

# The SystemC OCP Models

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An Overview of the SystemC Models  
for the Open Core Protocol

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# Contributors

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- ❑ OCP-IP & the OCP SLD-WG

# Outline

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- 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)

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- ❑ 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](http://www.ocpip.org)

# OCP-IP Public Member List

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- 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

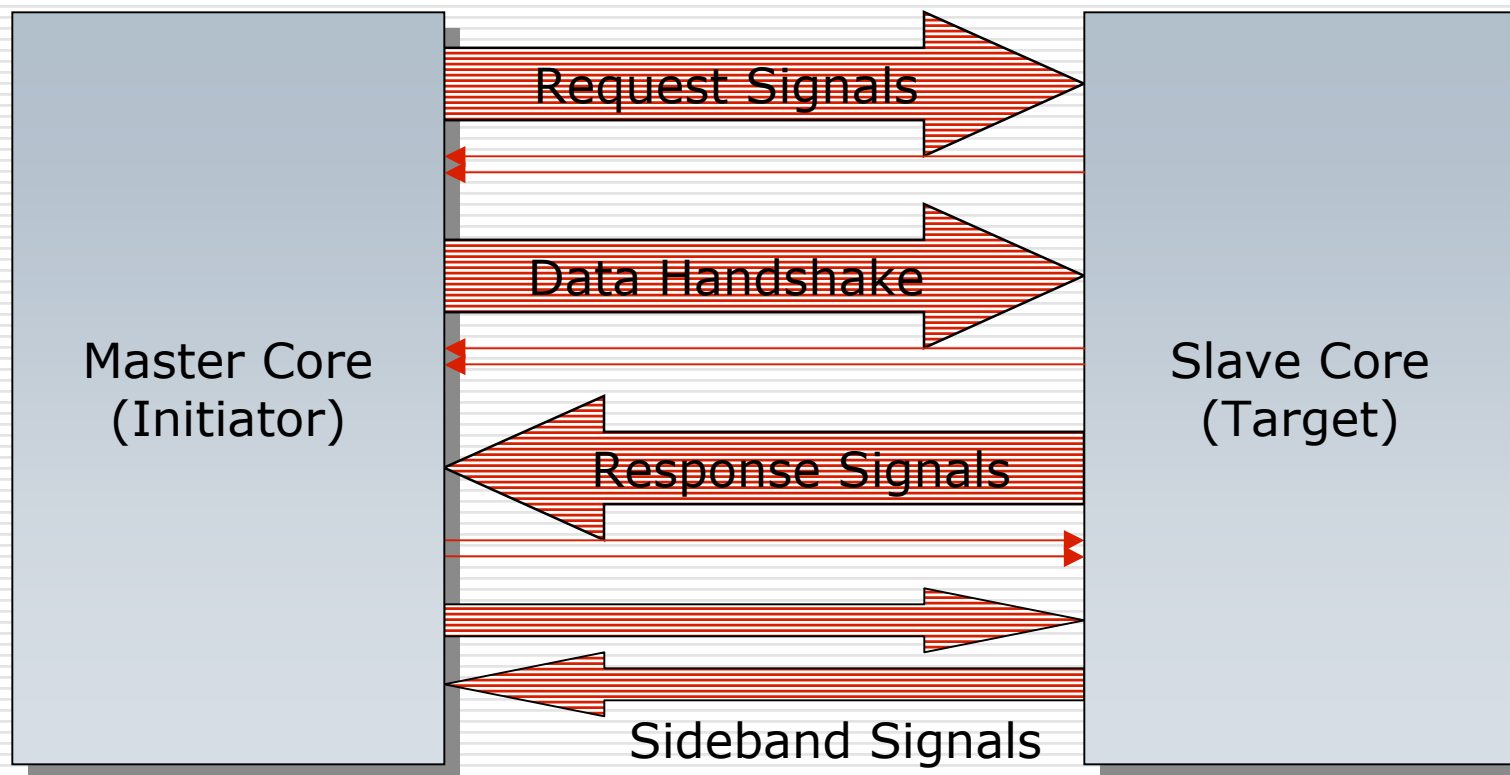
# OCP Layering & Terminology

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

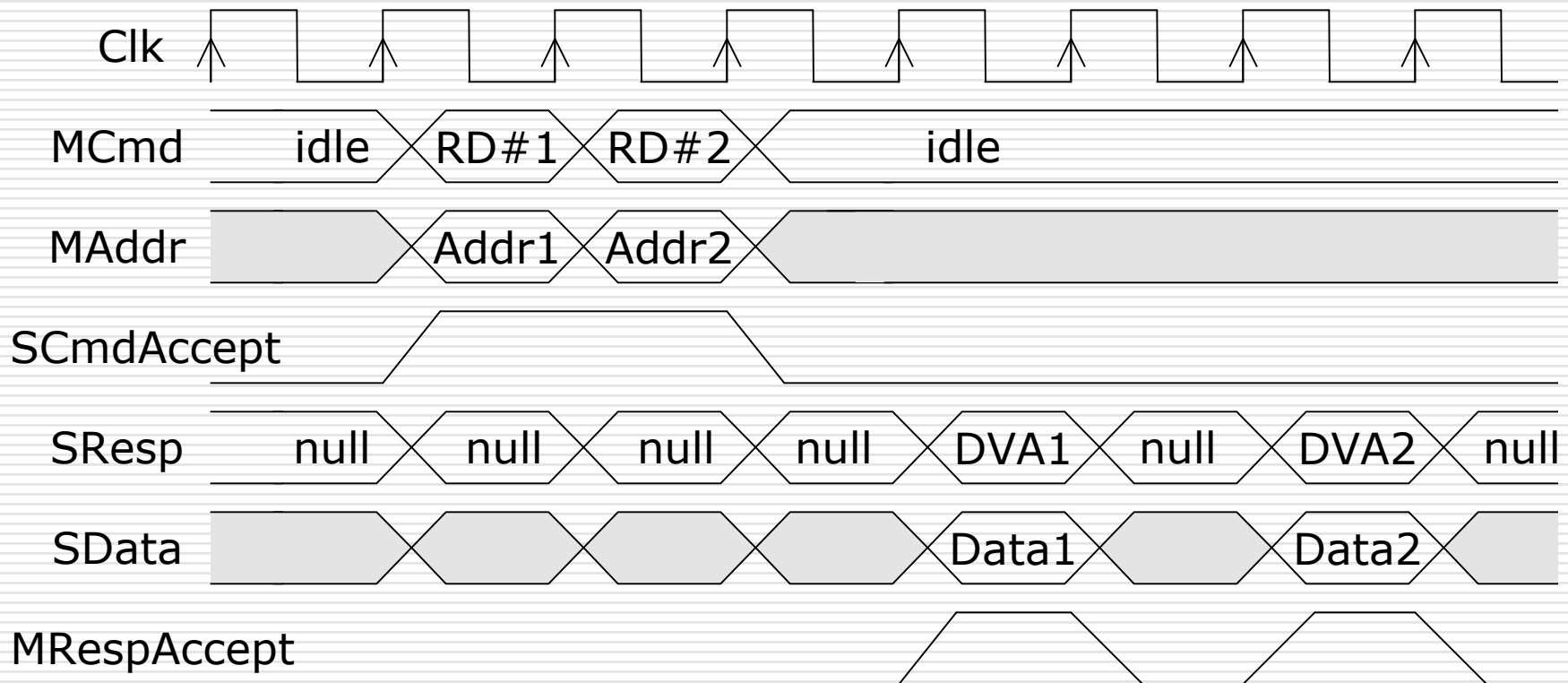
# OCP at the Hardware Level

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# Hardware Timing

