How to extend the Internet of the Things concept to the Military Simulation & Training systems?

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1 INTRODUCTION

The Internet of Things or IoT is promising to revolutionize how people communicate, what they do and how they work together. IoT will do it by transforming the way machines and devices work together, transforming the stovepipe and standalone systems into smart connected devices. IoT will reshape the competition within many industries because it will create ecosystems in which other related products will optimize the function of one product and the basis of the competition will be based on the performance of the Systems of Systems instead of the features of the standalone device.

IoT is promising a new era of interconnected devices, working together with unprecedented speed, scale and capabilities. Many foundations in today's commercial IoT have been translated from the network-centric warfare concepts that have been already developed at NATO since the end of last century.

This paper presents the case of how the application of IoT concepts can help to revolutionize the way military forces are using simulation & training systems (S&T). S&T systems are a key part of the life engineering cycle of a military system, useful for training, validation of requirements, virtual prototyping or integration and testing. Therefore, any improvement that IoT can bring to the S&T technologies will have a huge impact in the military forces.

2 THE INTERNET OF THINGS AND THE SIMULATION & TRAINING SYSTEMS IN THE MILITARY DOMAIN.

IoT works connecting heterogeneous devices to the network, this devices share data that can be exploited in the cloud by different data-consumers. In IoT a new technology is fundamental: a Network infrastructure platform that provides the mechanisms to connect the devices to the cloud and to share data between the publishers and subscribers or consumers of the data. Therefore, IoT is about to have smart devices that can connect to others through a platform in the network to improve their capabilities.

Is IoT concept useful for the military Simulation & Training Systems? Let us see what the main NATO stakeholders involved in S&T are asking and we will see if IoT could help to meet their requirements:

- Users of military simulators are requesting to interoperate simulators of any kind (live, virtual and constructive) and real systems in the network without any restriction.
- Users are demanding to work with the simulation systems as services, that can provide specific capabilities to other systems (simulator or operational) connected to the network.
- Users are demanding an increase in the application of distributed simulation, enabling new uses as for example Virtual Mission Training, mission rehearsal, etc.
- Users are demanding the integration of high fidelity simulations in the command & control loop, allowing the commander to use these simulations to support the decision-making.

All above requirements clearly demand for an Internet of Simulations, fully integrated in the overall Military Internet of Things. But military systems are still very far from the IoT concepts. These are the main handicaps to be solve before we can think on creating an Internet of the Simulations[1]:

[1] Based on the conclusions of the Live-Virtual-Constructive Architecture Roadmap Study by US M&S Coordination Office (www.msco.mil/LVC.html)

- Military simulators are still designed as stovepipe systems, without thinking on the network.
- Most of simulations works only in standalone configurations, never connected with other systems. They use to be based on proprietary architectures, lacking plug&play capability.
- Distributed simulation (connecting simulators in the network) is in fact not very common and, when it is done, is based on ad-hoc gateways that are difficult to develop, deploy and upgrade and introduce a lot of interoperability restrictions.
- There is a lack of common data-models, protocols and data distribution mechanisms. This lack of convergence avoids an easy connectivity of heterogeneous simulators.
- There is not common simulation services that can be shared by different simulators, enabling higher levels of interoperability. This is a very important gap because the simulated entities needs to be coordinated in their behavior and state within a common synthetic battlespace.

