The SystemC OCP Models

An Overview of the SystemC Models for the Open Core Protocol

Alan Kamas

Contributors

- Anssi Haverinen, Nokia
- Norman Weyrich, Synopsys Inc.
- Yann Bajot and Stéphane Guntz, Prosilog
- Joe Chou, Sonics Inc.
- James Aldis, Texas Instruments
- OCP-IP & the OCP SLD-WG

Outline

- What is the OCP Channel?
- OCP Hardware view
- OCP SystemC Channel Models
  - Generic
  - OCP TL1
  - OCP TL2
  - Layer Adapters
- Availability
- Future Directions

The Open Core Protocol (OCP)

- An Open Standard for connecting the blocks on a System-on-Chip
- Point to point connection
- Flexible & Configurable to work with a wide range of IP
- Web site: www.ocpip.org

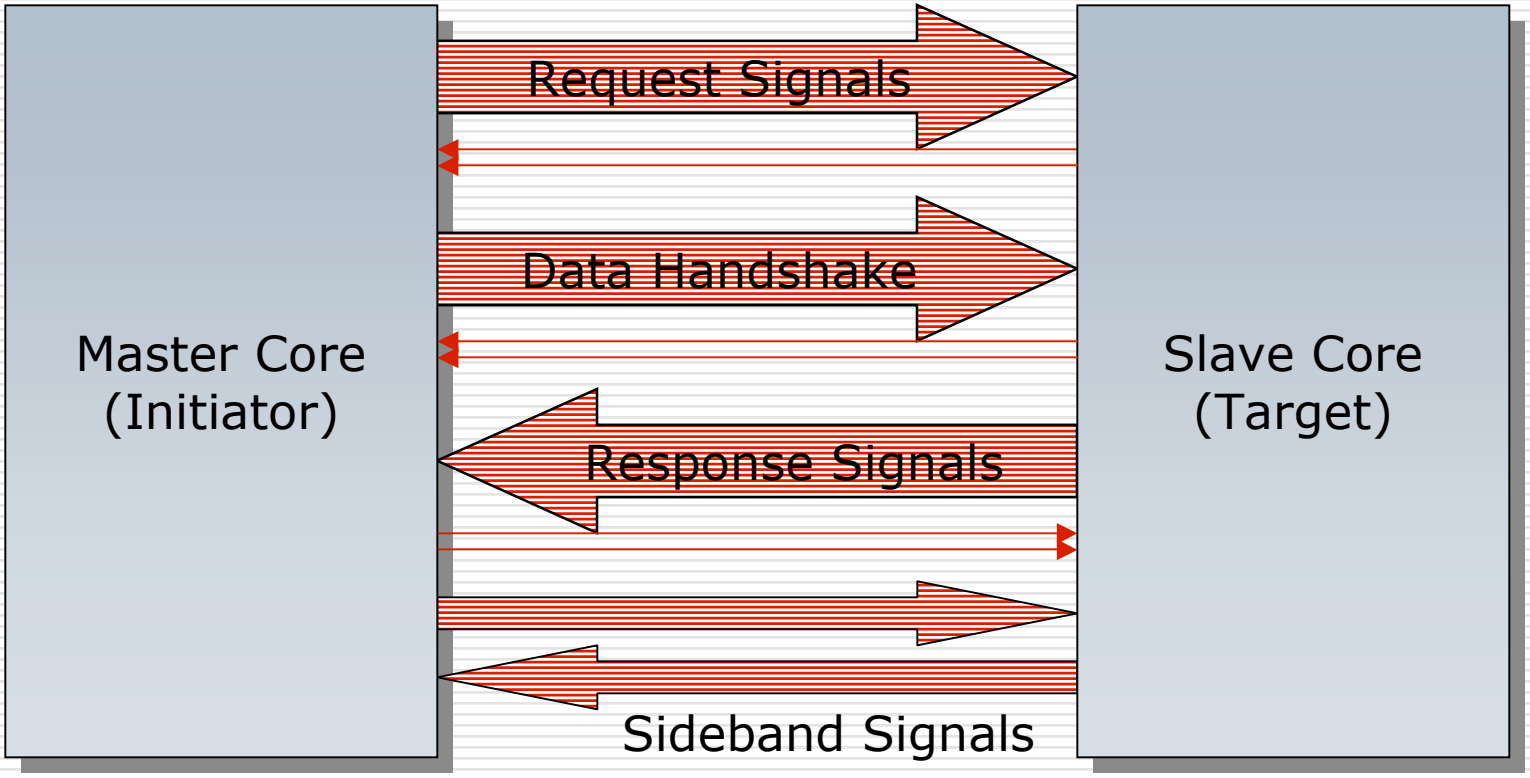
OCP-IP Public Member List

- 3rdeye Technology
- Accent
- Acculent Corporation
- Advanced Architectures
- Alcatel
- Amphion
- ARC International
- Artisan Components
- ATI Technologies
- AXYS Design Automation
- Beach Solutions
- Bitboys
- Broadcom
- Cadence Design Systems
- CAST, Inc.
- Chip Implementation Center
- ControlNet India
- CoWare
- DAFCA
- Denali
- Design And Reuse
- Dolphin Integration
- Duolog
- eASIC
- ECSI
- EDACafe
- eInfochips
- Esterel Technologies
- First Silicon Solutions
- Flextronics Semiconductor
- GDA Technologies
- GeoLogic
- HDL Design House
- Hughes Network Systems
- Icera Semiconductor
- IDT
- Infineon
- Imagination Technologies
- Kawasaki
- LIRMM
- LSI Logic
- LTRIM Technologies
- Manhattan Routing, Inc.
- Mentor Graphics
- Micronas
- MIPS Technologies
- National Tsing Hua University
- NEC
- NoBug
- Nokia
- Paradigm Works
- Philips Semiconductors
- PUCRS
- Prosilog
- QThink
- Qualis
- Royal Institute of Technology
- Si2
- Siemens
- Silicon Interfaces
- Silicon Designs International
- Silicon & Software Systems
- Siligence
- Siroyan
- Sonics
- SpiraTech
- STARC
- STMicroelectronics
- Summit Design
- Synergetic Computing Systems
- Synopsys
- Tampere University of Technology
- Technical University of Denmark
- TechOnLine
- Tensilica
- Texas Instruments
- TNI-Valiosys
- Toshiba Semiconductor Group
- Tower Semiconductor
- TranSwitch
- TSMC
- UFCG
- UMC
- University of British Columbia
- UC Berkeley
- Verisity
- Virtual Component Exchange
- Virtual IP Group
- Virtual Silicon
- VSIA
- White Eagle Systems Technology
- WiQuest Communications
- Yamaha Corporation
- YogiTech