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# Response Pipelining

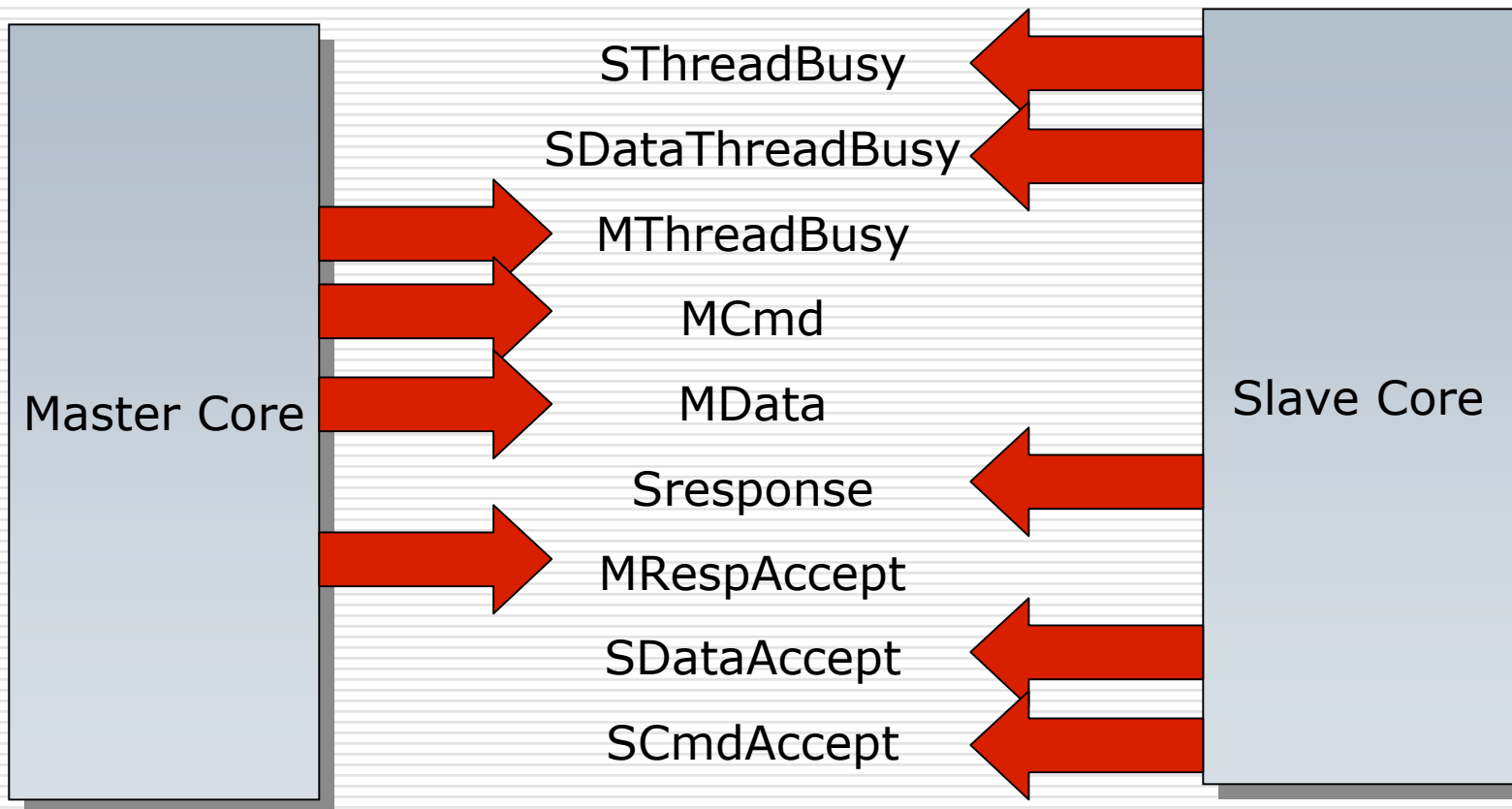
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- ❑ Next response may not match last request
- ❑ Very simple channel models will not work with response pipelining:

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

# Phase Timing

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# SystemC Model Requirements

