

Exploring Live-Virtual-Constructive (LVC) and NATO Network Standards to Enable C2

White Paper

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Modeling Virtual Environments and Simulations

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1. **BLUF:**

- a. The Naval Postgraduate School (NPS) becomes a contributing member of the Command-and-Control System-Simulation System Interoperation (C2 SIM) architecture team at NATO.
- b. NPS acquires the appropriate permanent infrastructure to observe NATO and U.S. exercises on CENTRIX and SIPR networks.
- c. NPS School builds a physical white cell CoC to observe and study NATO and U.S. constructive exercises.
- d. NPS should build classes and courses around current Joint and Service Level Exercises.

2. **Background:**

- a. Service Oriented Architecture allows commanders to modify the network to enable greater understanding amongst federates of the current operational pictures. The NATO network, or standards, is a method to implement greater mission understanding and interoperability among the 72 nations and organizations associated with NATO. This is enabled by a common set of network and classification standards being developed by NATO. These standards are called the Command-and-Control System-Simulation System Interoperation (C2 SIM) which allows simulation and C2 systems, and robots to share data.
- b. Frameworks exist for DIS and HLA sharing data. The only international standard to federate C2 systems is C2 SIM (data model), based on Web Ontology Language (W3.org). This language enables automated reasoning on computers. The systems have similarities such as naming units, type of units in battlespaces, reports, etc. An example would be a move order, or simulation report. This enables the exchange of reports, orders, plans, and the incorporation of real world C2 with simulation systems. If done correctly, someday some C2 and robotic system will natively utilize C2 SIM. NATO is working with SISO to implement the C2 SIM standard across the force.
- c. Command and Control: NATO and the DoD struggle to employ LVC interoperability standards, despite regulations encouraging these standards (STANAG). NATO is currently working on one for C2 SIM. This is due to the rapidly evolving network and positional tools available. Further complicating the process are varying privacy, health, and general network communication policies within the NATO nations.
- d. LVC Training: The Army conducts NATO LVC training at the Joint Multi-National Training Center (JMRC) in Germany. Many international interoperability issues are tackled within this training led by the Global Simulation Center at Fort Leavenworth and JMRC.

3. **Discussion:**

- a. Bridging the gap between training and operations: The ability to hastily capture terrain and reconstruct digitally in a realistic simulation enables forces to train on the battlefields which they will fight. High-fidelity terrain and battlefield entities gives NATO forces the ability to generate multiple AI opposing forces (OPFOR). This provides a hyper-realistic environment to train US and NATO allies on current and futures battles.

b. Training on Future Battlefields: The battlefield of the future can only be understood through a diverse input of allies who possess greater cultural similarities with potential adversaries. The ability to work with, and incorporate their input allows for increased model fidelity. Furthermore, it enables greater ability to access data and understand nuances often overlooked in warfare planning.

c. Apply Lessons on Different Battlefields: These lessons learned, combined with data attained from a network which enables NPS to work with NATO partners, places the university in a prime position to develop enhanced understanding of future battlefields. NATO allies not only possess knowledge of Europe, but they enable greater understanding of Southeast Asia and Africa based on historical ties. Enhanced data sets also provide improved data sets opposing AI and potentially Blue AI can be trained.

d. Simulation Agnostic: Enabled by a standards-based environment allowing multiple simulations to interact and efficiently communicate. If NATO CS SIM employs VPN capabilities, combined with the efficiency enabled by a common set of standards, users will be able to employ simulation and data models in a diverse set of machines.

e. There is a growing gap in the ability to develop enhanced models from data gained in training. Experts in military networking and AI are not available to refine the capability and employ this information to sharpen US and NATO warfighters capabilities. NPS long history with military simulations and expertise in behavioral AI modeling can be employed by NATO if a networking link is established. NPS is uniquely positioned as it sits within orbit of academic and industry experts in Silicon Valley; the crossroads of what can be an intersection of immense innovation in LVC simulations.

4. Security:

a. VPN, OpenVPN.net: NPS firewall can inhibit NPS participation. MOVES has been able to do this within a VPN enclave. NPS must work with other DoD organizations to ensure compliance with US and European laws which may inhibit communication.

b. Classification Concerns: NPS must embrace NATO Centrix classification system and standard to enable communication with NATO allies and secure data against threats.

5. Recommendations For NPS:

a. NPS adopt C2 SIM NATO standards to improve simulations interoperability. The future requires enhanced cooperation with allies in Europe and East Asia. Establishing a strong network connection with our NATO allies enables NPS to understand network interoperability standards while enabling greater data sets which incorporates nuanced details.

b. NPS establish formal relationship with JMRC and GSC: Gaining access to the NATO network and allows us adhere to standards, enabling highly effective training, and consequently effective operations. It opens the possibility of NPS students working with NATO aligned universities.

c. Work with Joint US counterparts to ensure compliance. This enables common standards amongst the DoD and other elements of the national security apparatus.

d. NPS must strengthen partnerships with Silicon Valley. Bring their experts to campus and discuss simulations.

e. Allows NPS to serve at forefront of modeling and simulation interoperability standards, and positions university to inform larger technology community in Silicon Valley

f. NPS must adopt a Centrix connection: This enables true sharing of data, and enhanced security.

References:

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NATO Community of Interest (COI) Cooperation Portal, Federated Mission Networking (FMN), <https://dnbl.ncia.nato.int/FMNPublic/SitePages/Home.aspx>

NATO MSG-193 Modelling and Simulation Group, Modelling and Simulation Standards in Federated Mission Networking (FMN)

- <https://www.sto.nato.int/Lists/test1/activitydetails.aspx?ID=16999>

NATO MSG-194 Modelling and Simulation Group, Employing the C2-Simulation Interoperation (C2SIM) Standard for Coalition Military Operations and Exercises.

- <https://www.sto.nato.int/Lists/test1/activitydetails.aspx?ID=17000>

MSG-194 Technical Course (Virtual) - Employing the C2-Simulation Interoperation (C2SIM) Standard for Coalition Military Operations and Exercises, 24-25 FEB 2021

NATO short course, MSG-194 Technical Course (Virtual)- Employing the C2-Simulation Interoperation (C2SIM) Standard for Coalition Military Operations and Exercises, 24-25 FEB 2021.

- <https://events.sto.nato.int/index.php/upcoming-events/event-list/event/25-tc/346-msg-194-technical-course-virtual-employing-the-c2-simulation-interoperation-c2sim-standard-for-coalition-military-operations-and-exercises>
- <https://c4i.gmu.edu/c4ifiles/MSG145/MSG145-short-web.mp4>
- https://www.youtube.com/watch?v=3L_Hhxuh6Zc