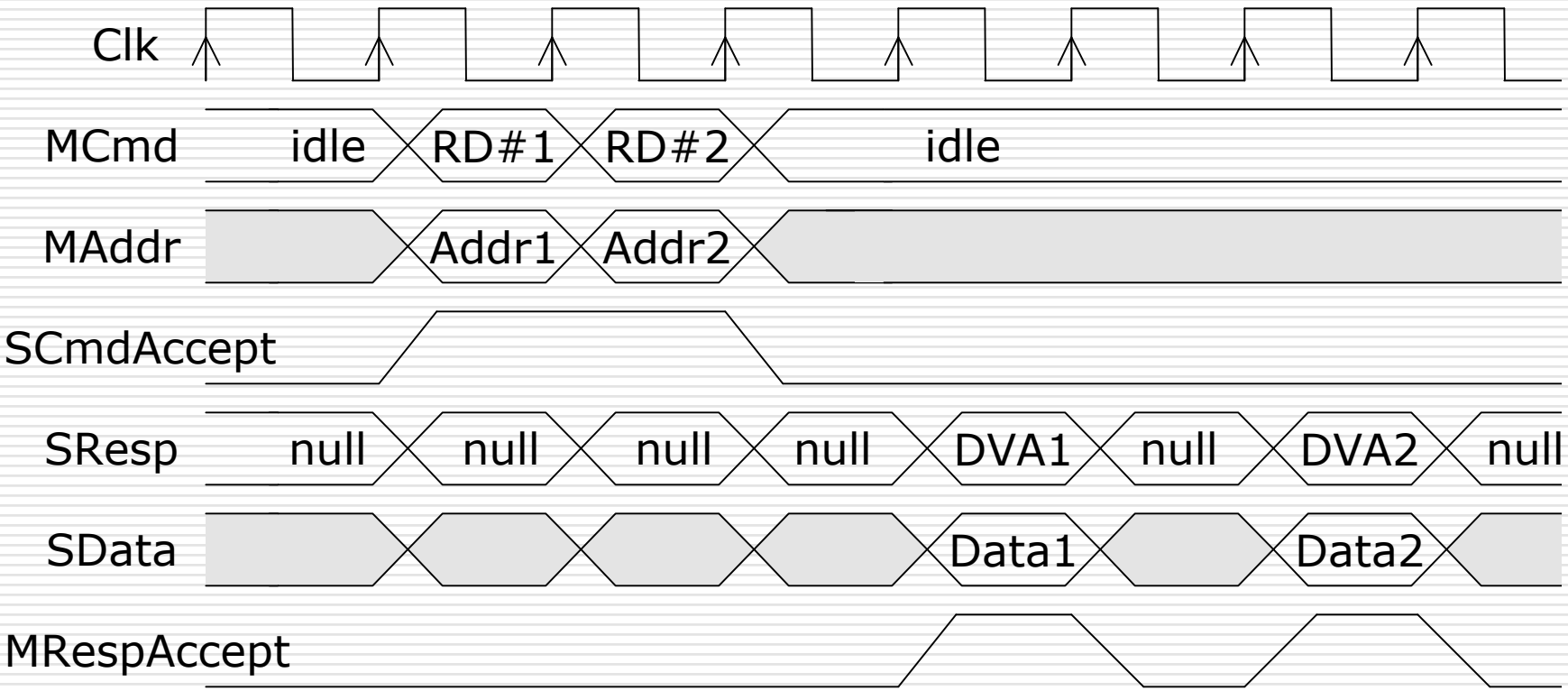
OCP Layering & Terminology

- Signals
  - Wires & fields
- Phases
  - Request, Data handshake, Response
- Transfers
  - A Read or Write
- Transaction
  - A complete burst of one or more transfers

