DoD LVC Architecture Roadmap (LVCAR) Study Status

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<table>
<thead>
<tr>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
<th>c. THIS PAGE</th>
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</thead>
<tbody>
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**The LVC Architecture Issue**

- **Current LVC environments are not inherently interoperable.**
  - High Level Architecture (HLA) and Distributed Interactive Simulation (DIS) are most often used for integrating virtual and constructive assets,
  - Test & Training Enabling Architecture (TENA) is widely used in testing and to integrate live assets into exercises/events.
  - Common Training Instrumentation Architecture (CTIA) promotes commonality among the U.S. Army's instrumented ranges and home stations; LVC - Integrated Architecture (LVC-IA) is next-generation Army multi-echelon, integrated, joint, training and mission rehearsal environment.

- **Multiple protocols, gateways, and object models are often used to bring an LVC Environment together.**
  - Interoperability and efficiency issues arise when bringing disparate protocols and entities together in a common operational environment.
  - Complexity, disconnects, duplication of effort, risk, and costs increase with multiple architectures.

_At least four communities agree; critical review needed to develop way forward for efficient, effective interoperability._
What We Are Doing

• Developing a recommended “way ahead” regarding LVC interoperability across three broad areas of concern:
  - Desired future technical architecture(s)
  - Desired business model(s)
  - Manner in which standards should be evolved and compliance evaluated

• The “way ahead” will provide:
  - Rationale for recommendations, citing the findings on which they are based
  - Recommendations on the required management / governance structures and processes to implement the “way ahead”
  - Recommended next steps (e.g., prototyping any new architecture)
**Desired Outcomes / Effects**

- Achieve greater LVC interoperability
- More efficient federation composition and federate re-use
- Reduce / avoid duplication of efforts / costs
- Responsive to evolving requirements
- Maintain or increase innovation
- Achieve the network effect
- Address the needs of broadest user domain feasible (flexibility vs. cost vs. performance)
Deliverables

✓ Project Plan
✓ Workshop #1 Report
✓ Literature Review Report
✓ Capabilities and Limitations of Current LVC Architectures
✓ Use Case Template
✓ Ideal Use Case Set
✓ Unified LVC Use Case Document
✓ Workshop #2 Report
✓ Use Case Requirements
✓ Capabilities and Limitations vs User Requirements Map
✓ LVCAR White Paper
✓ LVCAR Functional Requirements Document
✓ Capabilities and Limitations Unified Document
✓ Capabilities and Limitations vs Requirements Document
○ Interim Report
□ Business Model Comparison Document
□ Standards Management and Evolution Process Model Comparison Document
□ Alternatives Ranking Report
□ Final Report

✓ Completed
Requirements Data Sources

- Foundational Documents (Existing Requirements)
- Workshop Grass-roots
- Survey Data
- RFIs as follow-on to Survey Data
- Use Cases
- Expert Team, Government Team, and Working Group Reviews
Use Cases

- Urban Resolve 2015
- DDG 1000 Design and Testing
- AF LVC Operations
- AVCATT and CCTT Interoperability
- JTEM Sys Eng
- ISR LVC Integration w/ Red Flag
- Heavy Brigade Combat Team
- Ulchi Focus Lens using ALSP
- Korean Battle Simulation Center
- NASA
- FCS Imbedded Training
- CVN-21
How do we move forward to best meet current and future needs?
Baseline Schedule
LVCAR Organization

Oversight
Training*
Experimentation
Acquisition
Testing
Red Team

Manager
USJFCOM J7
Gov’t Team

Working Group
Project Team
Expert Team

Business Model Team
Standards Team
Integrating Architecture Team
Insights

- Mixed architecture environments are a by-product of the simulations chosen for the application, not because of any inherent benefit to mixing architectures.
- When mixed architectures are necessary, point solutions to bridging the architectures do work, although they may be relatively inefficient.
- Architectural choices of how data is transferred between applications and application-level choices of what data will be passed have impacts on interoperability.
- Significant improvements in LVC interoperability can also be achieved via supporting data, tool, and process standards.
- There will be a need to recognize and account for longer-term trends (e.g., SOA) in the LVC “way ahead.”
Architectural Options

1. Status Quo or “Do Nothing” – No architectural effort to unify or enhance the existing alternatives will be undertaken. Each existing architecture will evolve based on its own users’ needs, and mixed-architecture events will continue to exist as currently achieved.

2. Actively Manage the Existing Architectures – Create standard inter-architecture integration solutions (effectively create an “architecture of architectures”). Keep the current multiple architectures but invest in improving the construction / performance / integration of various gateways, translators, object models, and create processes and procedures to make inter-architecture integration “faster, easier, cheaper.” Stand up an architecture management board (both policy and technical) to oversee all of the architectures to discourage divergence and encourage compatible evolution.

3. Convergence – Each of the existing architectures is evolving, some quickly, some slowly. Create policy and procedures, and provide small amounts of seed money, to encourage the architectures to converge with one another in X-year time frame (e.g., 10). When they become so similar in features and capabilities, engineer the merging of them into a single architecture. Requires an architecture management board (both policy and technical) to oversee all of the architectures.

4. Select One of the Existing Architectures – Of the existing architectures, choose the one that is the most promising for the long term DoD LVC community. Use policy and funding to throw the weight of the department behind the one chosen, make improvements where necessary, discourage the others, and eventually get to the situation where the chosen architecture is dominant.

5. Develop A New Architecture – With a better understanding of the broad DoD LVC requirements and the manifest lack of any of the current architectures to fully meet them any time in the future, create a new architecture from the best ideas of all the existing ones, and put the whole weight of the Department behind it.
Management / Governance Considerations

- Alignment and establishment of relevant policy
- Allocation and influence of architecture related budgets
- Community Communication through papers, tutorials, liaison, …
- Product Support (technical assistance, cost sharing, LVC environment integration lab, …)
- Distribution of middleware/licenses and other tools
- Architecture requirements tracking, coordination, and arbitration
- Technical dispute tracking, coordination, and arbitration
- Participation in external standards bodies
What’s Next?

• **Focus on the finish line:**
  - Gather additional metrics data for COA evaluation
  - Finalize COA recommendations
  - Detail “way ahead” activities and milestones
Contact Info

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Questions
Backups
Terms of Reference

- **Interoperability**: The ability of a system to provide information/services to and accept information/services from other systems, and to use the information/services so exchanged to enable them to operate effectively together.

- **Integrating Architecture**: A set of protocols, specifications, standards and/or middleware services that define and enable interoperability between LVC systems (e.g., TENA, HLA, DIS, CTIA).
Architecture Requirements

- Create a distributed simulation, allow systems to join and resign; provide for initialization and destruction of the distributed simulation instance
- Support publish and subscribe information management
- Quality of service
- Support multiple message types
- Save and restore operation
- Region-based information management (filtering)
- Transfer of ownership
- Synchronize applications
- Object-oriented design
- Global event ordering
- Specification for Tools and Utilities
Future Requirements

- Quality of Service
- Fault Tolerance
- Information Assurance
- C4I System Integration
- Interface to GIG
- Load Balancing
- Gateways and Bridges
- Object Models