



# **Towards a SystemC Transaction Level Modeling Standard**

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June 2004**

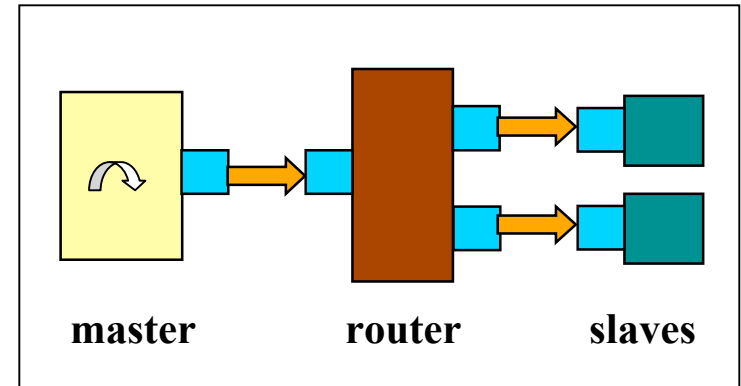
# SystemC Transaction Level Modeling

## ■ *What is TLM?*

- Communication uses function calls  
`burst_read(char* buf, int addr, int len);`

## ■ *Why is TLM interesting?*

- Fast and compact
- Integrate HW and SW models
- Early platform for SW development
- Early system exploration and verification
- Verification reuse



# SystemC Transaction Level Modeling

- ***How is TLM being adopted?***

- Widely used for verification
- TLM for design is starting at major electronics companies

- ***Is it really worth the effort?***

- Yes, particularly for platform-based design and verification

- ***What will help proliferate TLM?***

- Standard TLM APIs and guidelines
- Availability of TLM platform IP
- Tool support

- **SystemC TLM Standard**

# SystemC TLM Standards Efforts

- **OSCI TLM WG**
- **OCP-IP**
- **June 2004: OSCI / OCP-IP TLM Standardization Alliance**
  - Agreement to build on a common TLM API foundation
- **TLM API proposal from Cadence distributed to OSCI and OCP-IP**
  - Proposal intended as common foundation for OSCI and OCP-IP
  - Allows protocol-specific APIs (e.g. AMBA, OCP)
  - Wide range of abstraction levels

# Endorsements of Current TLM Proposal

**“We are excited about the TLM API proposal that is currently being reviewed by the OSCI TLM working group. This proposal satisfies the technical requirements of the TLM-API WG. We believe it can provide the standard foundation that enables transaction level SystemC IP to be developed and reused quickly and efficiently.”**

- **Mark Burton, ARM, Chairman of OSCI TLM Working Group**
- **Adam Donlin, Xilinx**
- **Frank Ghenassia, ST Microelectronics**
- **Serge Goossens, CoWare**
- **Anssi Haverinen, Nokia, Chairman of OCP-IP TLM Working Group**
- **Mike Meredith, Forte Design Systems**
- **Stuart Swan, Cadence Design Systems**



# TLM API Goals

- **Support design & verification IP reuse**
- **Provide common TLM recipe**
- **Usability**
- **Safety**
- **Speed**
- **Generality**
  - Abstraction Levels
  - HW / SW
  - Different communication architectures (bus, packet, NOC, ...)
  - Different protocols

# Key Concepts

## ■ Focus on SystemC interface classes

- Define small set of generic, reusable TLM interfaces
- Different components implement same interfaces
- Same interface can be implemented
  - ◆ directly within a C/C++ function, or
  - ◆ via communication with other modules/channels in system

## ■ Object passing semantics

- Similar to `sc_fifo`, effectively pass-by-value
- Avoids problems with raw C/C++ pointers
- Leverage C++ smart pointers and containers where needed