OCP at the Hardware Level



Hardware Timing

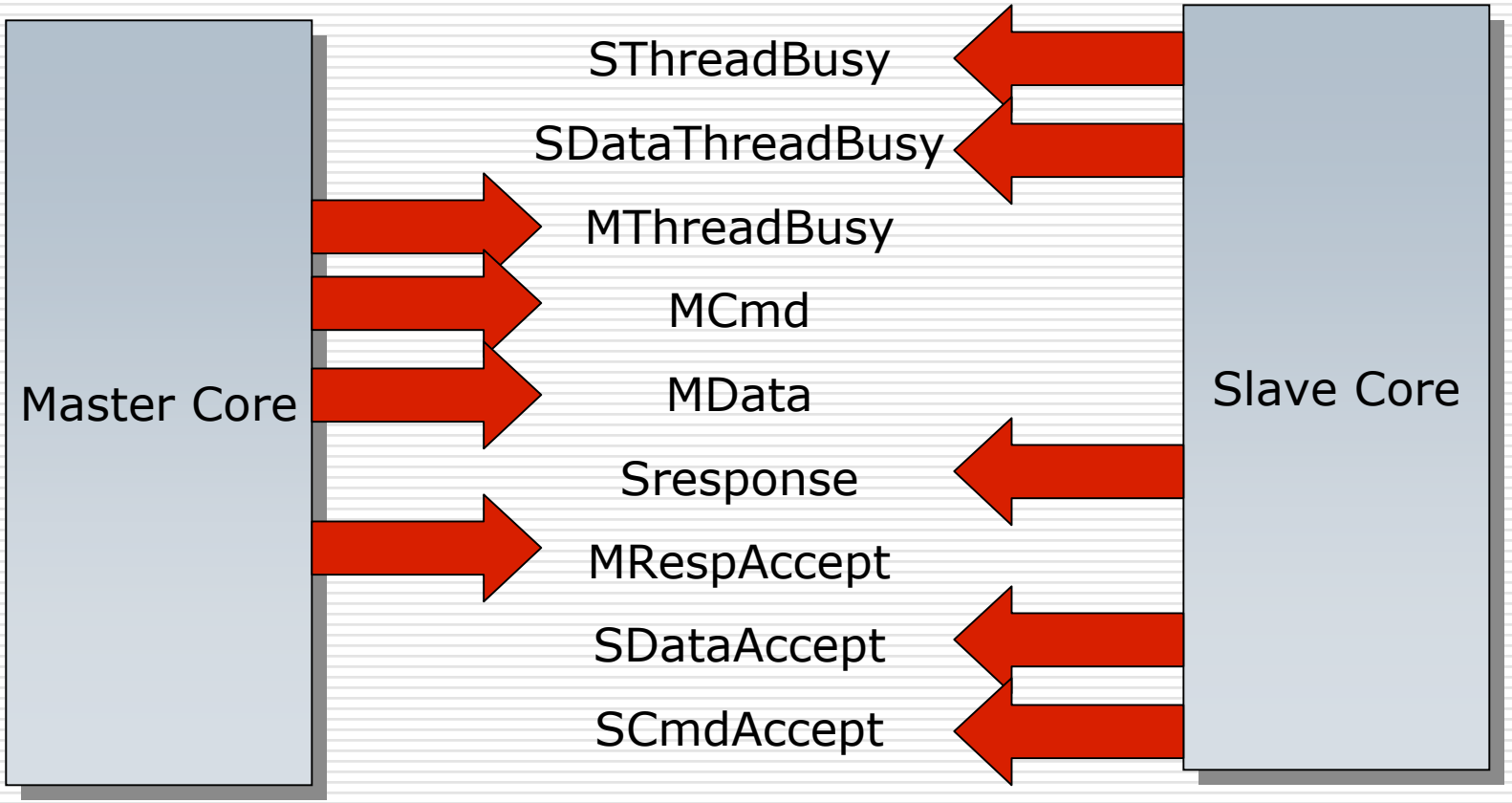


Response Pipelining

- Next response may not match last request
- Very simple channel models will not work with response pipelining:

```
MyData = channel->read(myAddress);
```

