



**HARDWARE
IN THE LOOP**

HARDWARE IN THE LOOP

Integrated System-of-Systems testing is required as DoD seeks to achieve revolutionary advances in warfare. Teledyne Brown Engineering's (TBE's) suite of Hardware-in-the-Loop (HWIL) test tools helps our customers meet emerging DoD requirements to operate in a fully integrated DoD network-centric System of Systems.

The Role of HWIL

Extensive and thorough ground testing is recognized as a necessary and critical process for the development of any complex military system. When operational success is essential, an HWIL test capability is needed. Many existing HWIL testing applications focus on a single system immersed in its own simulated environment. TBE has pioneered the development of capabilities that perform HWIL tests of large, integrated systems. TBE's HWIL testing solutions address the special characteristics of large, integrated systems:

- Critical timeline for integrated operations
- Complexity of individual systems
- Systems data exchange for coordination

- Dynamic system operation
- Significant regret if any system fails
- Coupling of individual systems.

HWIL Testing Benefits

TBE's HWIL testing has been proven effective in finding the latent errors in a large, integrated System of Systems. In one large-scale missile defense program, for example, over 40% of trouble reports were found by TBE's HWIL test tools. Results like this will significantly reduce overall pro-

gram cost as well as program risk.

Our Solutions to Successful HWIL Testing

- Complete management of all distributed operations
- Coordination of multiple contractors
- Full synchronization of environments
- Configuration and interface documentation
- Assured interoperability of systems

- Rapid feedback and data analysis
- Independent system integrator meeting requirements of Title 10, Section 2399, "No person employed by the contractor may be involved in the conduct of DT/OT."

The TBE Advantage

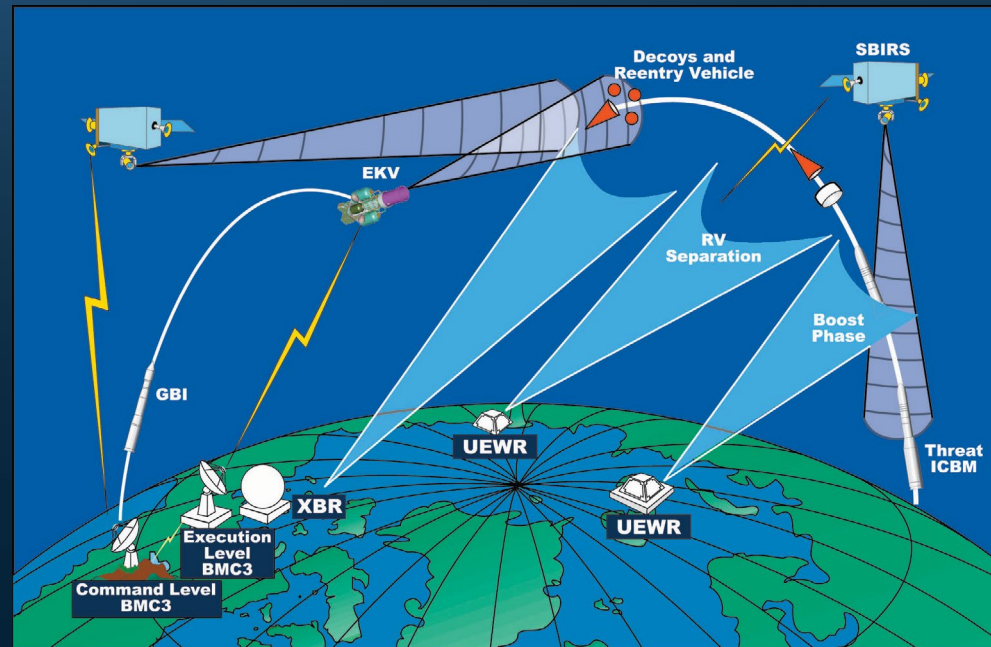
TBE offers a range of services that meets the full spectrum of needs for effective HWIL testing of large, integrated distributed systems. The TBE solution is comprehensive in providing management, design and implementation, and complete records management for cost-efficient HWIL testing applications. The TBE solution provides the following advantages over our competitors:

- Fully Synchronized Environments – The major problem of achieving synchronized operation of distributed environments has been solved by TBE's test infrastructure.
- Real-Time Distributed Testing – TBE has the know-how to make efficient use of the distributed network to mitigate latency

