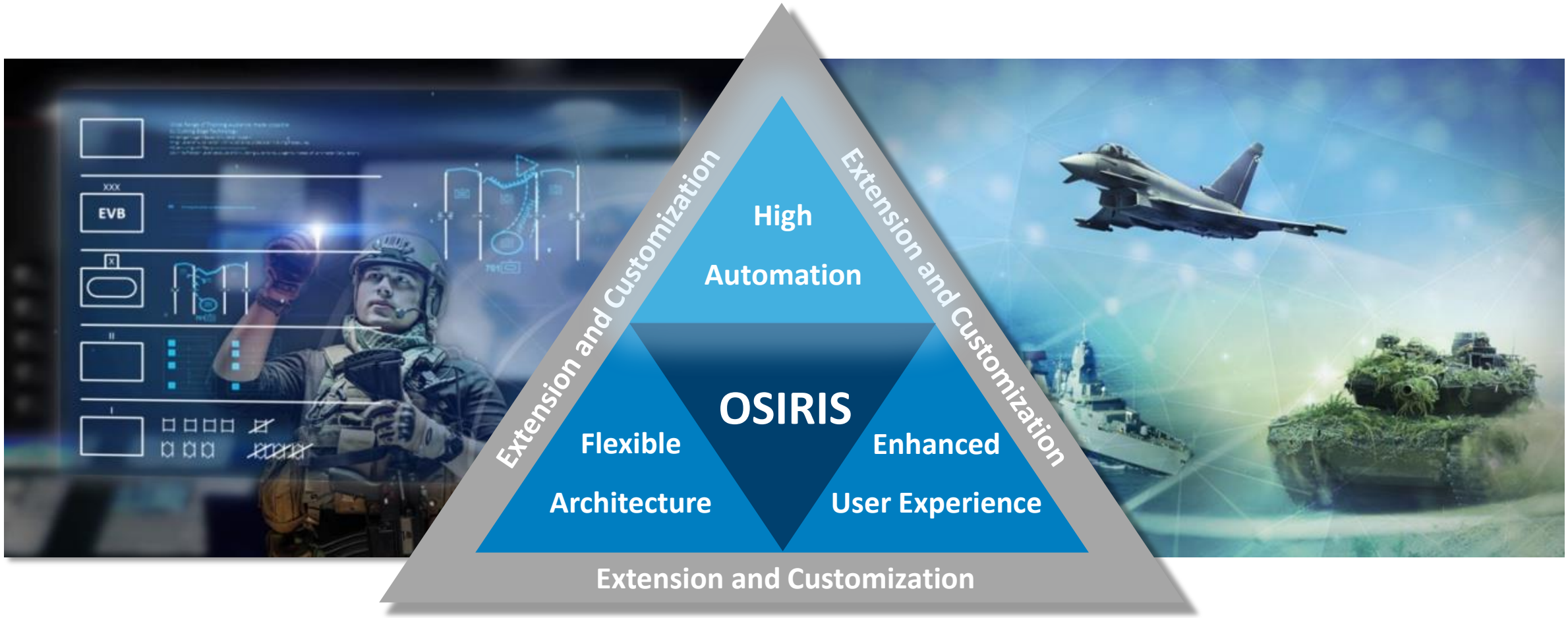
- Specific automation solutions
- Separate databases and infrastructure that needs to be maintained
- High integration costs and very specialized personnel required for each solution and exercise
- Tools needs to be filled with data from different parts of the situation for decision support