Phase Timing



SystemC Model Requirements

Hardware Compatible

Software Compatible

Full Timing

Ease of Use

Blocking Calls

Event Driven

Cycle Accurate

High Performance

Stand-alone

Layered

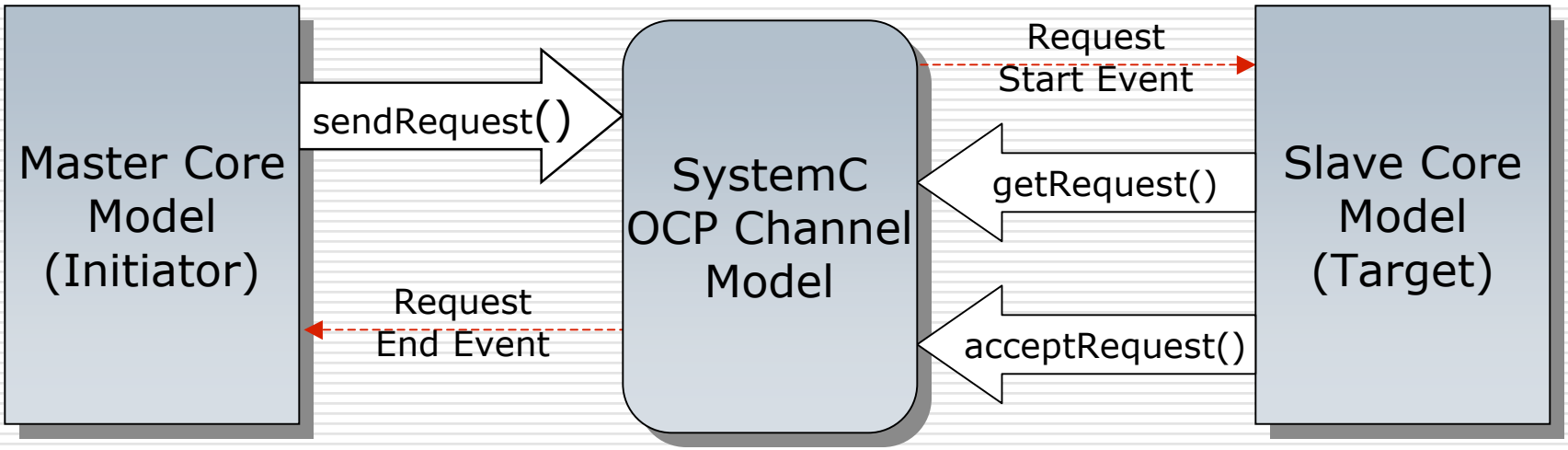
OCP Specific

General Purpose

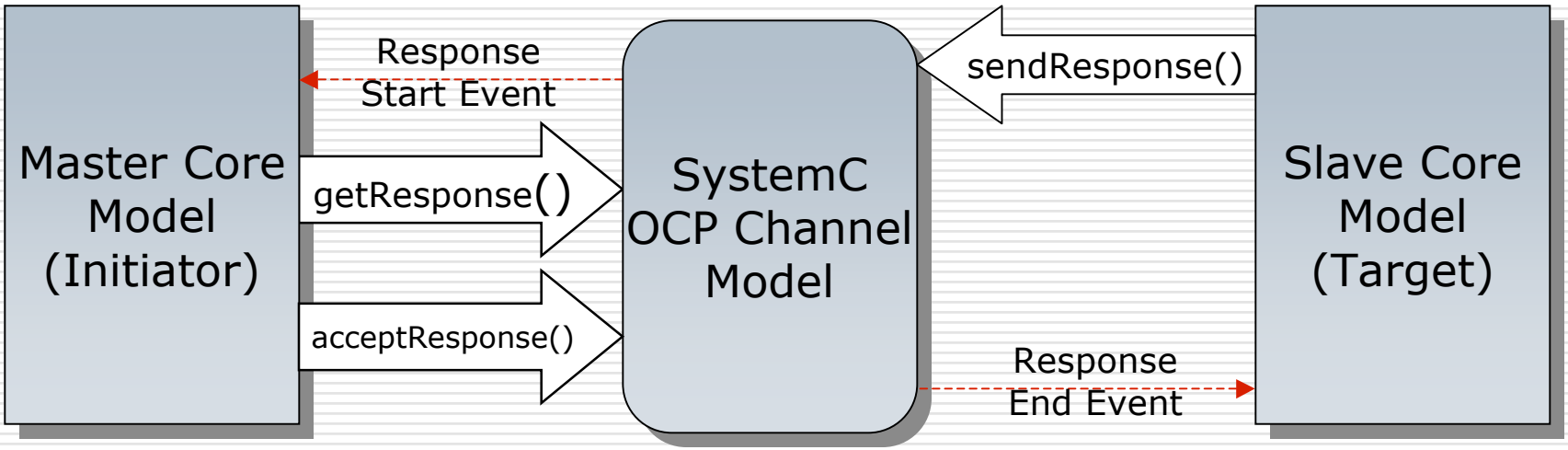
A Set of SystemC Models

- Generic Model
  - Transaction Level 1
  - Transaction Level 2
- OCP TL1
- OCP TL2
- Layer Adaptors

Basic SystemC OCP Model



Responses are Separate



Generic Channel Model

- Based on initial work of Generic Transaction Level Channel.
- Transfer Data type and format is templated.

Generic Channel Code

```
// Master Core Model Example.
// Send a read command over generic channel
// Channel uses TDataCl as its data class

TDataCl *cDataPtr;
cDataPtr = MasterPort->GetDataCl();
cDataPtr->MputMAddr(Addr);
MasterPort->MputReadRequest();
```

Transaction Level 1
TL1 OCP Channel

- Cycle Accurate
- Follows phase ordering of the OCP transfer cycle
- Clock Driven
- Uses all OCP parameters
- Request / Update
- All OCP signals supported
- OCP signal monitor available

OCP TL1 Code

```
// Send a write request over the OCP TL1
// Channel (using blocking commands)

OCPRequestGrp<Td,Ta> req;
req.MCmd = OCP_MCMD_WR;
req.MAddr = 0x0401;
MasterPort->startOCPRequestBlocking(req);
OCPDataHSGrp<Td> datahs;
datahs.MData = myData;
MasterPort->startOCPDataHSBlocking(datahs);
```

OCP TL1 Code – non blocking

```
// Send a read request over the OCP TL1 Channel (using
     non-blocking commands)

OCPRequestGrp<Td> req;
req.MCmd = OCP_MCMD_RD;
req.MThreadID = 1;
req.MAddr = 0x0401;
if (MasterPort->sendOCPRequest(req)) {
   cout << “Request Sent” << endl;
}
```