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Hardware Compatible

Software Compatible

Full Timing

Ease of Use

Blocking Calls

Event Driven

Cycle Accurate

High Performance

Stand-alone

Layered

OCP Specific

General Purpose



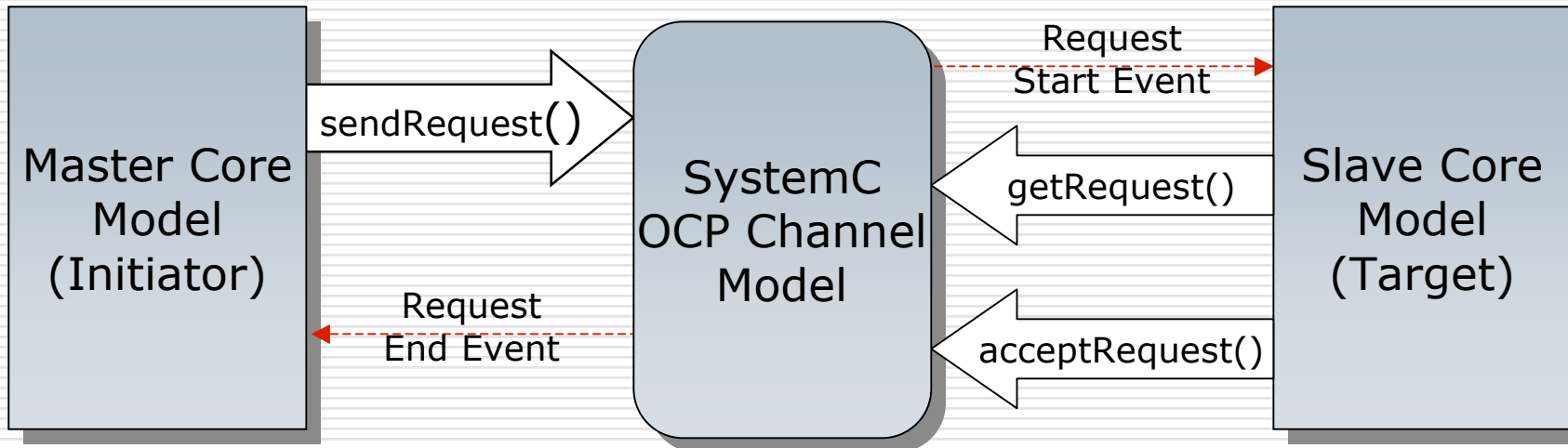
# A Set of SystemC Models

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

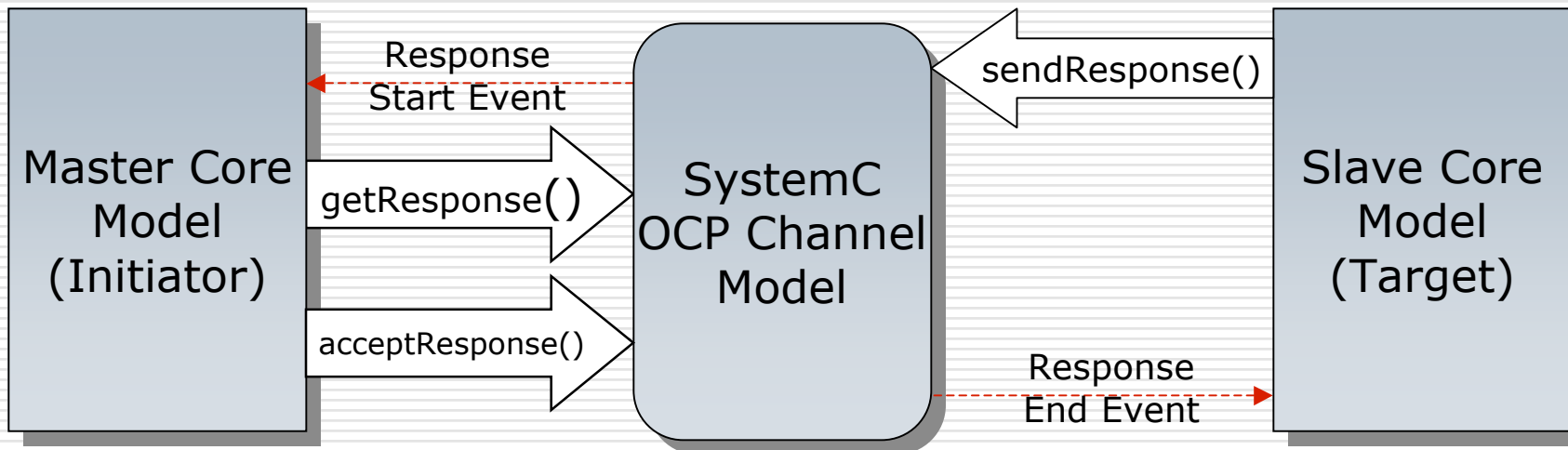
# Basic SystemC OCP Model

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# Responses are Separate

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# Generic Channel Model

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

# Generic Channel Code

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```
