GEMS FAQ
GIS-Enabled Modeling and Simulation

What is GEMS?

GEMS is a technical architecture and set of functional components that enable Modeling & Simulation (M&S) systems to interoperate with Command and Control (C4I) systems.

Is GEMS a product?

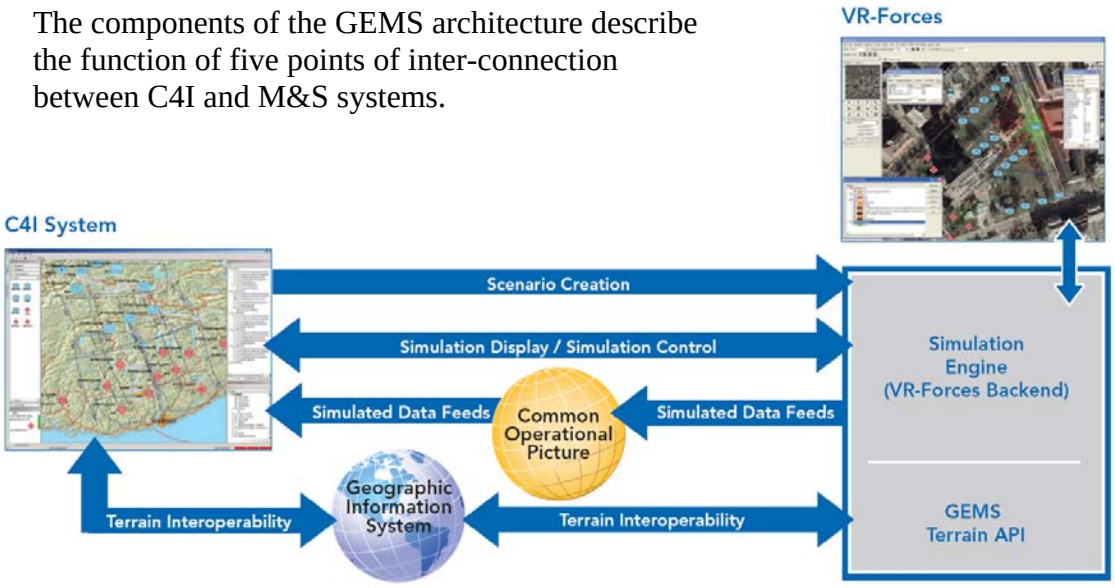
Not per se. GEMS is an architecture whose software components are being developed under development contracts.
We look forward to the opportunity to discuss how MÄK can use our COTS tools and the GEMS architecture to help solve your C4I and M&S interoperability problems.

A GEMS solution typically includes -

- A bundle of MÄK's COTS Products
  - VR-Link
  - VR-Exchange
  - VR-Forces
- Access to MÄK's GEMS Technology
  - GEMS Terrain API
  - GIS-to-SIM
- MÄK's Interoperability and Geospatial Expertise
- Integration support

What are the Functional Components of the GEMS Architecture?

The components of the GEMS architecture describe the function of five points of inter-connection between C4I and M&S systems.



1. Scenario Creation

Use live intelligence from the C4I system to create simulation scenarios.

In order to make a simulation, you must extract the units (aka entities), their organizational structure (aka order of battle) and their tasking (aka plans) from the C4I system and bring them into your simulation engine. Collectively this is known as a simulation scenario.

Ideally, the simulation scenario would be exchanged automatically between the C4I system and VR-Forces. SISO is working towards this goal by defining a scenario definition standard called Mission Scenario Definition Language (MSDL) and a Coalition Battle Management Language (CBML). After these standards are defined MÄK will implement them in VR-Forces so that a scenario developed in a C4I system (or other M&S system) can be loaded and executed. Until then, MÄK can develop custom exchanges or you can use the VR-Forces GUI to interactively create scenarios that match your operational conditions.

2. Simulation Display

Display the real-time simulated entities and interactions within the C4I system GUI.

In the Simulation Display component of the architecture, the native map display of the C4I system is extended to display updating information from the simulation. This allows you to monitor the real-time activity in the simulation including entity positions, status, and interactions.

For C4I systems using the US DoD standard Common Joint Mapping Toolkit (CJMTK), MÄK has developed a toolkit that extends the map display to dynamically visualize simulation network data. The toolkit uses MÄK's VR-Link technology to link to GIS software with standard simulation protocols, including Distributed Interactive Simulation (DIS), High Level Architecture (HLA), and Test and Training Enabling Architecture (TENA).

3. Simulation Control

Start, stop, and interactively control the simulation activity from the C4I system.

This component of the GEMS architecture enables the operator of the C4I system to interactively control the execution of the simulation scenario.

Two levels of integration have been developed. The first is the VR-Forces Toolbar, which extends the C4I GUI to start and stop the simulation and to control simulation time. The second uses the VR-Forces toolkit API to embed the complete VR-Forces menu system into the C4I application. This gives the C4I GUI complete control to setup up scenarios, define unit tasking, and interactively alter the simulation while it runs.