Transaction Level 2
TL2 OCP Channel

- Models OCP specific data flow through the channel
- Faster / Greater Throughput
- Commands to send an entire burst of data at a time.
- Request & Response only – no Data Handshake
- Timing Approximate

OCP TL2 Channel Code

```
// Send a write burst over the OCP TL2 Channel (using
    blocking commands)
Td myData[4];
myData[0]=0; myData[1]=1; myData[2]=2; myData[3]=3;
OCPRequestGrp<Td> req;
req.MCmd = OCP_MCMD_WR;
req.MAddr = startAddr;
req.MDataPtr = myData;
MPort->sendOCPRequestBlocking(req,4,true);
```

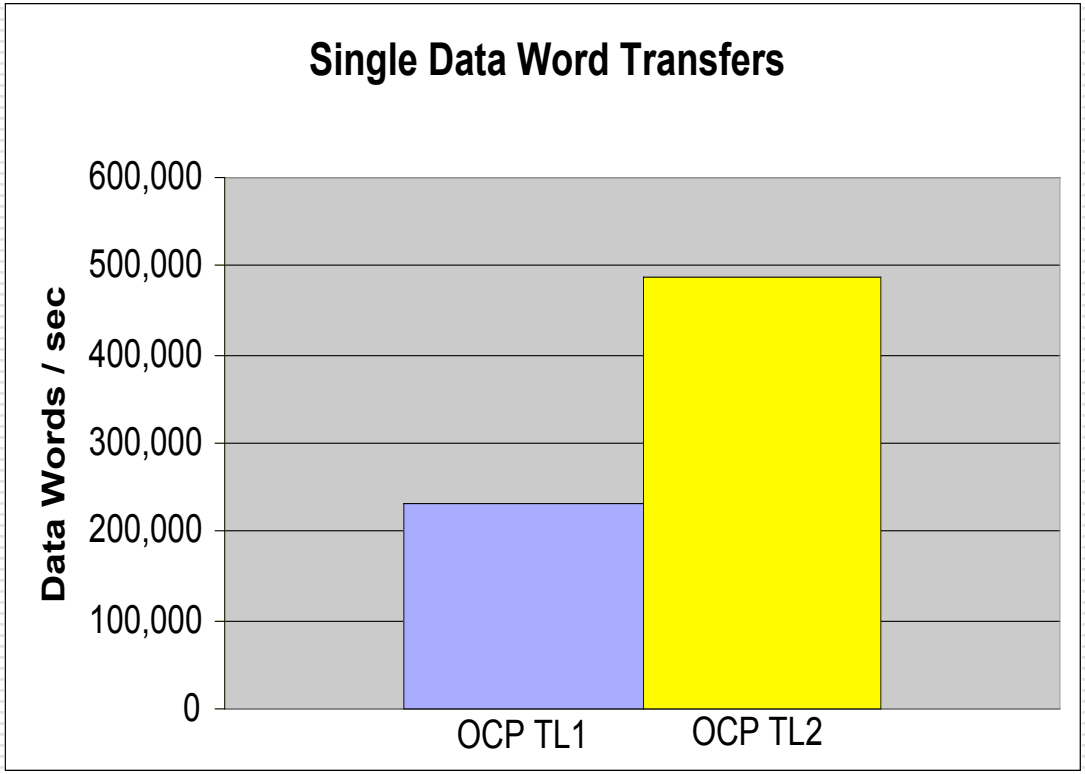
Performance OCP TL1 vs TL2

One at a time

Write of one data word then Read of one data word.

