

Establishing Simulation Standards for Military Vehicle Components

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Introduction

- This presentation will (hopefully) answer the following questions:
 - What is VSIL?
 - What is being standardized?
 - What is the Reference Architecture?
 - Why does it matter?
 - How will it become a standard?

What is VSIL?

What: Vehicle Simulation Integration Laboratory (VSIL) is a simulation system for testing all aspects (electrical, network, operations, thermal, weight, etc.) of prototype vehicle designs prior to committing to a physical prototype.

Who: The Army Tank and Automotive Command (TACOM) Tank and Automotive Research Engineering Center (TARDEC) in Warren, Michigan sponsors the work with Cybernet Systems, Inc. through a Small Business Innovative Research grant.

When: As soon as possible (Contract is currently in 3rd year of funding, with two more years funded).

Why: To enhance the ability of TACOM to create next-generation vehicles for our troops.

VSIL Objectives

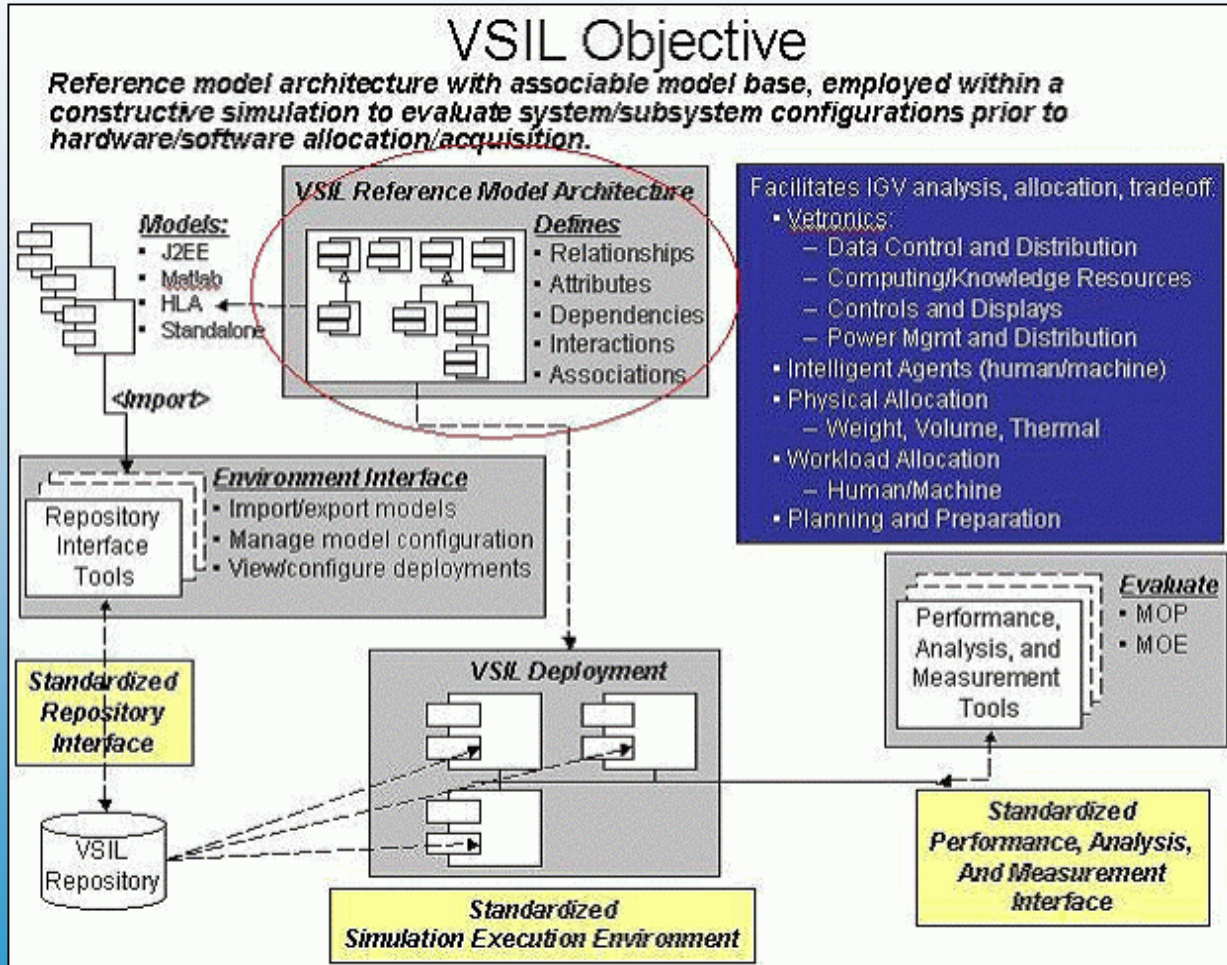
The objectives of the VSIL project are:

