IT/Web Technologies integration to DOD M&S, and Its Future Direction

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1   Integrate with IT/Web technology

In author's view, the next big step for the DOD M&S will be a synergistic integration with the IT/Web technology. The impact, in the author's view, will be really significant while transcending the current DOD M&S to a new plateau of richness of capabilities and possibilities that we might not ever dreamed of.

The two biggest reasons why the author has the above view:
1. The IT/Web technology can liberate the current DOD M&S, which is somewhat isolated in its own application domain.
    a. DOD M&S has been lived in its own world long time while only supporting DOD specific intrinsic needs – DOD training, research, analysis, engineering, etc. The synergistic integration can dramatically improve the current situation.
    b. Although it is obviously advantageous to adopt DOD M&S for non-DOD M&S application domains, there are relatively few success cases.
    c. The main reason is due to lack of a standard way to reach out and touch the other domains external to DOD M&S.
2. Our society has made a significant investment on the IT/Web technology. Now is the time to leverage those investments.
    a. The IT/Web technology might not be the only technology that can liberate the DOD M&S. However, at this point, there is no other technology except the IT/Web technology, which has been receiving the unprecedented level of investments from the whole society.
    b. Furthermore, the IT/Web technology is one of the best technologies ever invented for interconnecting systems over the networks.
    c. Consequently, the above DOD M&S liberation can be achieved by leveraging the IT/Web technology.

2   DOD Needs

In the author's view, DOD can be immediately benefited when the DOD M&S is adopted for the following areas:
- Predictive situational awareness
- Common operating picture
- Effects based operations.

1. C4ISR
   - Integrating DOD M&S to C4ISR quickly augments the above capabilities to C4ISR. The current generation C4ISR systems are weak on the above areas. Currently, they do not fully take advantage of the DOD M&S although there is a potential that dramatically improves the performance of C4ISR in the above critical areas.
   - Example Case: TBMCS (Theater Battle Management Core System), which is one of the central C4ISR systems of USAF, currently simply interfaces to JSIMS (Joint Simulation System) and AWSIM (Air Warfare Simulation). Such interface only provides C2 inputs to the simulation systems for the training purpose. Bi-directional tight integration between TBMCS and DOD M&S soon should be achieved.
2. Weapon systems
   - Simulation embedding in weapon systems is another area to vastly improve the performance by adding the capabilities listed above. However, the usage of the embedded M&S is still limited to support on-board training or at most mission rehearsals. Again, a full integration with the weapon systems will be the quickest way to make the next generation weapon systems be fully capable in the areas listed above.
   - Example Case: GSTF (Global Strike Task Force), one of the Task Forces of the future USAF, requires a horizontal integration of all existing and future weapon platforms and C4ISR systems. Integration of DOD M&S will be one of the key enablers.
3. Newly emerging concepts
   - JBI (Joint Battlespace Infosphere): Integration of C4ISR systems with IT/Web technology and infrastructure (USAF).
   - Web-Enabled TBMCS: TBMCS with Web interface.
   - JSB (Joint Synthetic Battlespace): Integration of DOD M&S simulation while supporting all domains of M&S as well as supporting all phases of C4ISR and weapons systems from conceptualization to disposal. It clearly requires to be interfaced to C4ISR systems.
   - JVB (Joint Virtual Battlespace): Simulation for US Army FCS (Future Combat Support).
4. Commercial world
   - In the author's opinion, DOD is the organization that has made the biggest investment on M&S. Naturally, many components of the current DOD M&S are immediately applicable to commercial uses from research, product development to game applications.
   - For example, SEDRIS (Synthetic Environment Data Representation Interchange Specification) and HLA/RTI (High Level Architecture and Runtime Infrastructure) surely facilitate the usage of DOD M&S technologies and data for the above commercial applications.
   - The commercial sector's embracement of DOD M&S would also means implicit investments of commercial world if the enhanced M&S components by the commercial sector are feedback to the DOD.

