Update of IEEE P1500 Core Wrapper Architecture

Presented by
Erik Jan Marinissen
on behalf of CTAG Working Group

Design Automation Conference (DAC’03)
Anaheim, CA – June 5, 2003
Topics

- Wrapper Overview & Applications
- Wrapper Architecture & Instructions
- Wrapper Harness Cells
- Summary
P1500 Wrapper Configuration Examples

Daisychained TAM

Standardized Plug&Play Wrapper Serial Ports

P1500 Wrapper Configuration Examples

Bussed TAM

Standardized Plug&Play Wrapper Serial Ports

P1500 Wrapper Configuration Examples

Direct Access TAM

Standardized Plug & Play Wrapper Serial Ports

P1500 Wrapper Configuration Examples

Local TAM Controllers

Controller

Controller

Controller

WPP

WPP

WPP

Core

Core

Core

Wrapper

Wrapper

Wrapper

WSP

WSP

WSP

EN

EN

EN

WSI

WSC

WSO

Standardized Plug&Play Wrapper Serial Ports

Wrapper Architecture & Instructions
View of the Required P1500 Wrapper Architecture

Functional Inputs: CFI → FI → Core → FO → Functional Outputs

Functional Outputs: FO → Core → FO → Functional Inputs

WSI → WSI (1) → Bypass → WIR → WIS (1) → WSO

Update

Shift

WSC

(WRST, WCLK, SelectWR, Capture, Shift, Update, Transfer)

## P1500 Wrapper Test Instructions

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS_BYPASS</td>
<td>Required</td>
</tr>
<tr>
<td>WS_PRELOAD</td>
<td>Optional</td>
</tr>
<tr>
<td>WP_PRELOAD</td>
<td>Optional</td>
</tr>
<tr>
<td>WS_CLAMP</td>
<td>Optional</td>
</tr>
<tr>
<td>WS_SAFE</td>
<td>Optional</td>
</tr>
<tr>
<td>WS_INTEST_RING</td>
<td>Optional</td>
</tr>
<tr>
<td>WS_INTEST_SCAN</td>
<td>Optional</td>
</tr>
<tr>
<td>WP_INTEST_RING</td>
<td>Optional</td>
</tr>
<tr>
<td>WP_INTEST_SCAN</td>
<td>Optional</td>
</tr>
<tr>
<td>WH_INTEST</td>
<td>Optional</td>
</tr>
<tr>
<td>WS_EXTERNAL</td>
<td>Required</td>
</tr>
<tr>
<td>WP_EXTERNAL</td>
<td>Optional</td>
</tr>
<tr>
<td>WH_EXTERNAL</td>
<td>Optional</td>
</tr>
</tbody>
</table>

* Example of an optional user-defined instruction

At Least One Optional INTEST is Required
## P1500 Wrapper Test Instructions

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Controlling Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS_BYPASS</td>
<td>WSP</td>
</tr>
<tr>
<td>WS_PRELOAD</td>
<td>WSP</td>
</tr>
<tr>
<td>WP_PRELOAD</td>
<td>WPP</td>
</tr>
<tr>
<td>WS_CLAMP</td>
<td>WSP</td>
</tr>
<tr>
<td>WS_SAFE</td>
<td>WSP</td>
</tr>
<tr>
<td>WS_INTEST_RING</td>
<td>WSP</td>
</tr>
<tr>
<td>WS_INTEST_SCAN</td>
<td>WSP</td>
</tr>
<tr>
<td>* WP_INTEST_RING</td>
<td>WPP</td>
</tr>
<tr>
<td>* WP_INTEST_SCAN</td>
<td>WPP</td>
</tr>
<tr>
<td>WH_INTEST</td>
<td>WSP and/or WPP</td>
</tr>
<tr>
<td>WS_EXTEST</td>
<td>WSP</td>
</tr>
<tr>
<td>WP_EXTEST</td>
<td>WSP or WPP</td>
</tr>
<tr>
<td>WH_EXTEST</td>
<td>WSP and/or WPP</td>
</tr>
</tbody>
</table>

Instruction Field Naming Conventions

[ Field 1 ] [ Field 2 ] [ Field 3 ] [ Field 4 ]

- Wrapper
- Test Access
- Test Mode
- Configuration

- Serial = S
- Parallel = P
- Hybrid = H
- Bypass
- Preload
- Clamp
- Safe
- Intest
- Extest
- User
- Ring
- Scan
- User