- Provide a set of modular simulation components with “Lego-like” interfaces,
- Provide tools to create, find, and manipulate these components into a full, working, system simulation,
- Provide tools to execute that system simulation, display and analyze the results, and archive the results.

If these objectives are met, TARDEC can expect the following benefits:

- Reduced development time,
- Improved re-use of simulation models,
- More inter-group communication,
- Third-party and commercial vendors able to create compatible models

VSIL System Overview



The Reference Architecture

“Reference Architecture” (RA) refers to the set of *interface specifications* for each of the components that are used to build a virtual system.

By defining the component interfaces, we leave implementation decisions in the hands of the vehicle designers. (But we are developing a reference implementation of components as part of our work.)

It is extremely challenging to develop interfaces that incorporate all current implementations and also anticipate future needs.

It is extremely challenging to develop interfaces that are generic enough to allow component interaction, yet specific enough to provide needed functionality.

Reference Architecture Requirements

- **Functional**
 - The interface must support the underlying implementation(s)
- **Interoperable**
 - Simulation engine agnostic
- **Hierarchical**
 - For both organizational and functional purposes, components are grouped into family trees
- **Support Legacy Models**
 - The reference architecture must be compatible with existing models
- **Scalable**
 - The architecture itself needs to support modularization of the system simulation.

Technical Challenges and Solutions

Challenge: Software team lacked systems engineering domain knowledge

Solution: Hold design working meetings with TARDEC engineers

Challenge: Need to balance functionality with “tight” interface design

Solution: Apply best-practices from Object-Oriented software design

Challenge: Expressing different relationships among component models

e.g. Inheritance versus Containment versus Association

Solution: Inheritance of interfaces, containment by reference, association by connection

Challenge: Supporting different levels of simulation fidelity with the same interfaces

Solution: More or less fidelity built into the underlying model, still communicating through the same interface