3 Challenges

3.1 Lack of QOS in the existing web

- DOD M&S often requires a real time operation while sending and receiving a tremendous amount of data. The current Web does not support this requirement. The current Web is essentially constructed without QOS (Quality of Services). Thus, when a critical data is sent over the Web, the latency of the reception of the data and the available throughput widely vary. Often a prototype demo with a limited scale works, but the lack of QOS becomes a serious obstacle when scaling up the prototype.
- This deficiency not only affects M&S to M&S integrations. It also affects both C4ISR-to-C4ISR integrations and C4ISR-to-M&S integrations.

3.2 No standard is available for interfacing between DOD M&S and IT systems

- Many of DOD M&S has been operated in a distributed mode. Because of this historical reason, DOD M&S has been having its own well-defined distributed computing standards – SIMNET, DIS, ALSP and HLA/RTI. On the other hand, Web has developed its own standards, which are mainly based on HTTP. HTML, XHTML, XML are some of widely accepted standards.
- Currently, there is no widely accepted standard that can handle both DOD M&S and Web/IT standards. Therefore, ad hoc or proprietary interfaces are introduced, and sporadically uses in limited application domains exist.

3.3 IT was not invented for supporting DOD M&S

- IT, which includes languages/framework such as Java, .NET, and Web applications such as Apache server, has been invented and evolved to provide solutions to business enterprise, B2B (Business to business), B2C (Business to Customer) and web users (web surfing, web based transaction, and P2P – person/point to person/point). Thus, IT is optimized for its intrinsic IT applications not for DOD M&S.
- For example, Java is a wonderfully designed to be web-friendly. However, it is not necessarily friendly to M&S although many attempts have been made to use directly Java for DOD M&S applications. For example, the relatively low run-time efficiency of Java has often become one of the obstacles.

4 Recommendation

4.1 Develop common standard for Web and DOD M&S

XMSF is a good example for this direction. Data representation, network representation and application representation are all important to be considered, as discussed in the XMSF white paper. The author views the following areas should be also addressed:

4.2 Glue for DOD M&S and C4ISR/Weapon systems

DOD M&S will be an integral part of C4ISR/Weapons systems.   To achieve the advantage has been addressed above, the future DOD M&S and Web integration standard/protocol should support the integration of DOD M&S and C4ISR/Weapon systems. Essentially, Web/IT technologies should be the glue between them.

4.3 Dynamic V&V

Web is inherently distributed without a centralized control. If a web-like DOD M&S is constructed, users will instantiate their own simulations as needed. Then, the resultant M&S instantiation on each user's computer will be a customized version of simulation using downloadable plug and play components from the DOD M&S web. First, to make DOD M&S plug and play capable, we can easily adopt the current plug and play component technology of the current web. However, it will be a significant issue that the instantiated simulations by composing plug and play components are correct. That is, the instantiation can support the specific need, while generating valid results as the user intends. A-Priori V&V for all possible cases is prohibitively expensive due to the combinatorial complexity of the possible instantiation space. Dynamic V&V, which performs V&V dynamically as a new component is added, is required. The future integration standard/protocol should be able to facilitate the dynamic V&V.

4.4 MLS (Multi-Level Security)

Multi-level Security is another critical issue when Web based DOD M&S becomes prevalent in future.   Security among plug and play components in a single CPU address space as well as the components crossing multiple CPU address spaces should be provided, and again the future DOD M&S and Web integration standard/protocol should be able to support MLS.

4.5 IDE (Integrated Digital Environment)

DOD M&S protocols have been mainly focusing on the execution of DOD M&S systems in a distributed fashion. Execution of DOD M&S is one phase of the entire life cycle of DOD M&S. Moreover, the future DOD M&S will heavily leverage the IDE. Even, from the point of the IDE, the future DOD M&S will be a part of the IDE, and the entire life cycle of the M&S will be coordinated through the IDE.   The future DOD M&S and Web integration protocol/standards should facilitate this area too.

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