DoD LVC Architecture Roadmap (LVCAR) Study Status

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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

Leading Transformation

Requirements Data Sources

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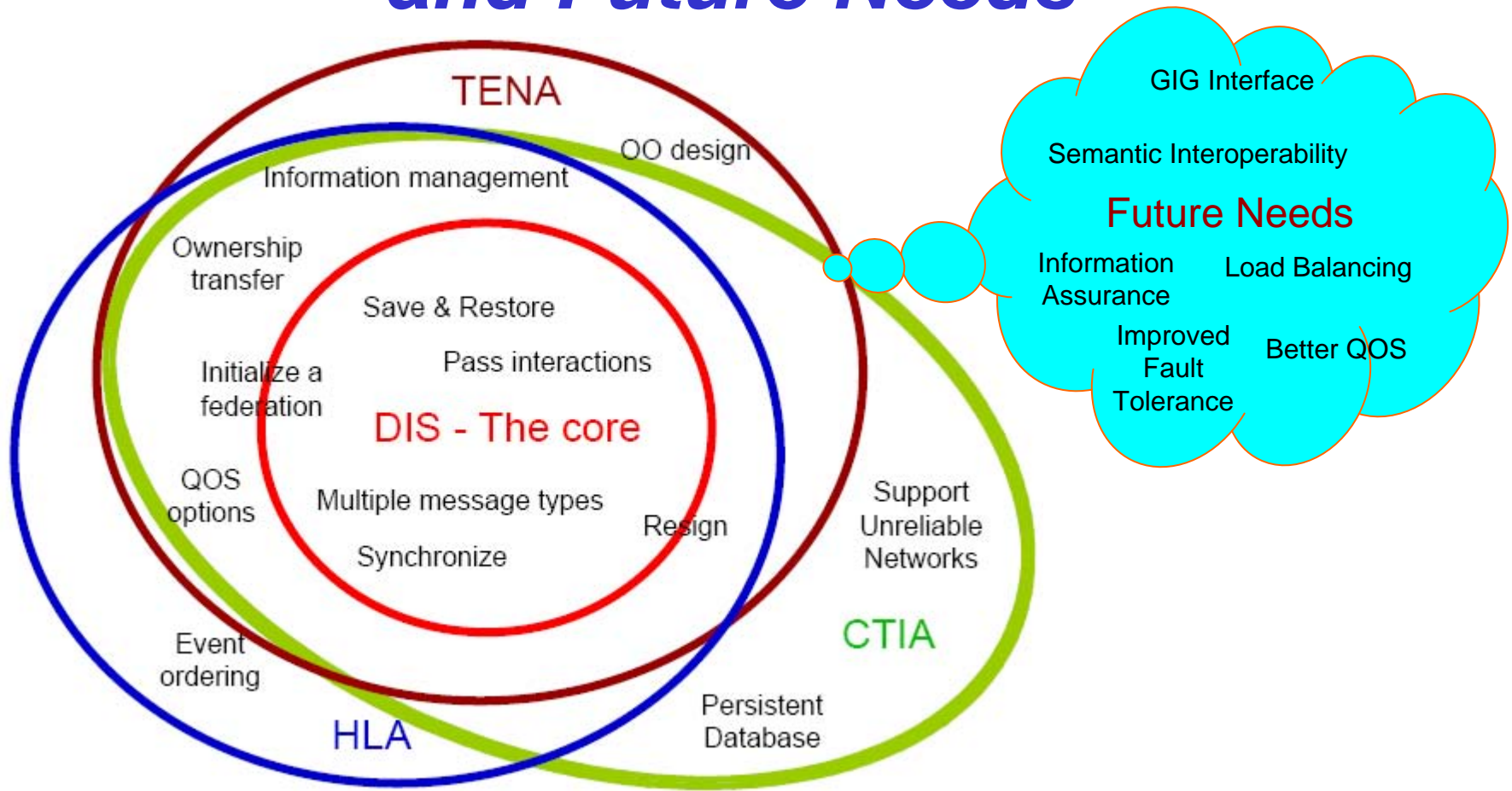- **Expert Team, Government Team, and Working Group Reviews**