Integration Solution

Flexible scaling according to the Audience

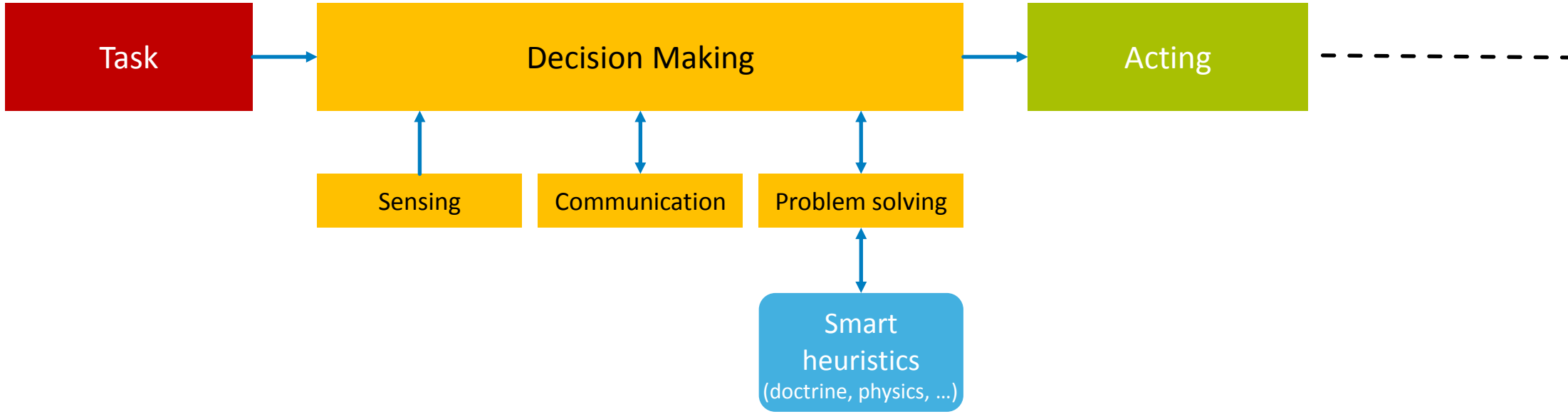
- High level of Automation with autonomous decision making procedures
- Integrated synthetic arena with detailed realistic simulation
- Seamless simulation for all Echelons covering a wide range of scenarios with large number of entities
- Integration of Operators depending on needs

OSIRIS is Rheinmetall's solution to face and meet the challenges



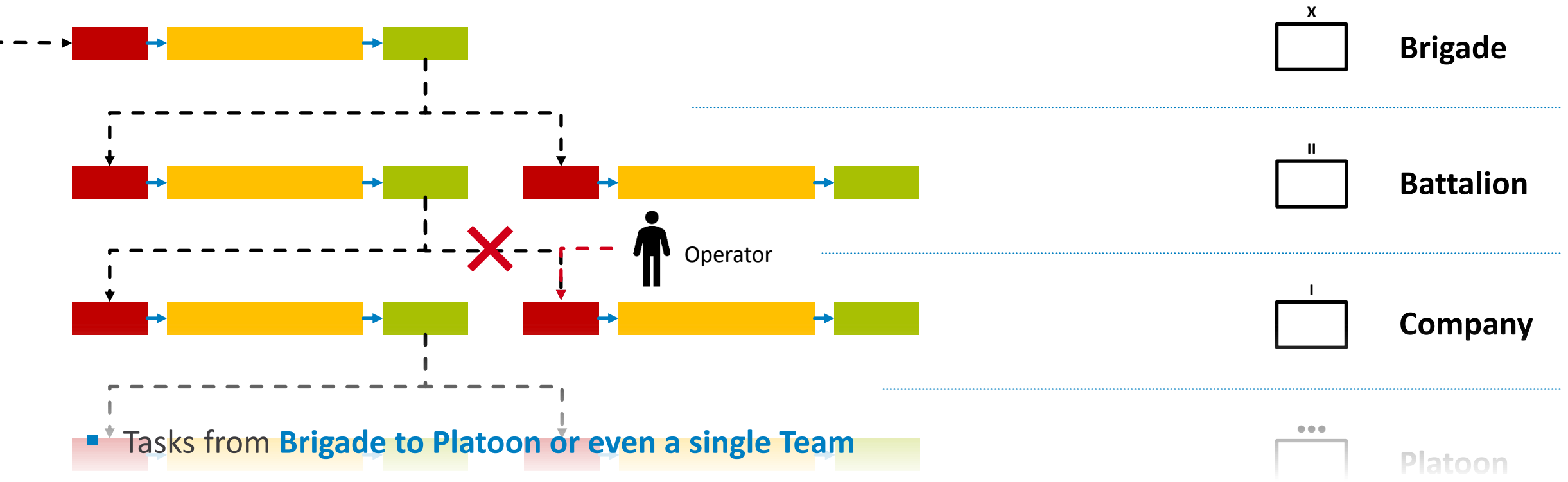
Agenda

Autonomous behavior of Units in an agent based simulation model for minimal interaction efforts