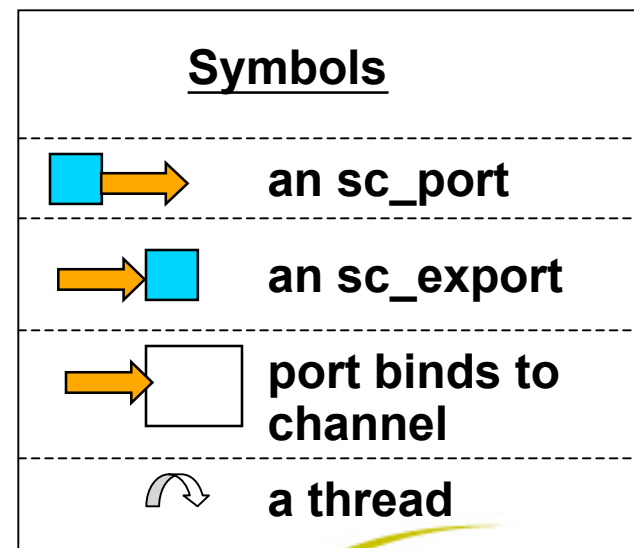
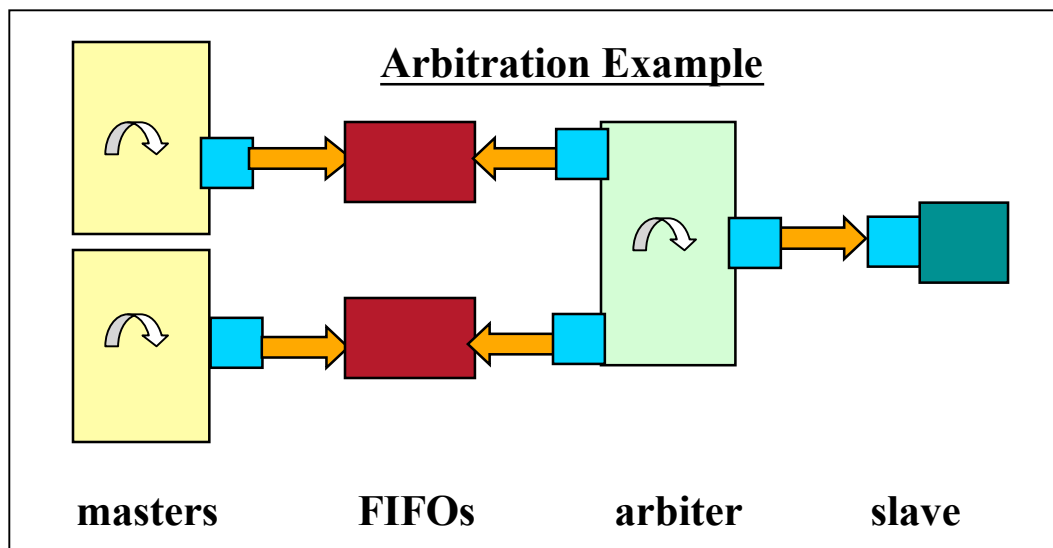
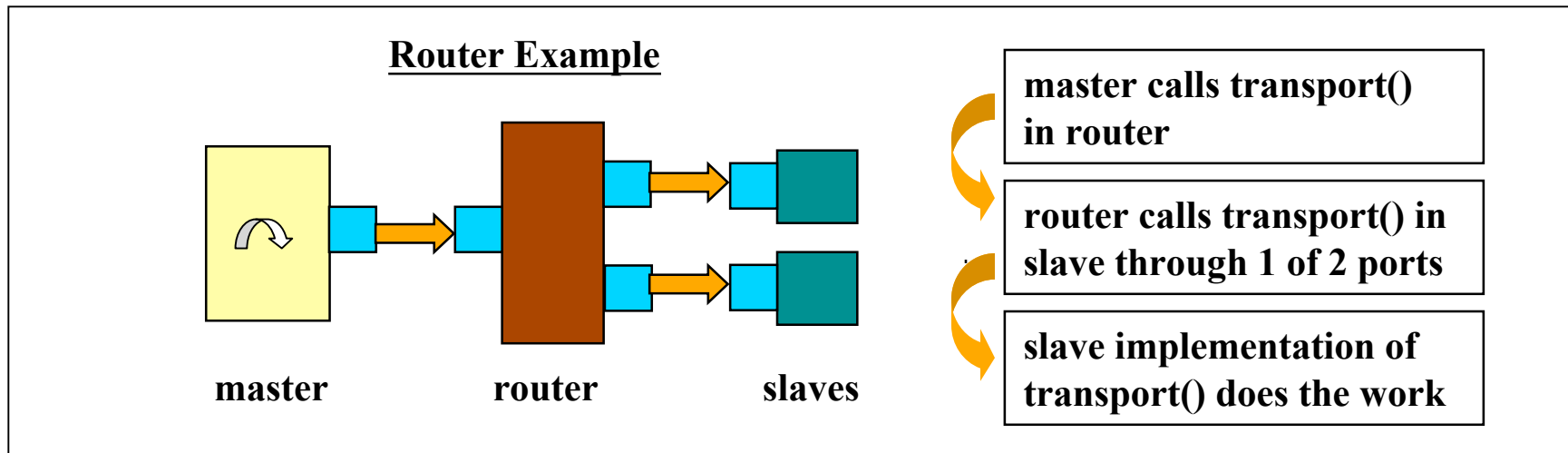
# Key Concepts (cont.)

