OCP General Features

• OCP supports range of sophisticated bus interface capabilities … which translates into a lot of analysis complexity
  – 64-bit read and write data busses
  – 32-bit multiple mode addresses
  – Multiple Outstanding transactions
  – Multiple Command and Response types
  – Multiple User defined signals
  – Single or Bursted Reads and Writes
  – Single Request Multiple Data
  – Multiple synchronous core to bus ratios
  – Data Ordering and reordering using tags

• System debug needed to get a full picture
  – Processor debug is needed to get best out of the core
  – Bus visibility is needed to optimize complex interactions
Drive Ongoing Needs for OCP System Debug

- Merging debug operations for multiple cores and fabrics
- Control/data transfer via a single JTAG TAP or TRACE PORT
- Global control signals for multi-core cross triggering and synchronous actions (go, halt and breaks)
- Multi-core trace (cores and buses) with timestamps
- Probe Hardware and tool API’s to support multi-core trace
- Handle multiple instantiations of source level debuggers
- Customization to measure activity on buses, caches, execution of cores, co-processors, interrupts, peripheral device events, . . .
Nexus addresses these Needs

• Multi-processor interface - Packet based standard architecture with Implicit multi-core support
• Support for JTAG and/or parallel port interfaces
  – Low pin count and high function trace options
• Independent Input and Output debug ports
• Trace packets include timestamp fields
• Supported by most leading Debug tools vendors
  – Proven debug & calibration interface
• Packet-based protocol supports multiple source level debuggers
• Standard interface and protocol allows simpler and better integrated customized instruments.
IEEE 5001 Nexus Introduction

• Real Time Debug Instrumentation Architecture and methodology standard
  – IEEE Standard ISTO program – 20+ member companies
  – CPU/SoC architecture agnostic standard (25+ different architectures to date)
  – Default standard use in US Automotive electronics
  – Aligned with other standards bodies - 1149.1. 1149.7, Power.org, OCP-IP
  – Support from range of vendors in the tools community
  – Nexus Specification is freely available - www.nexus5001.org
  – Nexus 5001-2009 specs include support for 1149.7 interfaces

• Nexus provides a Instrumentation toolbox for to address OCP Debug
  – Debug oriented packet messaging (TCODES) and application registers
  – 4 levels of increasing debug functionality
    • Embedded run control, Breakpoints , Instruction/data trace
    • Memory and Register configuration and system analysis access
  – Defines Multiple Trace and Debug Access Methods and interfaces
    • JTAG & Parallel– Aux. Read (Trace) / Write (Configuration) Ports
    • High speed Serdes and 1149.7 interfaces - 2009 standard
5001 Nexus Debug Environment

Processor Independent signaling
Multiple on-chip processor/core support

Packet-Based Messaging
- Program Trace
- Data Trace
- Memory Substitution
- Vendor-Defined

IEEE 1149 - 2 or 4 wire Protocol and/or packet based Messaging
- Low bandwidth Control and Status using 1149.7
- High Performance Read/Write Access to internal resources using Aux ports

Logic Analyzer
Trace Debugger, Performance Analyzer, Data Acquisition, SW Prototyping, Run-Time Debugger, Parameter Tuning, Calibration
Nexus supports Range of Features

Class 1

- Static Debug
  - r / w regs. & mem.
  - start/stop processor
  - hw / sw breakpoints

Class 2

- Watchpoint Msg

Class 3

- Ownership Trace Msg
- Program Trace Msgs
- Read / Write Access
- Data Trace Msgs

Class 4

- Memory Substitution
- Port Replacement

Basic Run Control
Instruction Trace
Watchpoints
Read/Write Access
Data Trace
Memory and Port Substitution

Download the IEEE 5001 spec at www.nexus5001.org
Nexus integrates IEEE 1149.7 for Next Generation JTAG

- Custom instrument integration interfaces
- 2 wire JTAG interface
- Parallel or Serial data connection
- Improved speed of debug operations
- Streamlined JTAG Function control
- Full 1149.1 emulation

Increasing layers of functional enhancements
Based on compliance with 1149.1 operations
IEEE 1149.7 JTAG & 5001 Nexus

- Specification release in 2010
- Nexus debug over 2 wire interface
- Nexus Aux In and Out ports extend 1149.7 bandwidth for trace, calibration, mem access, …
- 1149.7 Star configurations allow direct control/data connection for Nexus ports in different devices
  - Compatible with AUX ports
- Native Multi-Processor/SoC debug support using TCODE IDs
- Nexus operation is compatible with 1149.7 (T0-T5) classes
  - Nexus protocol sits on top of 1149.7 signaling,
  - Customized capability using 1149.7 T5 CDX/BDX functions
Nexus Multi-Trace Example

Multicore Embedded Debug Nexus environment

Synchronized Timestamps Cross-triggers

Core A to Nexus Interface

Core B to Nexus Translation

Embedded Nexus Bus Trace

Nexus Port Control

Nexus Probe (Off Chip)

Core A Debugger SW

Core B Debugger SW

1149.7

AUX Data Interfaces

Synchronized Run/stop/ Stall control, breakpoints/tracepoints, trigger in/out signals

Core A (Nexus) subsystem

Core B (Non-Nexus) subsystem

Nexus Port

Debug Port

Bus Monitor Gasket

Inst/Data/ Addr trace

Compression/ Formatting

Nexus Message streams

Combined Nexus Message Stream
Example Nexus Message Packet

<table>
<thead>
<tr>
<th>Program Trace - Indirect Branch Message</th>
<th>Direction: from target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Packet Size (bits)</td>
<td>Packet Name</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>0</td>
<td>TSTAMP</td>
</tr>
<tr>
<td>1</td>
<td>U-ADDR</td>
</tr>
<tr>
<td>1</td>
<td>I-CNT</td>
</tr>
<tr>
<td>0</td>
<td>B-TYPE</td>
</tr>
<tr>
<td>0</td>
<td>SRC</td>
</tr>
<tr>
<td>6</td>
<td>TCODE</td>
</tr>
</tbody>
</table>

- Standard Massages defined AND custom message types are supported using different TCODES
ISTO Nexus 5001™ Forum

Mission Statement:
To define and support global, open, embedded processor and system development interface standards for range of applications.

Key Nexus Applications
• Real Time Debugging
• Hardware in the Loop
• Program Tuning
• Logic Analysis
• Run Control
• Prototyping
• RTOS Support

With Development Tool
Standard Focus

Low Level API
Mechanical Interconnect
Silicon

Join at www.nexus5001.org
5001 Nexus Benefits

**Users**
- Learning cycles – tools and architecture(s)
- Quicker time to market
- Development tool reuse
- Proven capabilities - multiple architectures
- Single small foot print interface
- Non-stop debugging, triggering & trace

**Tool Vendors**
- Reduced development cost
- Rapid migration to new architectures
- Standard functions
- Opportunity to differentiate tools
- Opportunity to address customer requirements
- High performance – lower cost tools

**MPU Vendors**
- Simplifies tools support
- Customer understanding of tools strategy
- Design re-use reduces time & cost
- Leverage best in-class tools
- Easier, faster check-out of tools on new architectures
- Ability to add features in standard method
- Same MCU in development & production
- Trace without the bus (pin overhead)
HDL Dynamics

HDL Dynamics provides IP and integration support for Nexus application

– Customization and application of Nexus to systems
– Integration with OCP based processor and bus subsystems
– Development and Integration of 1149.1 interfaces

Contact us at info@hdldynamics.com
REFERENCE - Nexus Members

Nexus Membership - 2009

[Logos of different companies]