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**
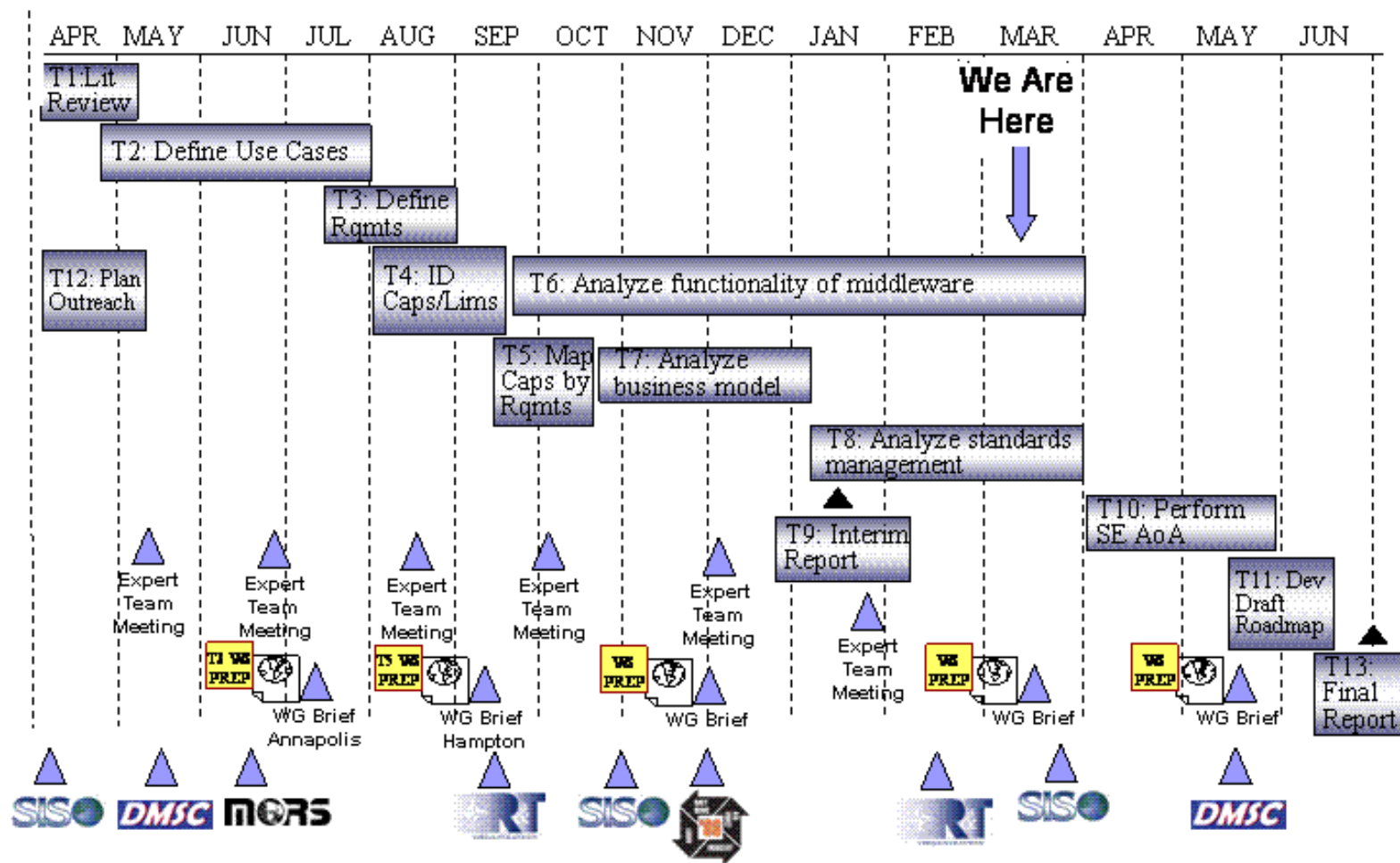- **NASA**
- **FCS Imbedded Training**
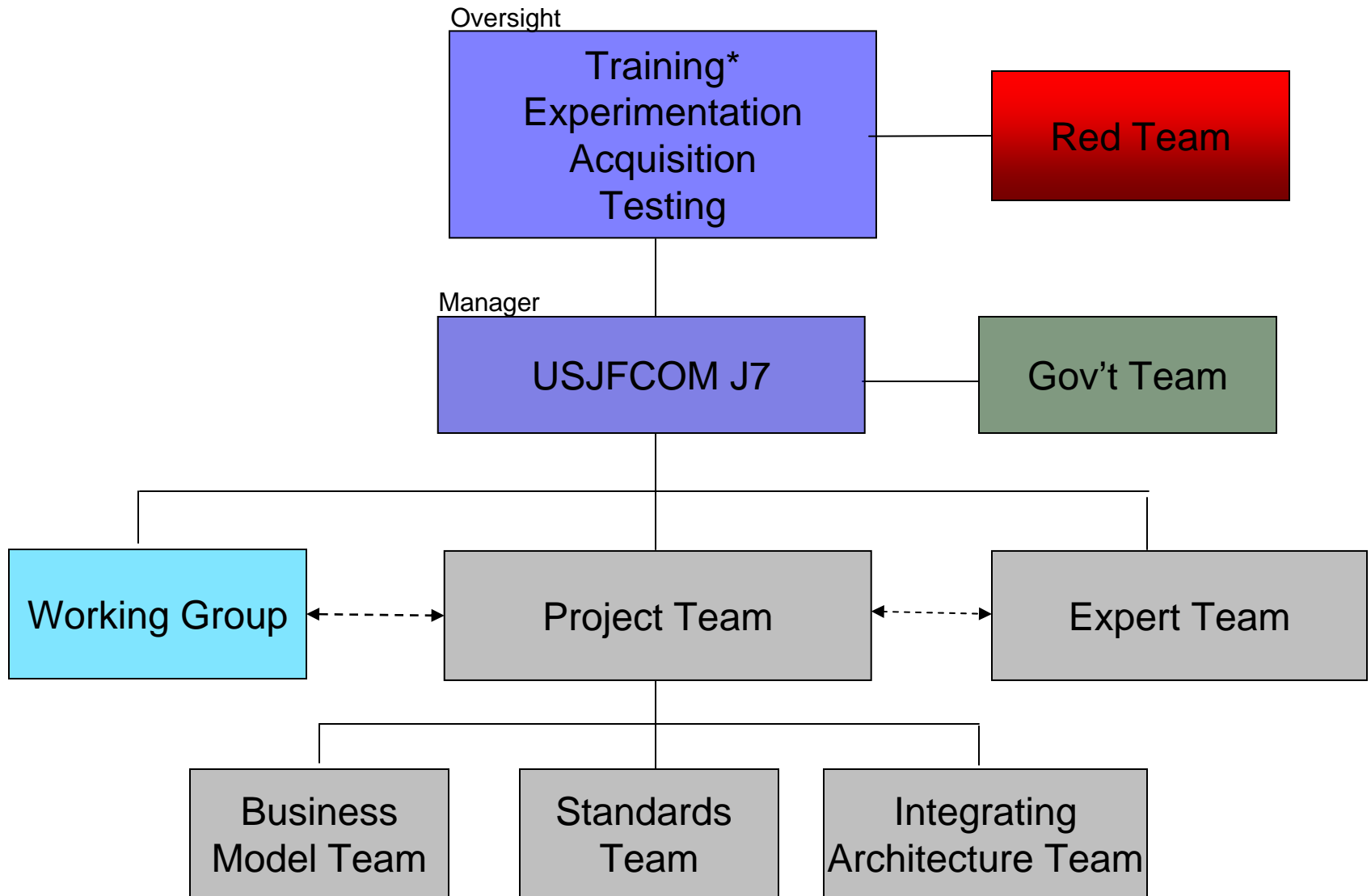- **CVN-21**

Integrating Architecture Overlap and Future Needs

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

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Questions

Leading Transformation

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**