WS_Intest_Ring

Wrapper Serial Bypass (WS_Bypass) Instruction

Wrapper Parallel Preload (WP_Preload) Instruction

WPC signals are User-Defined

Mission Mode

WPO

WPI

Mission Mode

WPO

WPI

Mission Mode

WPO

WPI

WPP Data Paths indicated in Green

WSC

WP_Preload

Wrapper Serial Clamp (WS_Clamp) Instruction

Inputs may also be controlled to preloaded states

Preloaded States

Disabled

Core

Test Enable(s)

Preloaded States

WSI

Bypass

WIR

WSC

WSO

WS_Clamp is preceded by WS/P_Preload
Wrapper Serial Safe (WS_Safe) Instruction

Inputs may also be controlled to safe states

Forced Safe States

Disabled

Core

Test Enable(s)

FI

FO

FO

FI

Forced Safe States

WSI

WSO

Bypass

WIR

WS_Safe does not require WS/P_Preload

WSC

Wrapper Serial Intest Ring (WS_Intest_Ring) Mode

Test is applied via WSC Controlled WBR Scan Path

Core

Test Enable(s)

WSI

Bypass

WIR

WSC

WSO

Wrapper Serial Intest Scan (WS_Intest_Scan) Mode

Test is applied via WSC Controlled WBR & Internal Scan Path

Core

Internal Scan

Test Enable(s)

FI

FO

FI

FO

WSI

Bypass

WIR

WSC

WSO

Wrapper Parallel Intest Ring (WP_Intest_Ring) Mode

Test is applied via WPC Controlled WBR Segments

Under Consideration as a Standard Instruction

Wrapper Parallel Intest Scan (WP_Intest_Scan) Mode

Test is applied via WPC Controlled WBR & Internal Scan Segments

Under Consideration as a Standard Instruction

Wrapper Hybrid Intest (WH_Intest) Mode

Test is applied via WSC & WPC Controlled WBR Segments
Wrapper Serial Extent (WS_Exttest) Mode

Test is applied via WSC Controlled WBR Scan Path

Core

Test Enable(s)

Disabled

UDL WDR WDR UDL

WSI

Bypass

WIR

WSC

WSO

Wrapper Parallel Extest (WP_Extest) Mode

Test is applied via WSC Controlled WBR Segments

Wrapper Parallel Extest (WP_Extest) Mode

Core

Test Enable(s)

Disabled

WPC

WPO

UDL

WPI

WBR

WBR

WBR

WBR

Bypass

WIR

WSI

WSO

WSC

WP_Extest

Test is applied via WPC Controlled WBR Segments

Wrapper Hybrid Extest (WH_Extest) Mode

Disabled Core

Test Enable(s)

Test is applied via WSC & WPC Controlled WBR Segments

WPC

WPO

UDL

WPI

WPI

UDL

WPO

UDL

WSI

Bypass

WIR

WSC

WH_Extest

WSO

Wrapper Harness Cells
Applying Wrappers to Test Only Inputs & Outputs

Reduced Functionality Harness Cells

Functional Inputs

Functional Outputs

Test Inputs (TI)

Test Outputs (TO)

Core

Test Enable(s)

Bypass

WSI

WIR

WSO

WSC

Pass-Through Harness Cells

Example Using Pass-Through Harness Cells

Pass-Through Harness Cells

WPI -> WBR -> WPC

Core

WBR

WPC

Test Enable(s)

WPO

Example Using Scan-Through Harness Cells

Scan-Through Harness Cells

Core

Test Enable(s)

WSI

Bypass

WIR

WSC

WSO

WS_Intest

Example of Pass/Scan Through Cells in Pass Mode

Pass/Scan-Through Harness Cells in Pass Mode

Enable Factory Testing using Parallel Access

Example of Pass/Scan Through Cells in Scan Mode

Pass/Scan-Through Harness Cells In Scan Mode

Enables In-System Testing using Serial Access

Pass/Scan-Through Harness Cells in Scan Mode

Summary

- A Standard Core Wrapper has been presented
- Its Architecture is Simple and Extendable
- Its Serial Port is Plug&Play for Standardized Testing
- Its Parallel Port is User Defined for Test Flexibility
- Its Instruction Set is Well Defined and Expandable
- A Draft is in preparation for Ballot in 2003