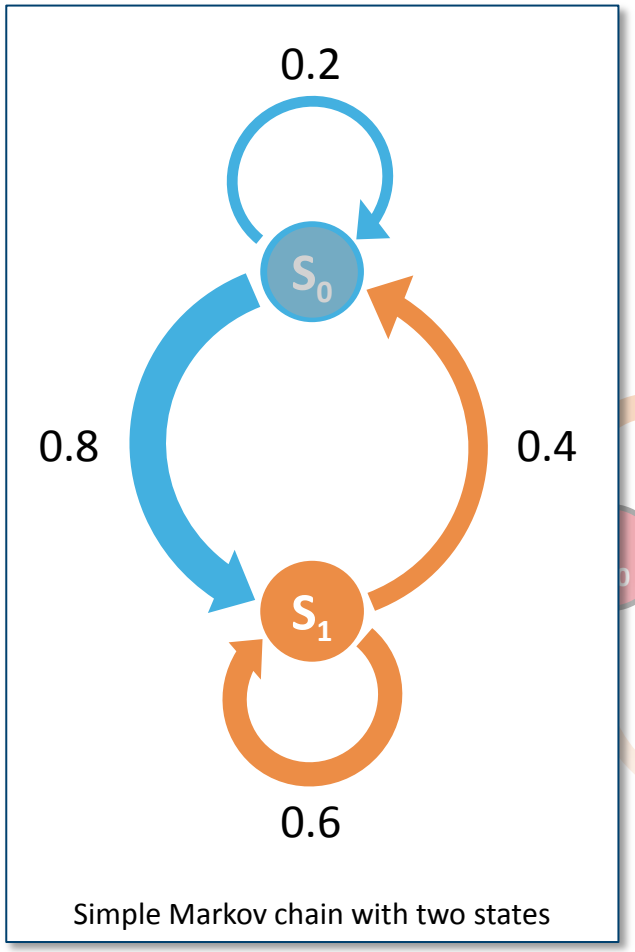
- Every Agent executes its **own OODA loop**
- **Autonomous behavior** of Agents according to defined goals and rules
- Decision making of an Agent based upon the **local operational picture** → realistic situational awareness

Order input at all hierarchy levels
allows flexible command and control for Units

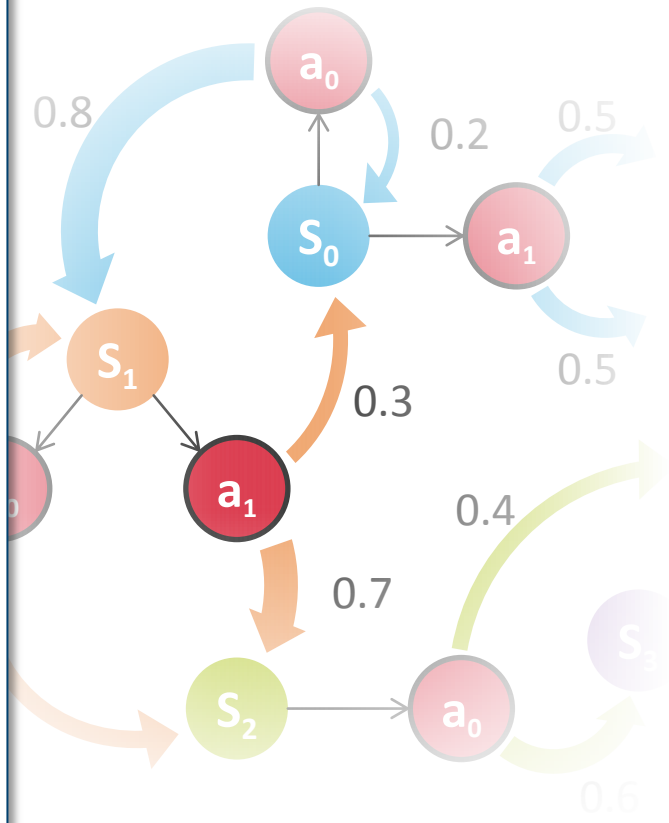


- Tasks from **Brigade to Platoon or even a single Team**
- Automatic (re)organization and building of **Task Forces**
- Simulation of **each individual platform** as real entity