- **Unidirectional vs. bidirectional dataflow**
  - Unidirectional interfaces are similar to `sc_fifo`
  - Bidirectional can be easily and cleanly layered on unidirectional
  - Separates requests from responses
- **Blocking vs. nonblocking**
- **Use `sc_port` & `sc_export`**

# Layered TLM API Architecture

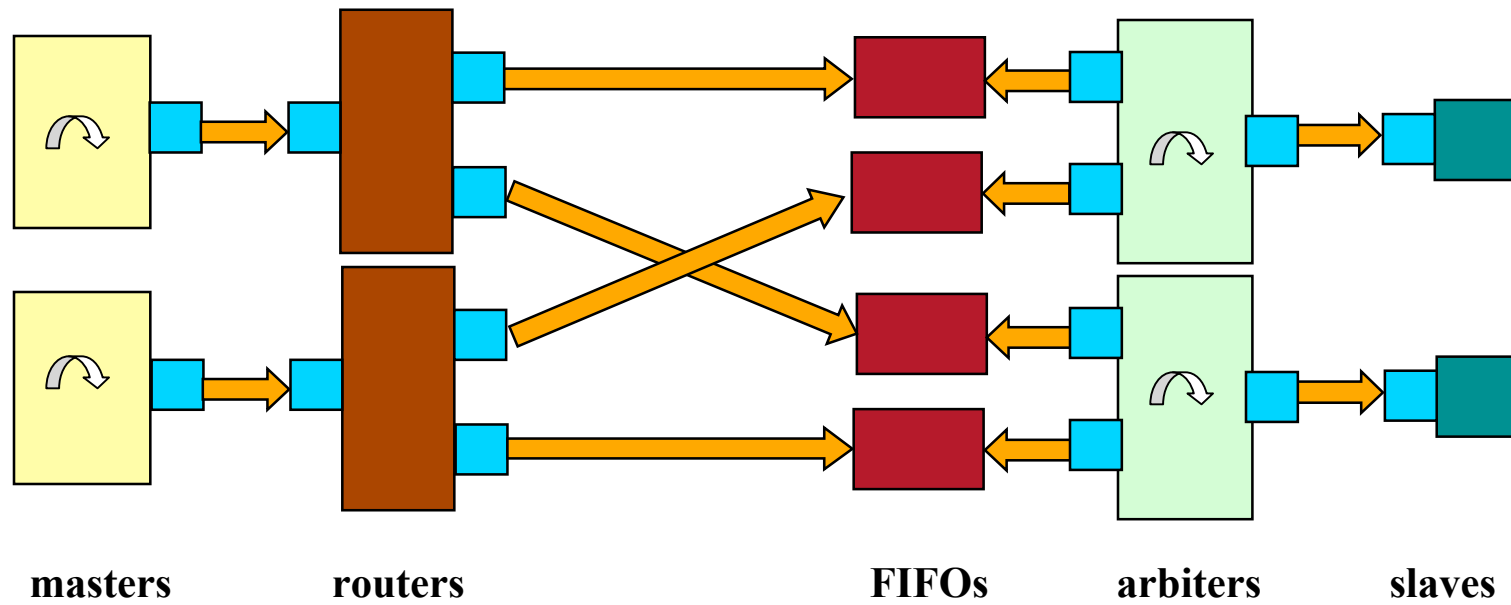
|   |   |
|---|---|
| <p><b><u>User Layer</u></b></p> <p>Protocol-specific “convenience” API<br/>Targeted for embedded SW engineer<br/>Typically defined and supplied by IP vendors</p>   | <pre>amba_bus-&gt;burst_read(buf, adr, n);</pre>                                      |
| <p><b><u>Protocol Layer</u></b></p> <p>Protocol-specific code<br/>Adapts between user layer and transport layer<br/>Typically defined and supplied by IP vendors</p>  | <pre>req.addr = adr; req.num = n;<br/>rsp = transport(req);<br/>return rsp.buf;</pre> |
| <p><b><u>Transport Layer</u></b></p> <p>Uses generic data transport APIs and models<br/>Facilitates interoperability of models<br/>Key focus of TLM standard<br/>May use generic fifos, arbiters, routers, xbars, pipelines, etc.</p> | <pre>sc_port&lt;tlm_transport_if&lt;REQ, RSP&gt; &gt; p;</pre>                        |

# Transaction Level Modeling with the TLM API



# Transaction Level Modeling – Cross Bar

- Uses the same components on the previous slide connected in different ways



**Cross Bar Switch**

# Getting More Information

- **Join OSCI and the TLM WG**
  - [www.systemc.org](http://www.systemc.org)
- **Contact me - Stuart Swan**
  - [stuart@cadence.com](mailto:stuart@cadence.com)
- **Contact Chairman of OSCI TLM WG – Mark Burton**
  - [mark.burton@arm.com](mailto:mark.burton@arm.com)
- **Contact Chairman of OCP-IP TLM WG – Anssi Haverinen**
  - [anssi.haverinen@nokia.com](mailto:anssi.haverinen@nokia.com)
- **Any Questions?**