Performance

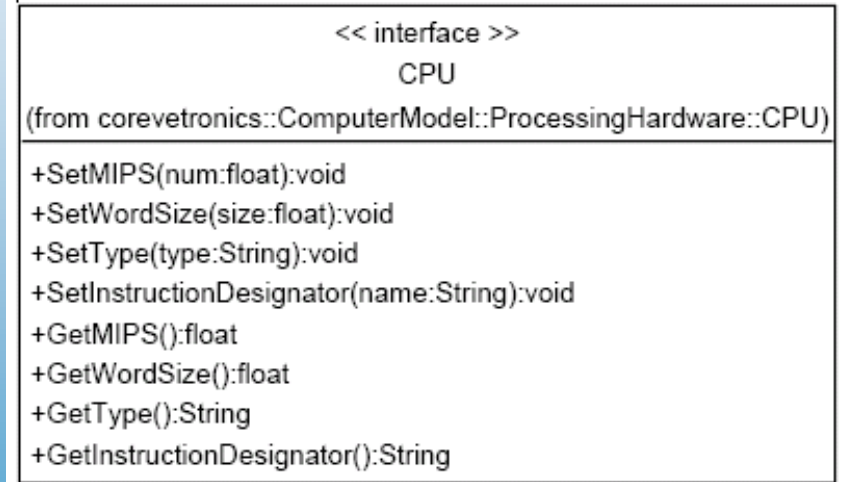
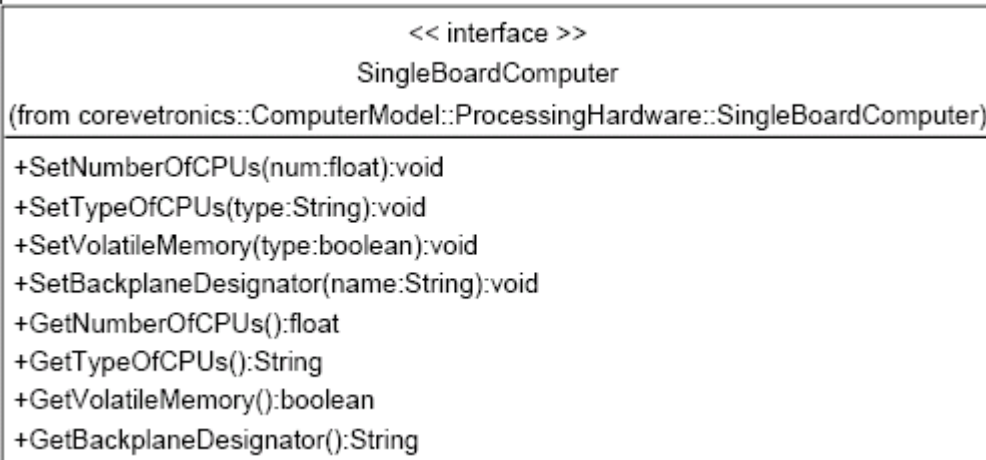
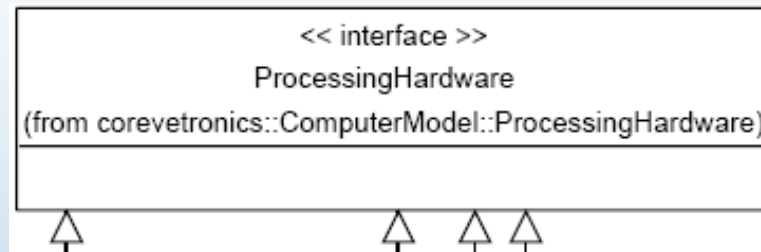
Non-Technical Challenges

Challenge: To promote the adoption of the VSIL Reference Architecture as the standard for all future TACOM design work.

Solution:

- High visibility,
- Fostering relationships with key personnel,
- Demonstrating the cost/benefit advantage

An Example



Tools

One of the key objectives of the VSIL effort is to make an interface-based system so that the implementations can be changed without re-engineering the core components. We achieved this by creating socket-based services that can be implemented for any simulation engine, repository infrastructure, and/or display suite. Our choices for reference implementation components were driven by cost, functionality, and availability.

Ptolemy II – An open source simulation construction and execution framework
<http://ptolemy.eecs.berkeley.edu/>

Concurrent Versioning System (CVS) – An open source configuration management tool.

OpenSIM™ - A data visualization toolkit developed under SBIR by Cybernet



VSIL - CPU Comparison Demo - Automated

File Edit Window Help

VSIL: CPU Demonstration

VSIL: Created by Cybernet Systems under contract DAAE07-03-C-L151 for US Army TACOM.

This demonstration simulates three different CPUs to show the tradeoffs made when selecting a CPU for the Hull Processing Unit of the Bradley IFV.

Contact: Glenn Beach - 734.666.2567 or gbeach@cybernet.com

Demo Status

9. CPU Processing...

START PAUSE RESUME STOP

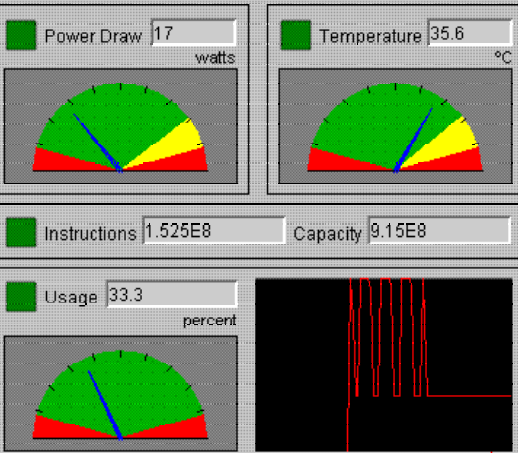
CPU Status (Model 3)