Markov chains as concept for realistic acting Agents



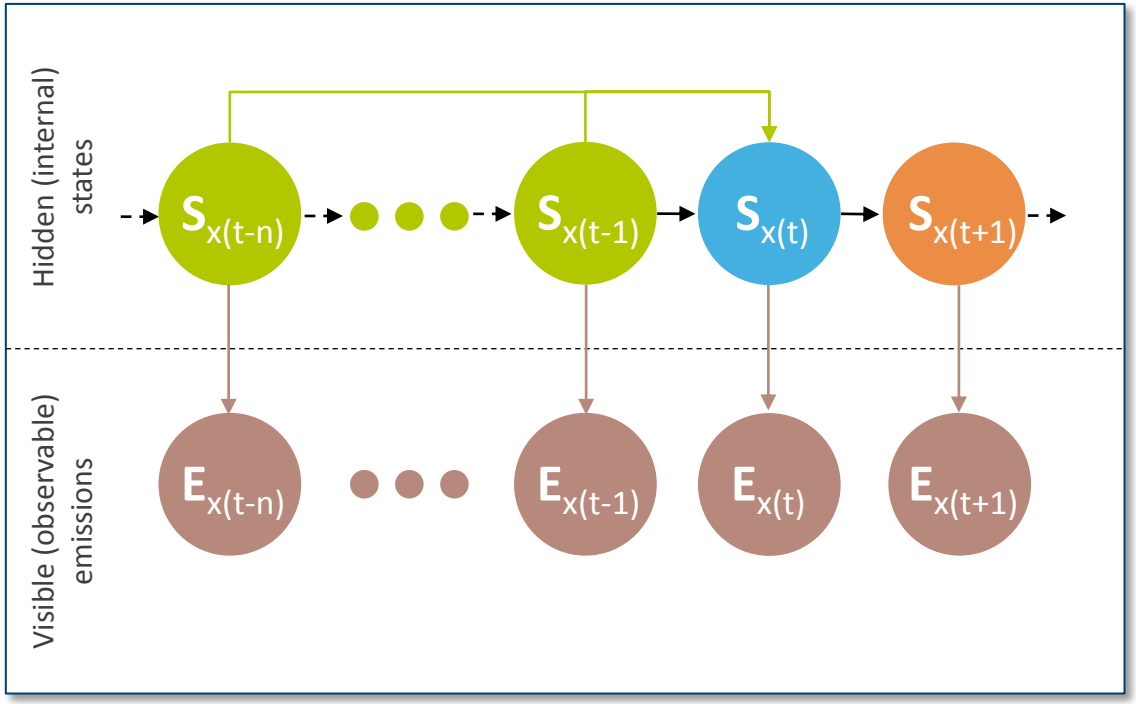
Simple Markov chain with two states



- Finite set of states (S_n), actions (a_n) and transitions
- Model describes probabilities of switching from one state to the next state
- Knowledge about previous states is not required to express **possible future**
- Non deterministic characteristics for **realistic variance** and interoperation between Agents instead of just random behavior