4. Simulated Data Feeds

Simulate a Common Operating Picture (COP) by generating intelligence reports derived from simulated missions.

As a simulation is running in VR-Forces, the sensor models on the simulated vehicles determine the probability of detection, classification, and identification of other entities in the simulation. The simulation can be tasked to issue reports that convey this detection and other situational awareness information.

The Simulated Data Feeds component of the GEMS architecture relies on brokers to be written for VR-Exchange that post spot reports to the COP database.

5. Terrain Interoperability

Simulate directly on the operational geospatial data without developing a separate M&S terrain database.

Traditional M&S systems require a specialized terrain database where C4I systems operate directly on the geospatial data. Terrain Interoperability allows

you to simulate directly on the C4I system's geospatial data without developing a separate database.

MÄK's GEMS Terrain API enables M&S applications to access the same geospatial data for terrain reasoning, vehicle dynamics, and visualization that is used by C4I systems for terrain analysis and visualization.

The GEMS Terrain API consists of a GIS specific layer for accessing the terrain data, and a simulation specific layer for providing the data to the simulation models. The API has been developed for MÄK's VR-Forces simulation system. Other simulation specific layers can be developed as needed (for other CGF systems).

What Are the Benefits of M&S Systems Using GIS?

By leveraging a GIS, VR-Forces can benefit from enhanced functionality to manage, access, and visualize terrain data. The benefits include the ability to:

- Manage data seamlessly for anywhere, at any scale, from a number of distributed geo-databases.
- Load a wide variety of terrain data types and formats.
- Support hundreds of coordinate systems, datums, and projections.
- React to changes in the geospatial data enabling dynamic terrain functionality.
- Access operational data directly, reducing the need for specialized runtime terrain databases that are time consuming to produce and costly to maintain.

Where is GEMS Useful?

The problems solved by the GEMS architecture are organized into four categories or types of use cases.

Correlate M&S systems with Operational Terrain Data — You can use geographic information system (GIS) data and geo-processing models to interoperate in the same terrain environment. And use intelligence in the Common Operational Picture (COP) to create relevant simulation scenarios.

- Battlefield Awareness – simulation behaviors will more closely match the decisions made by C4I human operators.
- Concept Evaluation – enables systems integrators to prototype a platform, weapon system or sensor.

Stimulate C4I Systems with M&S Systems — To allow C4I operators to sustain their training on Tactics, Techniques, and Procedures (TTP), M&S can be used to stimulate the C4I system with events from a variety of preplanned and interactive scenarios.

- Sustainment Training – C4I operators can keep sharp on Tactics, Techniques, and Procedures (TTP) by being exposed to a variety of scenarios.

Embed M&S Capabilities into C4I Systems — Rehearse timing of operations and evaluate mission plans, using M&S to play out scenarios defined in the COP. Provide decision support by modeling scenarios and performing course of action analysis (COA).

- Mission Planning and Rehearsal – where simulation is used to play out the plan for the day, thus giving the operator a sense of the timing of operations and synchronization points in the mission.
- Course of Action Analysis (COA) – where the simulation is used to model scenarios based on the mission plan, thus providing opportunities to analyze unit mobility, sensor utilization, and communication network effectiveness.

Implement C4I Systems using M&S Technology — Implement C4I systems, battle management systems, and situational awareness systems with distributed simulation protocols, tactical map displays, and 3D visualization developed for M&S.

- Situational Awareness Systems – Use the same geo-processing algorithms used in operational terrain analysis, to, for example, develop navigation paths that avoid threats. By off-loading geospatial reasoning functions, simulations can use their processing cycles for higher level models and behaviors.
- Simulated Battle Management Systems – where M&S technologies are used to develop BMS systems concepts.

GEMS Use Cases	GEMS Architecture Components				
	Scenario Creation Create simulation scenarios from Live Intel	**Simulated Data Feeds** Simulate missions and generate intelligence reports	**Simulation Display** Display real-time simulation in C4I system	**Simulation Control** Control simulation from C4I system	**Terrain Interoperability** Interoperate with geospatial terrain data
Correlate M&S systems with Operational Terrain Data	X				X
Stimulate C4I systems with Modeling & Simulation	X	X			X
Embed M&S Capabilities into C4I Systems	X	X	X	X	X
Implement C4I Systems using M&S Technologies	X				X

This matrix illustrates the functional components needed to address each type of use case by listing some of the relevant technologies.

What is operational terrain data?

Operational terrain data is the map data used in real world command and control systems. In the US, this data is generated by organizations such as US Army TEC for use in the field. The Theater Geospatial Database (TGD) is an example of a US operational terrain data set.

What is a geo-processing model?

A geo-processing model is an algorithm for manipulating geospatial data. These models can be used for route planning, mobility analysis, cover and concealment analyses, line of sight analyses, and the locating military significant terrain features, like battle positions and choke points.
They can be composed using built-in GIS functions or they can be defined as scripts using languages such as Python or Visual Basic. These models can be executed locally or run remotely on a GIS server.
With GEMS, the results of these models are available for use within the simulation.