

# An Insider's View on the Making of the New TLM-2.0 Standard

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**In case** you haven't heard, the Open SystemC Initiative (OSCI) announced the new transaction-level modeling (TLM) standard, TLM-2.0, at this year's DAC. The result of several years of intensive work by the OSCI TLM Working Group, the standard represents a milestone for the SystemC community to deliver a truly viable standard for model interoperability and reuse of intellectual property.

Why is TLM-2.0 so important? TLM-2.0 standard interfaces for SystemC provides an essential framework needed for model exchange within companies and across the IP supply chain for architecture analysis, software development and performance analysis, and hardware verification. It explicitly addresses virtual prototyping in which SystemC models can easily be exchanged and arranged within a system. By providing a strong modeling foundation for virtual prototyping, the standard enables optimal reuse of models and modeling effort across different use cases.

And why is the completion of TLM-2.0 so noteworthy? The demand for standards-based modeling guidelines is strong, and adoption by the industry will be swift – and in fact is already underway today. More than 2,100 SystemC users and OSCI members participated in a public review initiated late last year, providing feedback on the second draft of the standard and leading to significant enhancements. Some of the key changes in TLM-2.0 include new unified interfaces for the loosely-timed and approximately-timed modeling styles and increased support for extended protocol definitions using the generic payload.

OSCI is currently developing a SystemC TLM-2.0 language reference manual (LRM) that should be completed by the end of 2008. This OSCI LRM will then be used to drive the IEEE standardization process for TLM-2.0.

## The Making of a Standard

As model interoperability has become a fundamental necessity across the electronics supply chain, so has the tremendous amount of effort expended to define and support a viable standard to address the issue. Members of the TLM Working Group represent a cross section of ESL, EDA, IP, Semiconductor, and Systems companies who bring a wealth of TLM expertise and broad perspective to aligning on a modeling standard.

### OSCI TLM-2.0

*Advancing Model Interoperability and Reuse for Transaction-Level Modeling*

#### Use Cases, Coding Styles and Mechanisms

##### Use Cases

Software development

Software performance

Architectural analysis

Hardware verification

##### Coding Styles, Abstractions

Loosely-timed

Approximately-timed

##### Mechanisms

Blocking interface

DMI

Quantum

Sockets

Generic payload

Extensions

Phases

Non-blocking interface

##### Contents

- Interfaces for Loosely-Timed (LT) Modeling
- Interfaces for Approximately-Timed (AT) Modeling
- Generic Payload for Memory-Mapped Buses
- Direct Memory Interface (DMI)
- Debug Transaction Interface
- Users Manual, Training Materials, Examples

Working together for the past three years, the group has invested significant effort in developing a comprehensive users manual, training presentation, and examples to describe and demonstrate the standard's content. All are extremely committed to delivering a language reference manual this year, and the ultimate goal of IEEE standardization for TLM-2.0.

When the group started out, the primary goal was to standardize the way models communicate. The group achieved that and, along the way, found a way to satisfy key performance requirements. In December 2006, OSCI announced the delivery of the TLM-2.0 draft 2 kit, containing proposed extensions to OSCI TLM application programming interface (API) standards, an open-source library implementation, and interoperable modeling examples. Since then, the scope of the standard has been expanded. It is more cohesive, and where possible, simplified to include more thorough documentation and improved examples.

The extended APIs provide a fundamental, general-purpose interoperability layer. A specific payload, to be used in conjunction with these interfaces, helps achieve a higher degree of interoperability when generically modeling memory-mapped bus-based components. Over time, this generic payload has been simplified, and the efficiency of the mechanism for extending it has been improved.

After a successful public review period of the TLM-2.0 draft 2 kit ending January 31, feedback from companies throughout the worldwide SystemC ecosystem offered significant ideas for improvement. OSCI was committed to reviewing and addressing all suggestions received in this process. Experts from over 18 SystemC user companies, ESL tool developers, and IP providers provided their input to refine the interoperability benefits of the emerging standard.

As TLM-2.0 progressed, several features were added to boost simulation performance – enabling what is called “speed interoperability” in addition to “model interoperability” for SystemC virtual platforms. Temporal decoupling allows initiator models, such as instruction set simulators, to run ahead of the SystemC kernel and synchronize only periodically to significantly reduce the required number of costly context switches. The addition of the direct memory interface allows interconnect models to be bypassed, facilitating high-speed access to modeled memory. A dedicated transaction debug interface ensures that debugging is an integral part of a system model while

enabling debug activity without interference with the system simulation.

With worldwide interest so high, a lot of attention has been paid to thoroughly documenting the TLM standard every step of the way. Now completed, the TLM-2.0 standard is posted on the OSCI website along with a users manual, training presentation, and multiple examples to describe and demonstrate TLM-2.0 in action. We encourage you join in and move forward with the industry to adopt standards-based SystemC TLM-2.0 modeling guidelines for your system design environment today.



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OSCI is hosting the 7th Symposium on Electronic System Level Design with SystemC on June 8-9. Co-located with DAC in Anaheim, the event features an in-depth workshop on TLM-2.0. Find out more about the symposium at [www.systemc.org](http://www.systemc.org).

TLM-2.0 has been a fantastic journey, and I thank all of you who have had a part in making it such a success.



**Open SystemC Initiative**  
Defining and Advancing SystemC Standards

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