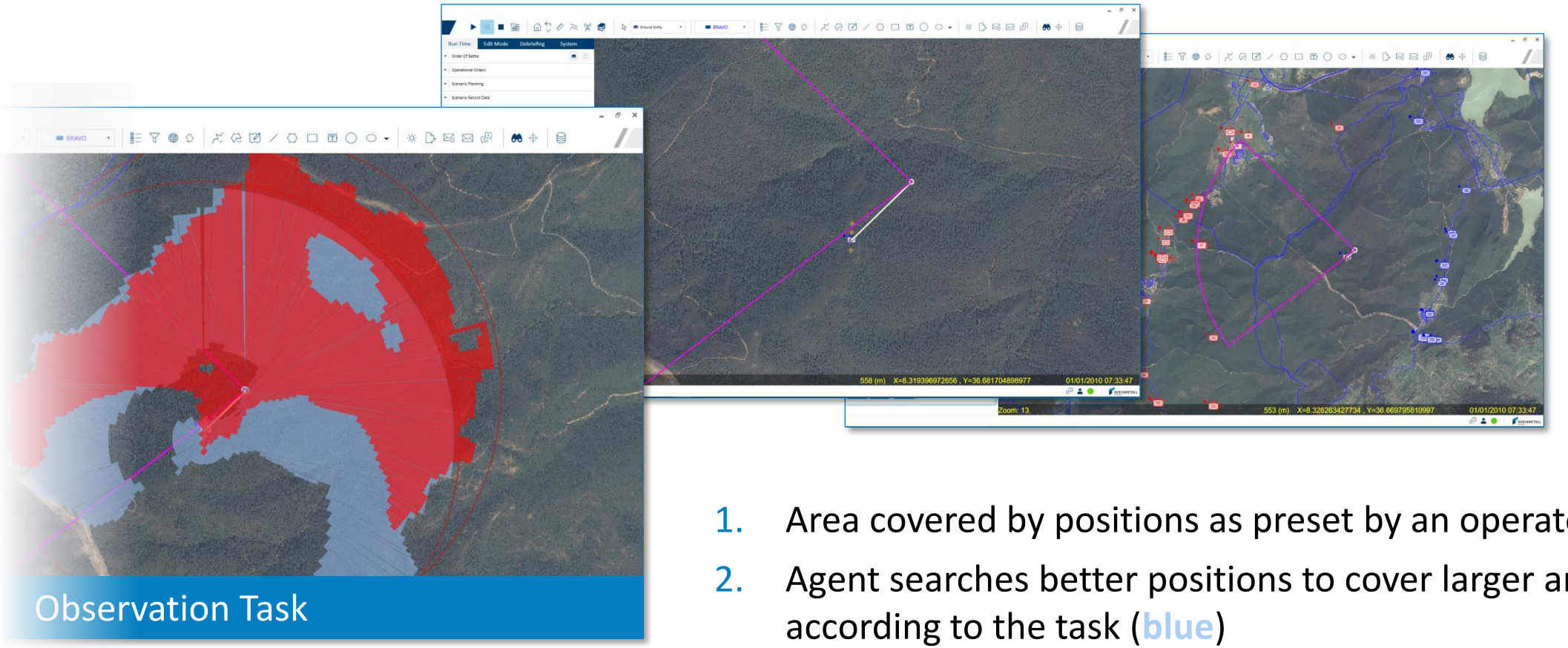
Hidden Markov Modell (HMM) with „Brain“ for intelligent Agents for reducing human interaction efforts

- Hidden Markov Modell (HMM) with „Brain“ for intelligent Agents for **reducing the required interaction** → OSIRIS built-in solution for automatic problem solving
- Every agent **with own «brain» memory** → includes awareness of previous states for planning
- Single emissions and complete sequences can be classified (categorized)
- Change of state is decoupled from emissions (no need to be identical or 1:1) → point of **abstraction**, **simplification** and **decoupling**