OCP TL1: 232,000 data words / sec

OCP TL2: 486,000 data words / sec



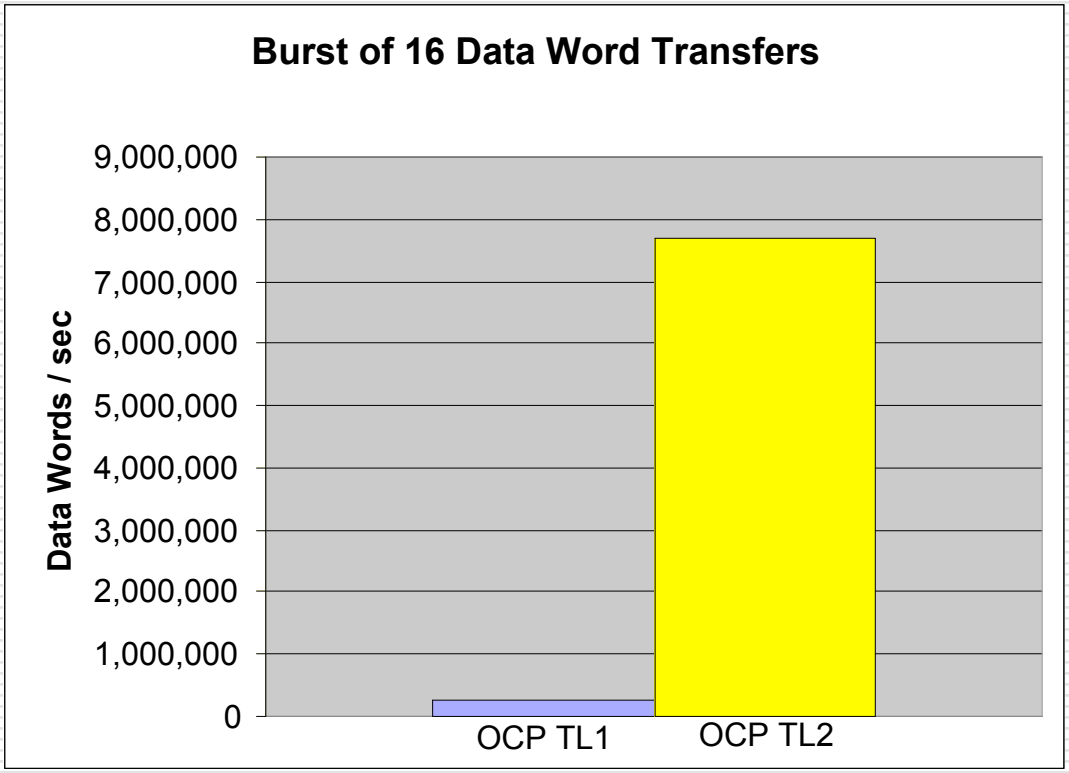
Performance OCP TL1 vs TL2

With Bursts

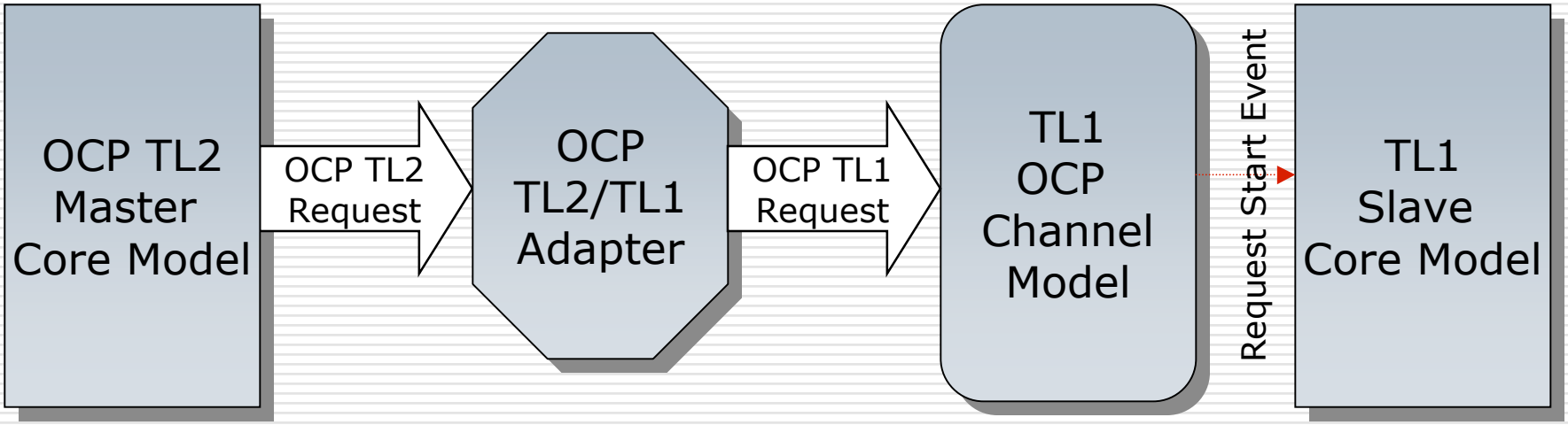
Burst Write of 16 data words then Burst Read of 16 data words.