// 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

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- 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

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```
// 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

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```
// 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

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- ❑ 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

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```
// 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

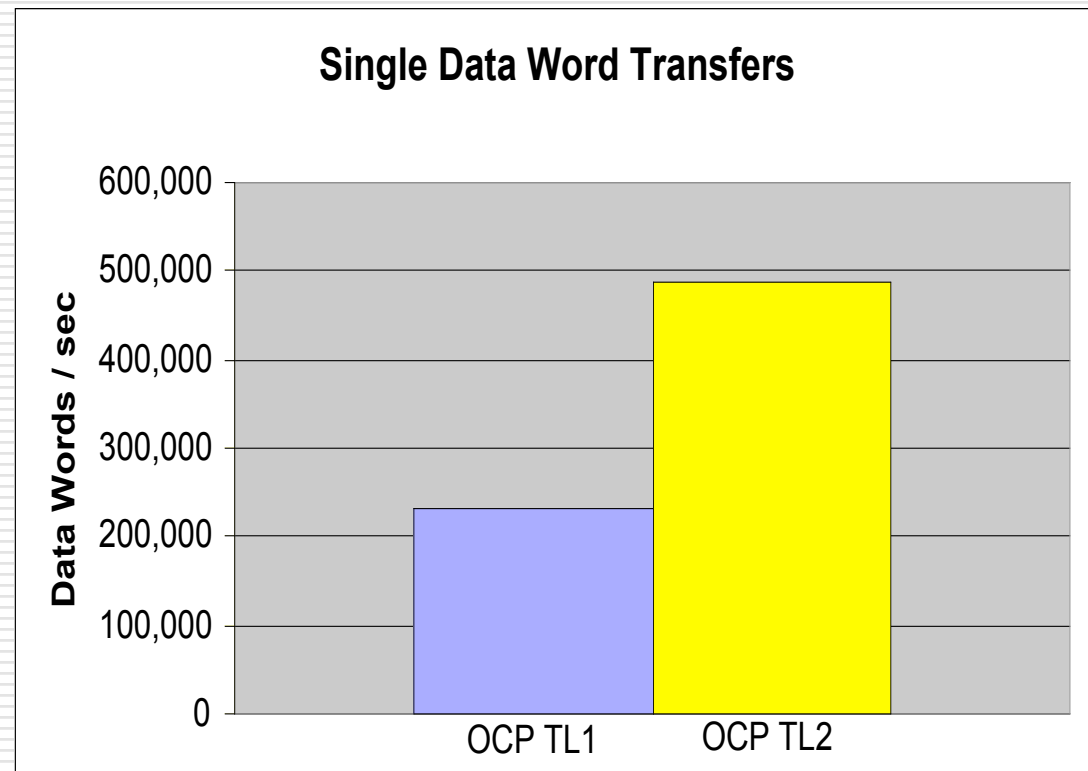
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## One at a time