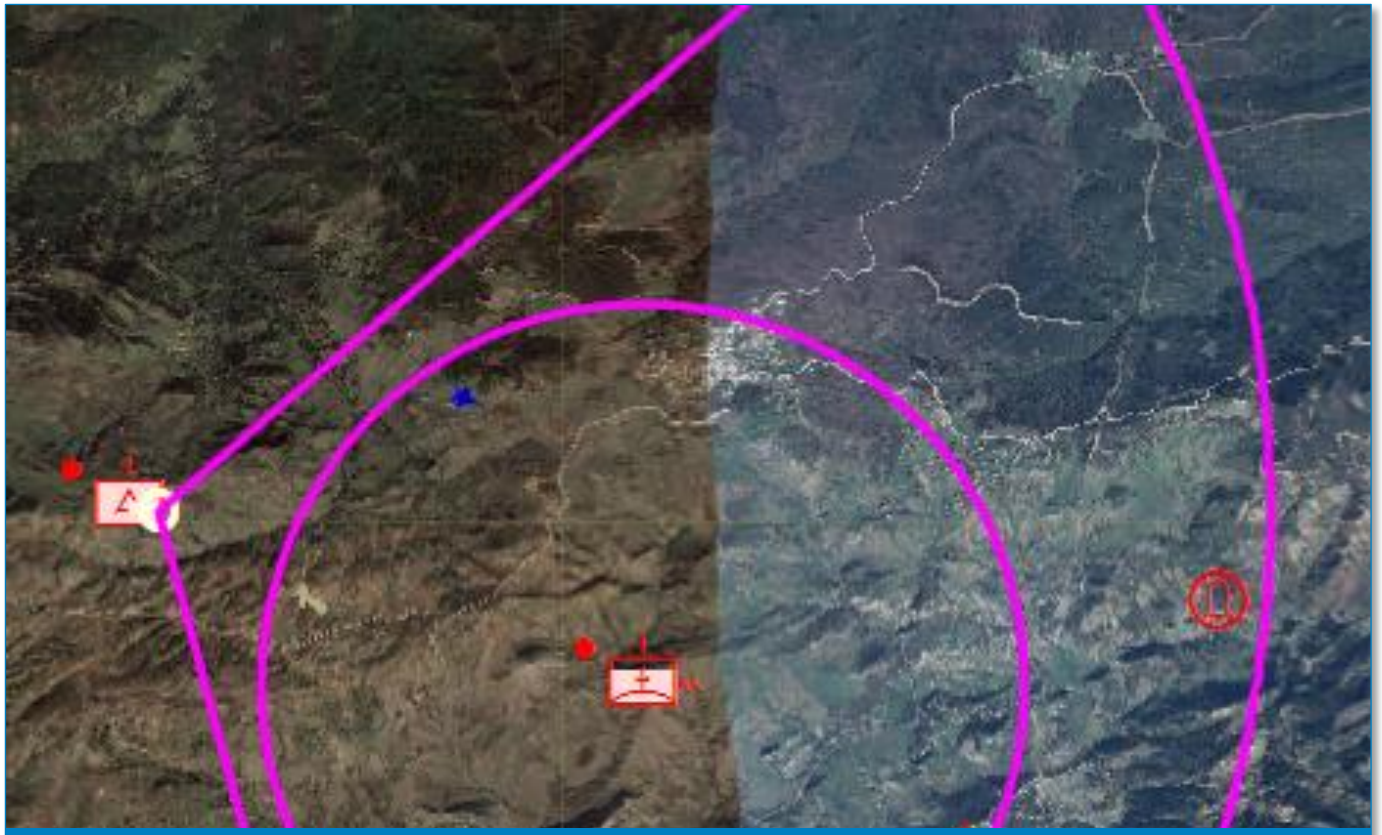
Agenda

Optimized, automatic positioning of platforms reducing need of operator control and allows fair equal conditions for command and staff training



1. Area covered by positions as preset by an operator (**red**)
2. Agent searches better positions to cover larger area according to the task (**blue**)

Cooperation of Agents with automatized deployment, equipment usage and resource consumption for a realistic battlefield simulation