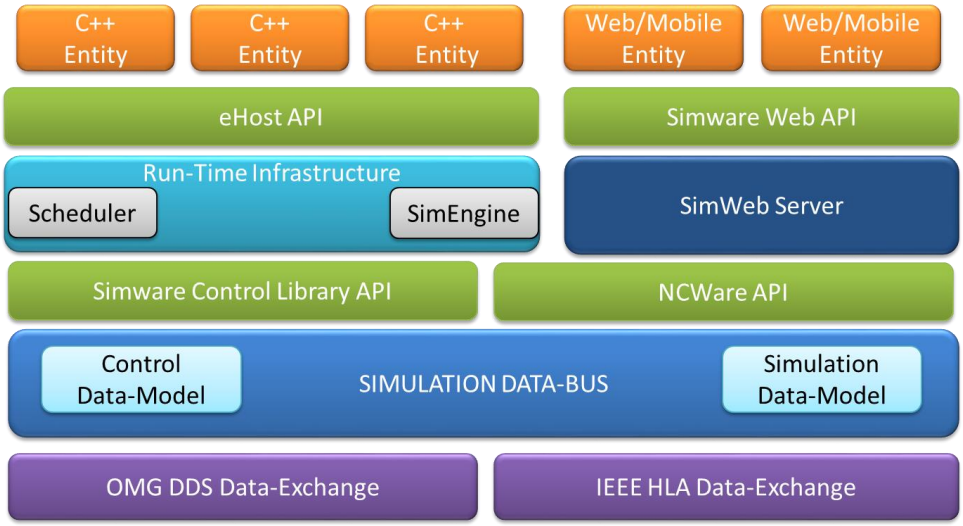
Because of former gaps, networking simulators is still a big pain for the military forces and this is the main reason why distributed simulation, now best known as LVC Simulation, is still a difficult issue, requiring large budgets, and a lot of time and work to connect and interoperate simulators within a network. Even when this is achieved, the capabilities of this federation of simulations are also much fewer than the capabilities provided by stand-alone simulators – a curious paradox, as we are used to seeing an improvement in performance when devices are connected to a network in any Internet application

In order to bring LVC simulation to the mainstream; unleashing the real value of distributed simulation in a new market of the Internet of Simulations, we must evolve the simulators from their current proprietary and stovepipe architecture into open, interoperable and connected devices that can plug and play in a network with other live or virtual systems without any type of restriction. This evolution is vital if we want to bring LVC simulation into the mainstream, making affordable to the military forces worldwide

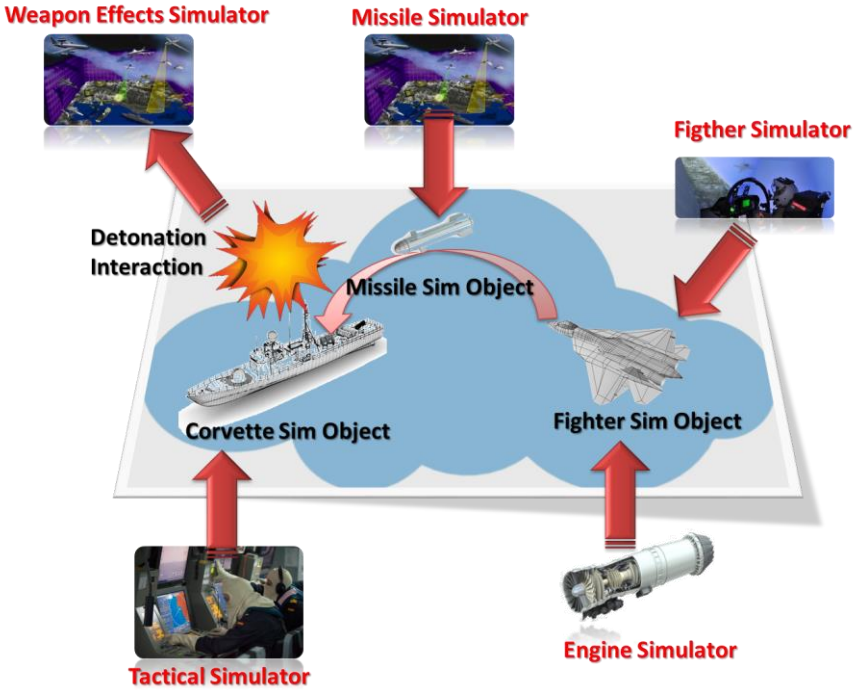
3 MOVING TOWARDS THE INTERNET OF SIMULATIONS.

Simware Solutions and his parent company, NADS, has been working since last decade to solve this challenge and to offer the market a new Distributed architecture for simulation, his name it is Layered Simulation Architecture or LSA (www.simware.es/lsa.html). Compared with other simulation architectures, LSA excels in features that are essential for LVC simulation: it uses a pure distributed and data-centric architecture, based on industry standards, and converges multiple standards and protocols in a common platform (such as HLA, DDS, DIS and web), allowing interoperability between any type of simulation or operational system. It can also be used as the real-time platform of the simulator itself, opening its architecture.