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

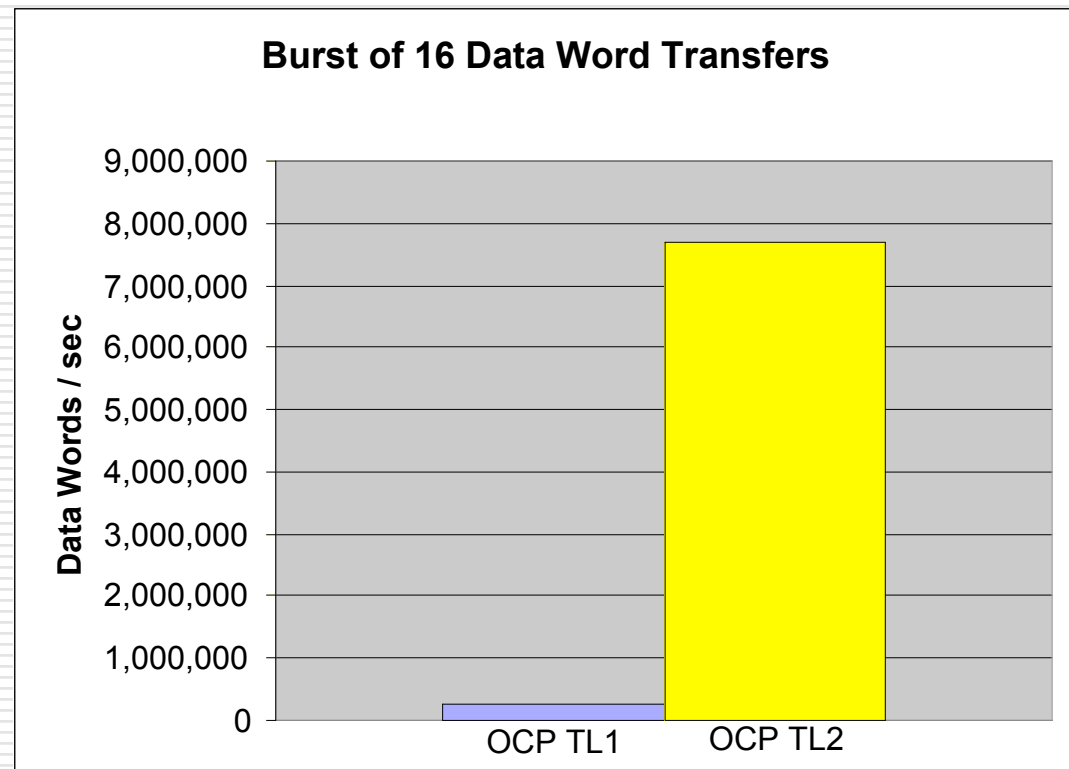
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## With Bursts

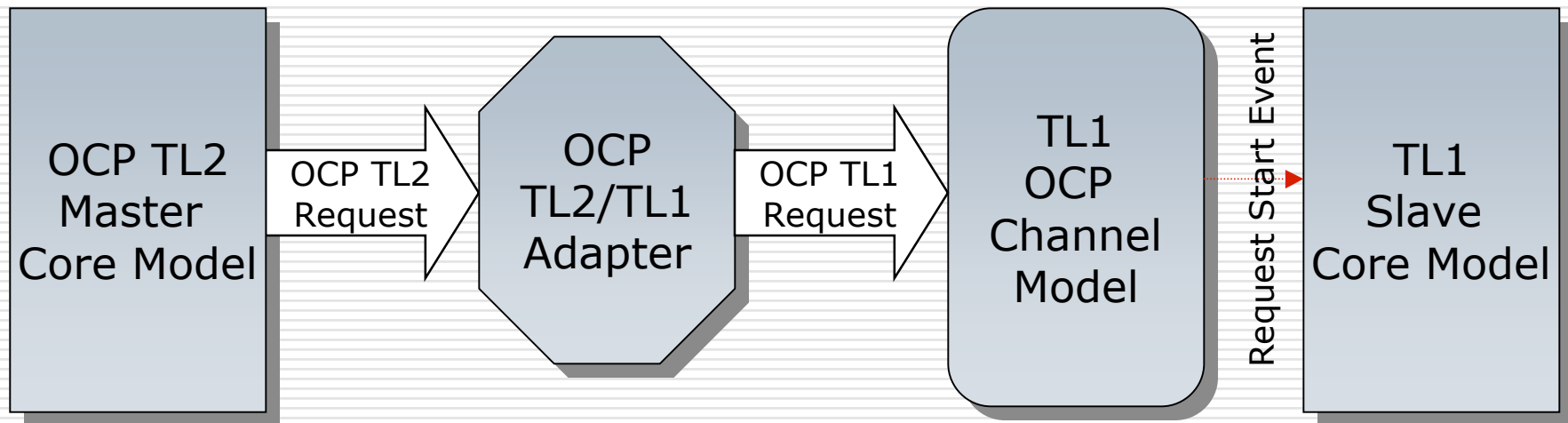
Burst Write of 16 data words then Burst Read of 16 data words.