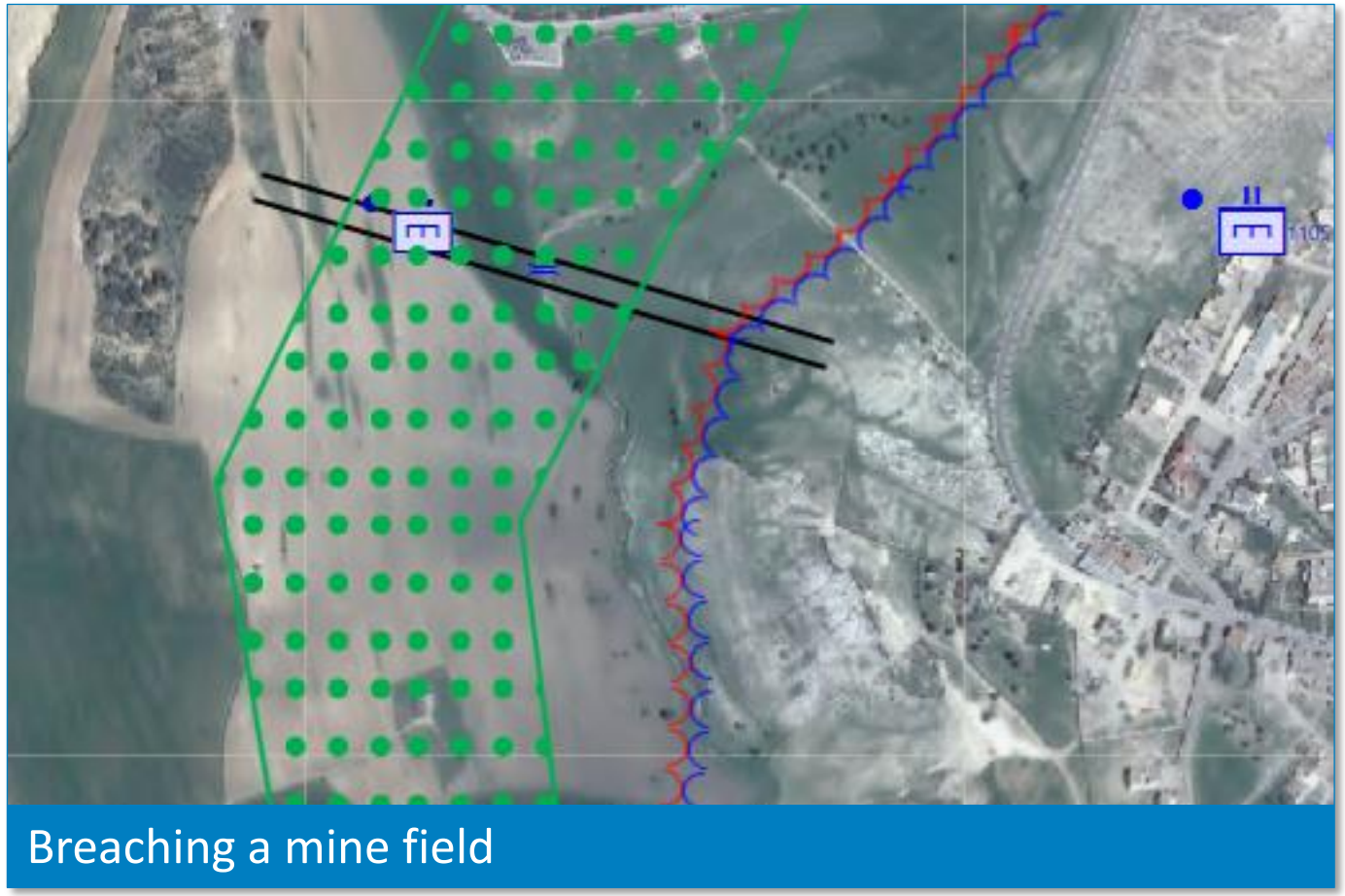
Anti-Aircraft Warfare

- Sensors of one platform detect and identify opponent target (e.g. radar detects enemy fighter)
- Effectors of another platform try to destroy acquisitioned target (e.g. guided missile)

➢ **Autonomous combined acting of different platforms and equipment**

➢ **If platforms assigned to different Units → combined acting of different Units and their capabilities (not limited to subordinates)**

Cooperation of Agents with automatized deployment, equipment usage and resource consumption for a realistic battlefield simulation



Breaching a mine field

- Higher Unit executes an order
- Subordinate Units are automatically used according to the capabilities to breach the obstacle

➢ **Goal oriented problem solving and planning allows Agents to use capabilities without man-in-the-loop interactions**

➢ **Required for control on higher Echelons and high resolution simulation down to each platform at the same time in the same simulation**

Cooperation of Agents with automatized deployment, equipment usage and resource consumption for a realistic battlefield simulation

Logistics

Medical Service

Artillery Support

Close Air Support

...