LSA is the bedrock of our Simware Platform (//www.simware.es/). Simware provides open APIs, runtime distributed infrastructures and tools to build fully interoperable simulators, ready to be connected to the cloud without limitations. Simware is a TRL9 product-line that is enabling the Internet of Simulations not only for new developments but also for legacy simulators already deployed in NATO. Next figure shows the layered architecture in Simware. These layers can be combined in many different ways to build almost any kind of simulation application, from simple federates to complex real time high-fidelity simulators. Our layered architecture provides a great modularity and flexibility of use, because you do not need to use all the layers in a system, only those that are needed to fulfil the specific requirements of the system.



As any IoT's network infrastructure platform, Simware provides the mechanisms to connect the simulators to the network and to share data between the publishers and subscribers or consumers of the data. Simulators can leverage Simware platform to evolve to smart devices that can connect to others in the network through the platform to improve their capabilities.



The main difference in Simware when you compare with any other COTS in the market it is its pure data-centric architecture. Simware only leverages data to enable the interactions between all the entities connected to the platform. Data is used to exchange information about the dynamics and behaviors of the different simulated objects, including the interactions between them. Simware also use data to manage the execution of the simulation in a distributed environment (control of the state-machine and the clock, management of instances of the different objects, etc.). Data based interfaces are very useful when you want to integrate heterogeneous systems, as is typical in any Systems of Systems scenario as indeed the Internet of Simulation is.

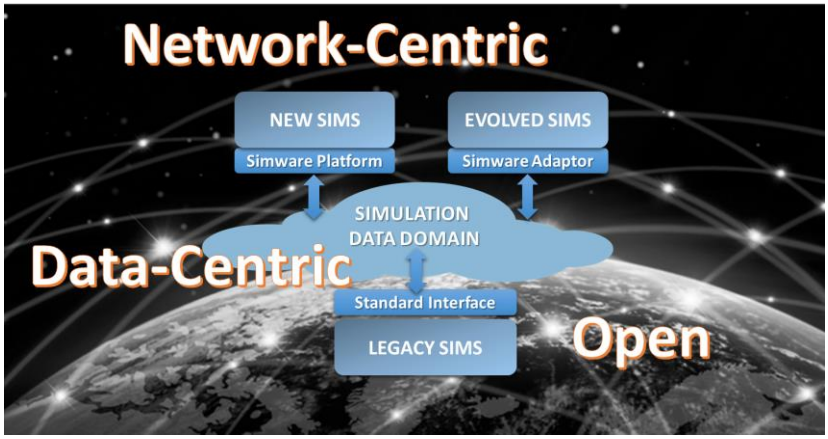
LSA and Simware are enablers of the Internet of Simulation because:

1. they allow different companies and users work together to create an ecosystem in which to benefit mutually.
2. the industry can leverage LSA to upgrade capabilities of existing and legacy systems, by connecting them to other devices and systems in the network. In this way, militaries could do a smart use of the budget, updating systems to deliver tactical training by a fraction of the cost of doing a new development.
3. they allow to migrate the stovepipe simulators to real smart connected devices. Systems that are able to cooperate with other systems in the network to provide specific capabilities to the users and operators.
4. new demands as the use of simulation as a service can be fulfilled by them. Only an open platform, fully based on standards, will allow the collaborative work of different services to provide a specific capability to a Smart Connected Simulator

4 ABOUT SIMWARE SOLUTIONS

Simware Solutions is leading the introduction of Open platforms into the Simulation & Training markets. Our platform Simware leverages the new Layered Simulation Architecture or LSA to fulfill the requirements of the lead users of the industry, which are demanding open architectures, better interoperability and increasing economical returns for their investments in simulation and training solutions.

Our platform is the first commercial product available to build and federate simulations in compliance with initiatives at SISO and NATO related to the use of Simulations assets as Services in the Network. Simware platform provides, out-of-the-box, seamless interoperability of SISO simulation standards like HLA, DIS or CBML with the OMG DDS standard. Multi-standard compliance makes affordable to any budget the development and deployment of LVC simulations over any kind of network.



Beyond our products, our commitment is with standards, actual and future; because of that, we are working at SISO and NATO to develop the future standards and technical architectures for distributed simulation and for the use of M&S as Services (MSaaS).

Simware Solutions is the technological company of NADS. NADS is a simulation company, leveraging radical innovations to make affordable the use of simulation solutions for anyone, anywhere and anytime.