Model: 1.4 ghz, UltraSPARC III Cost: 5000.00 dollars

Power Draw: 17 watts
Temperature: 35.6 °C

Instructions: 1.525E8 Capacity: 9.15E8

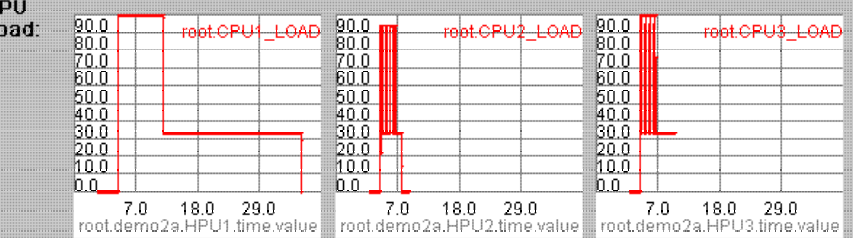
Usage: 33.3 percent



System Analysis

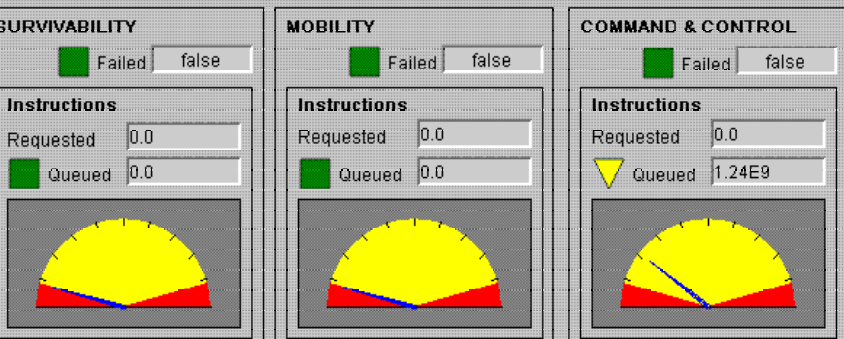
Model:	550 mhz, UltraSPARC II	1.2 ghz, UltraSPARC IV	1.4 ghz, UltraSPARC III
Average Power:	105.9 watts	127.9 watts	116.8 watts
Unit Cost:	5600.00 dollars	24600.00 dollars	9600.00 dollars
Run Time:	36.6 seconds	9.0 seconds	10.2 seconds
CSCI Failure:	true	false	false

CPU Load:



CSCI (Software) Status (Model 3)

SURVIVABILITY	MOBILITY	COMMAND & CONTROL
Failed: false	Failed: false	Failed: false
Instructions Requested: 0.0	Instructions Requested: 0.0	Instructions Requested: 0.0
Instructions Queued: 0.0	Instructions Queued: 0.0	Instructions Queued: 1.24E9



Project Status

- Currently 18 months into 24 month Phase II effort
- We have completed the implementation of:
 - The Simulation Execution Environment
 - The Component Model Repository
 - Performance Analysis and Measurement
 - Reference Architecture Implementation
 - Power generation and distribution
 - Mobility and Survivability Vetrionics
 - Computer and software components
 - Data distribution
 - Integration with Matlab/Simulink component models

Future Direction

We are currently developing a tool to allow a test engineer to rapidly construct whole-vehicle simulations with simple drag-and-drop interactions with the component library.

We will shortly complete interface implementations for J2EE, HLA, and DIS component models.

Whole-vehicle simulations of the Bradley Fighting Vehicle and Stryker are planned for the upcoming year.

As SoSCOE and WSCOE systems come online, compliant system-level (as opposed to component level) simulation interfaces will need to be developed.



Questions

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