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

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- 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

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- ❑ Performance OCP TL2 Channel
- ❑ OSCI TLM

# New OCP TL2 Channel

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

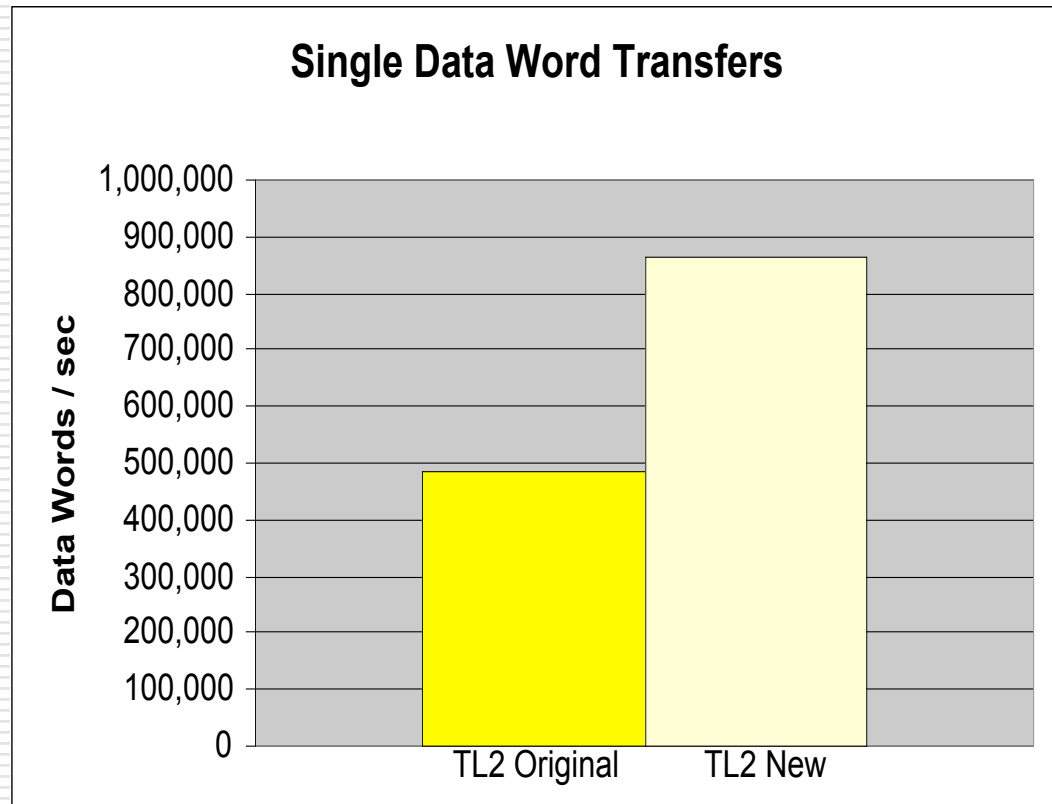
# New TL2 Channel Performance

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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

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- ❑ 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

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- ❑ More information is available online:  
[www.ocpip.org](http://www.ocpip.org)
- ❑ OCP Specification
- ❑ White papers
- ❑ Channel model download
  - Documentation
  - Source code
  - Example cores