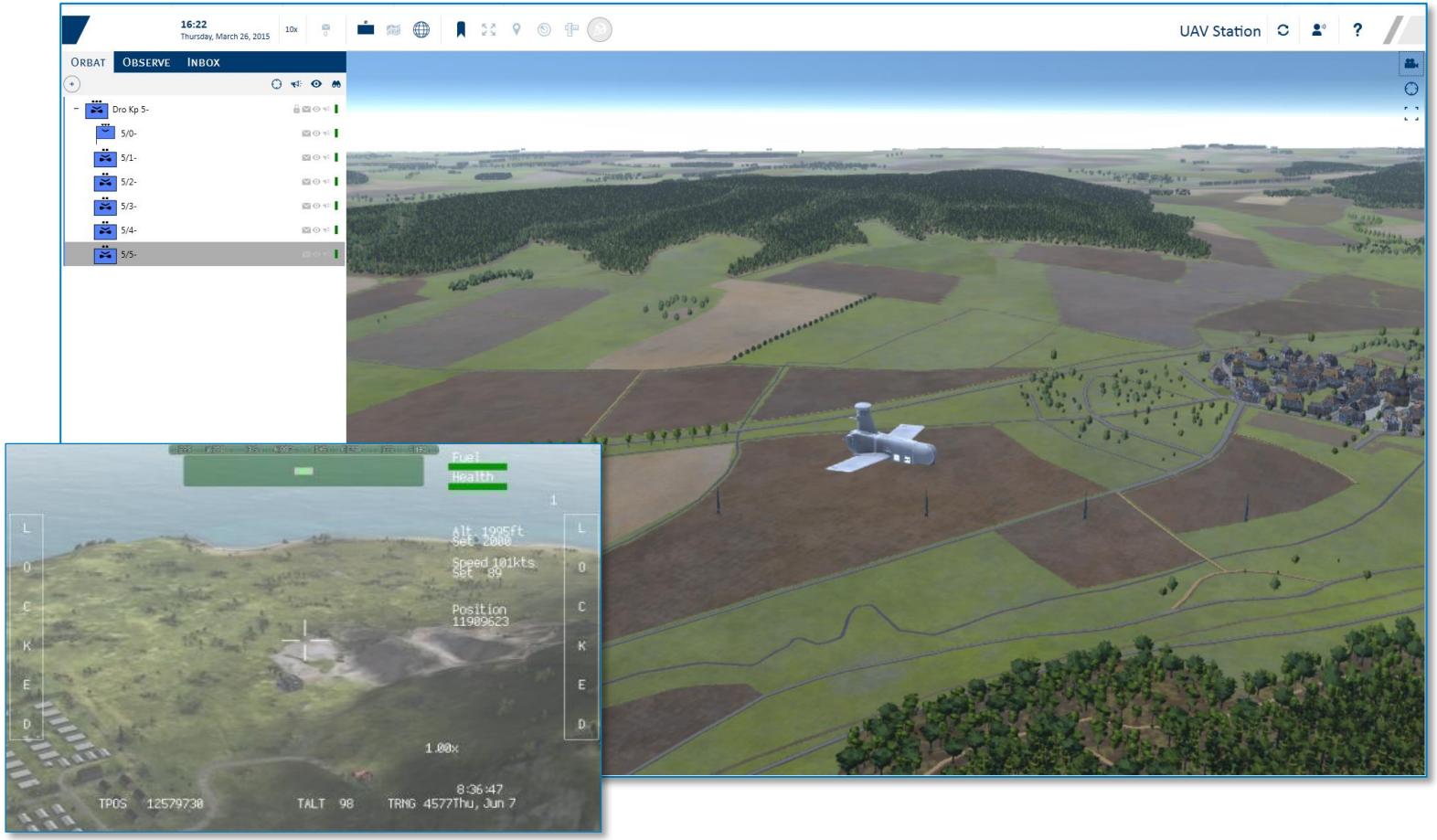
… a lot more examples where Agents cooperate intelligent

- **Logistic chains** can be broken by blocking roads or destroying transportation vehicles
- **Medical Service and Ordnance** procedures can run out of capacity and resources
- Capabilities are automatically used according to availability and best fit

➢ **Agent based simulation approach results in flexible and realistic variants to interact with the synthetic environment**

➢ **Detailed control across all levels required to override automatic behavior**

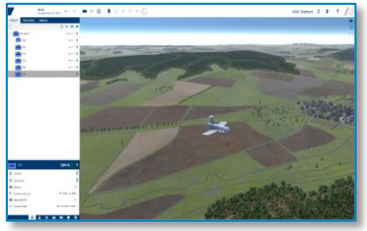
Calculation of each single platform solves the classic aggregation gap



- Resolution down to single platform **removes need for aggregation and disaggregation** of entities when exchanging data between simulations
- 3D-View directly from the scenario
  - UAV videos/photos
  - Detailed views for terrain assessment
- Enables integration of **new tactical elements** into the training

Agenda

Efficient calculations serve as basement for intelligent automation using Agents to enable integration solutions for a wide range of scenarios and applications



- Agent based simulation with optimized algorithms using Markov chains (HMM) allows calculation of large number of entities with **realistic and intelligent behavior** (OSIRIS supports 3+ million entities in a single scenario)
- Supporting a **huge number of entities** allows to compute large scenarios down to **each single platform** (incl. sensors, weapons, resource consumption)
- Automation approach using agents (up to brigade level) allows **flexible cooperation to execute orders** in a wide range of scenarios from conventional to asymmetric and hybrid warfare with **including Land, Air and Sea**
- Ready for **real LVC**: Real positions and states for every platform enables simplified integration with virtual simulators by solving the problem of aggregation and disaggregation

Agenda

Answering Open Questions

… if not yet answered always welcome to our booth!

Rheinmetall Booth D10

RHEINMETALL GROUP

MOBILITY. SECURITY. PASSION.