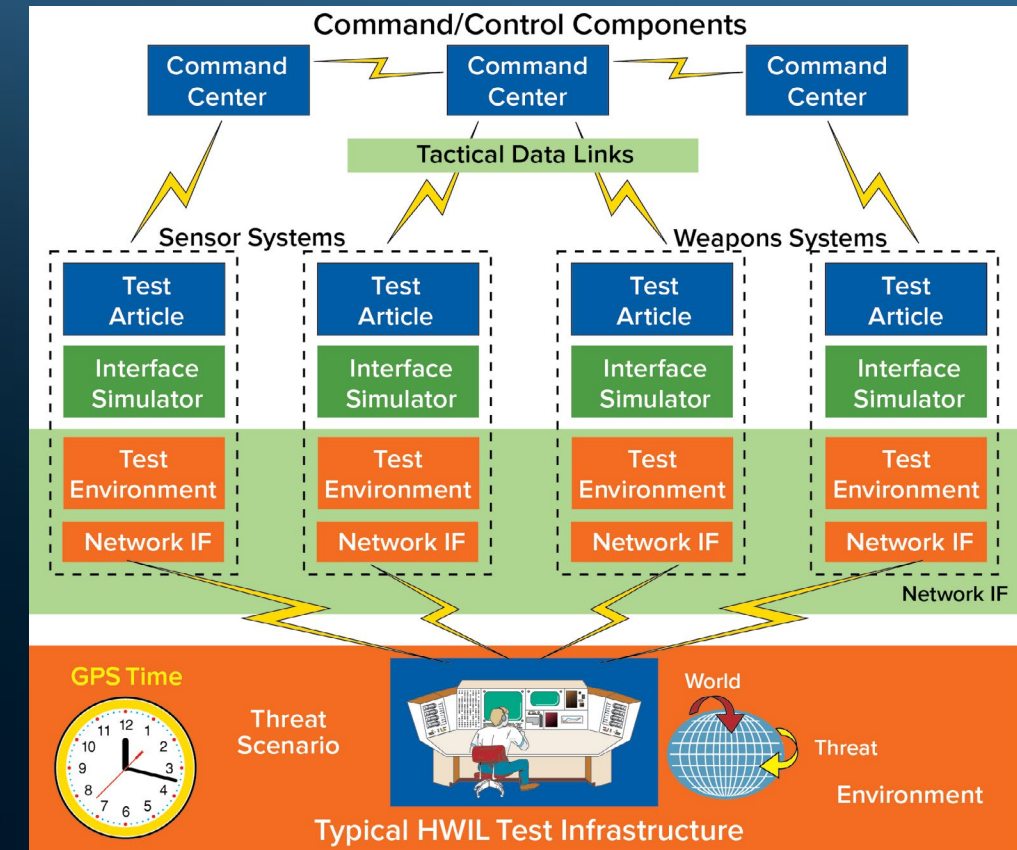
effects of a distributed network.

- Test System Cost Efficiency – Our automated tools and processes make the data usable and available quickly. TBE's rapid analysis and reporting on each test configuration increases the efficiency of the test system, eliminating delays as each test case is reviewed.

- Reduced Development Time – We have an extensive inventory of environment and system models to rapidly assemble a HWIL test system for your needs.



Example of a System of Systems



environments, and test analysis tools to optimize your HWIL test systems.

Past Performance

The following successful programs demonstrate TBE's competence and knowledge base to meet the requirements for your HWIL test system:

- Integrated Systems Test Capability (ISTC) – A HWIL integration laboratory developed for and used on a current missile defense program.
- Missile Defense Systems Exerciser (MDSE) – MDSE provides a full, integrated solution for the interoperability and system performance assessment of the Ballistic Missile Defense System.
- Test System Control Center (TSCC) – This HWIL control center coordinates the test assets at the Kwajalein Test Complex.
- Single Stimulation Framework (SSF) – Team Teledyne provided sustainment and enhancement support to SSF to provide a modular test framework interconnecting BMDS Elements/Components and HWIL facilities.

SSF supports distributed exercises and training. The SSF allows for the tactical systems to be exercised in a realistic theater and/or global conditions by utilizing tactical HW and SW.

- Objective Simulation Framework (OSF) - Team Teledyne developed initial versions of MDA's flexible M&S Architecture – the Objective Simulation Framework. OSF is configurable to support all Stakeholder Applications to include BMDS Concept Evaluation, Developmental Engineering, Assessment (including Ground Test and Continuous Digital Assessment), and Training. OSF provides Truth Stimulation and Integration to support interoperability, performance assessment testing, and training events.

Benefits Provided by TBE for Your HWIL Requirement

- Experience – Beginning in 1984, our innovative engineering team pioneered the initial work for the MDA to realize the vision of full HWIL testing.
- Teamwork – Our dedicated

functional and technical team has demonstrated the ability to perform integrated systems tests involving Government personnel, system users, and system developers. Our collaboration network and full documentation support this objective.

- Technology – We have the full range of technological resources to make your System-of-Systems test program a success. TBE is assessed at SEI CMMI Maturity Level 3 and is ISO 9001 registered.
- Meeting the Challenge through Experience and Innovation – TBE has built positive working relationships with the MDA, Missile Defense Integration and Operations Center (MDIOC), all branches of the military, Project Offices, and the element developers. We are prepared to apply our knowledge and innovative techniques to develop, integrate, and enhance System Frameworks for future clients.

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