OCP TL1: 277,000 data words / sec

OCP TL2: 7,688,000 data words / sec



Layer Adapters



- TL2 ⟺ TL1
- TL1 ⟺ TL0 (RTL)

Getting the OCP Channel Models

- Available for download from OCP-IP:
  http://www.ocpip.org/socket/systemc
- Click on the license
- Fill in the form
- Read the email
- Download the Channel Models

Future Directions

- Performance OCP TL2 Channel
- OSCI TLM

New OCP TL2 Channel

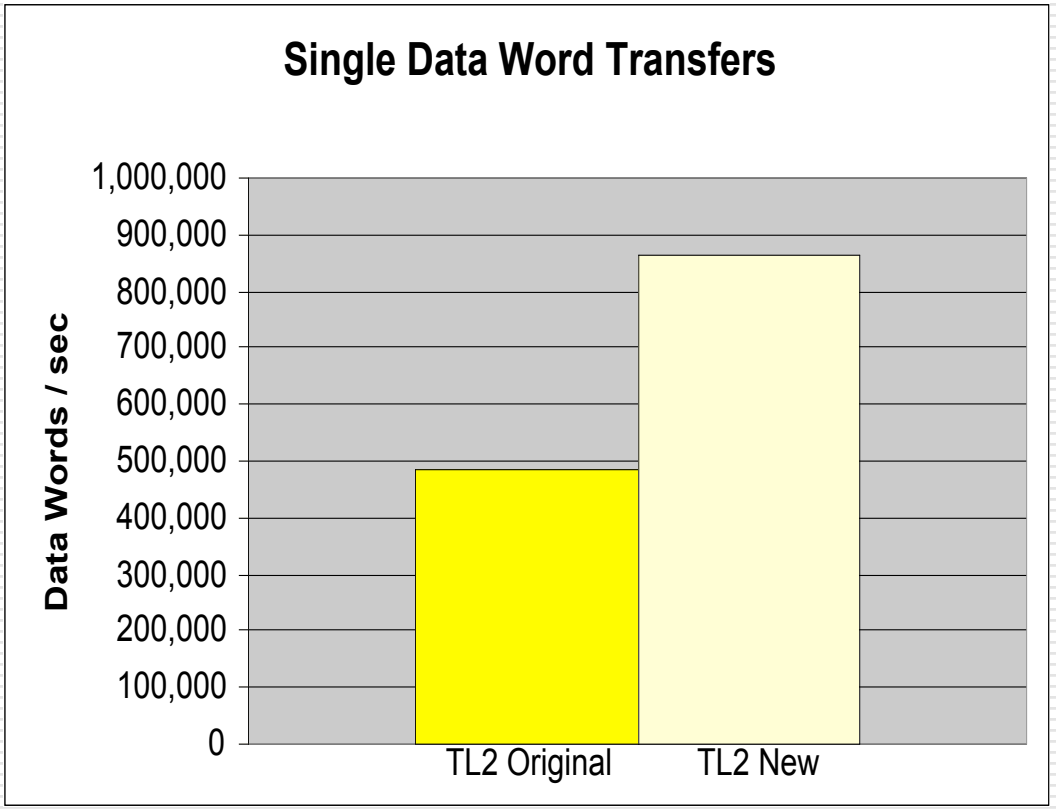
- Available this Fall
- Timing Values for greater accuracy
- Higher Throughput
- Written for Performance
  - No layering
  - No request / update
  - Loss of generic commands

New TL2 Channel Performance

Write of one data word then Read of one data word.

OCP TL2 Orig: 486,000 data words / sec

OCP TL2 New: 865,000 data words / sec



OSCI TLM and the OCP Channel Models

- OSCI TLM and OCP Channel working groups share members and continue to work together.
- OCP TL1 Channel similar to the proposed Verification view
- OCP TL2 Channel similar to the proposed Architecture view

Further Information

- More information is available online: www.ocpip.org
- OCP Specification
- White papers
- Channel model download
  - Documentation
  - Source code
  - Example cores