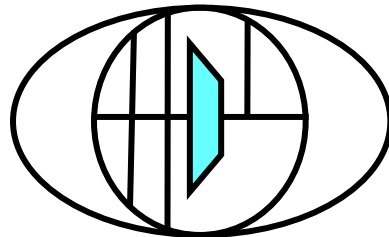


IEEE 5001/Nexus-2010 integration with 1149.7

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HDL Dynamics
SoC Solutions



IEEE 5001 Nexus Introduction

- Real Time Debug Instrumentation Architecture and methodology standard
 - IEEE Standard 5001 - ISTO program – 20+ member companies
 - CPU/SoC architecture agnostic standard (15 different architectures to date)
 - Default standard use in US Automotive electronics
 - Aligned with other standards bodies - 1149.1, **1149.7**, Power.org, OCP-IP
 - Nexus Specification is freely available - **www.nexus5001.org**
 - Nexus 5001-20010 specs in work – **include support for 1149.7 interfaces**
 - Support from range of vendors in the tools community
- Nexus provides a Instrumentation toolbox for SoC 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 – 2010 standard

REFERENCE - Nexus Members

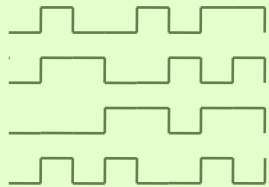
Nexus Membership - 2009



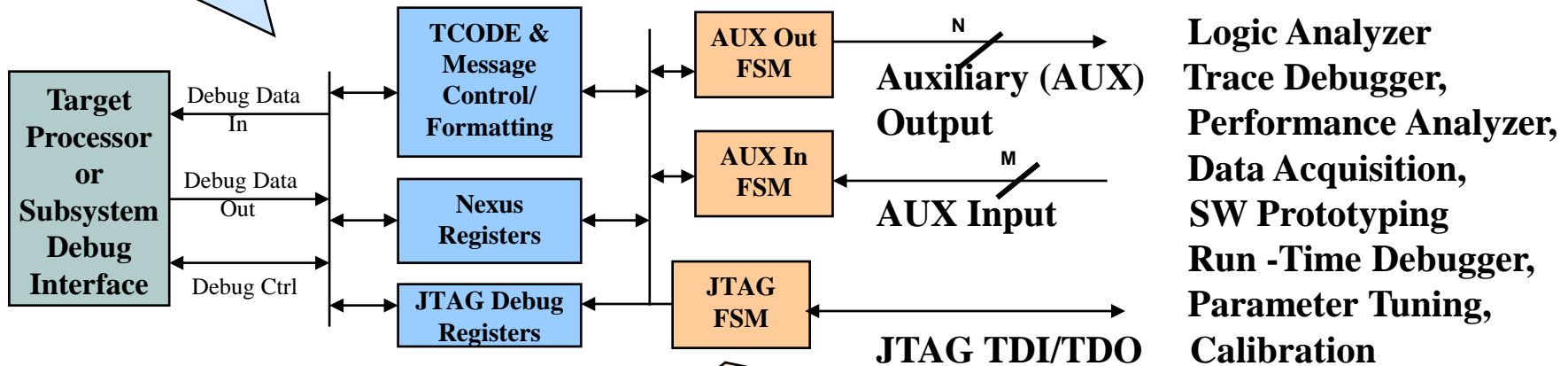
5001 Nexus Debug Environment

Processor Independent signaling for data access
Multiple on-chip processor/core support

Packet-Based Messaging



Program Trace
Data Trace
Memory Substitution
Vendor -Defined



1149 TAP - 2 or 4 wire Protocol and/or packet based Messaging for Low bandwidth Control and Status AUX Ports High Performance Read/Write Access to internal resources

Nexus packet TCODE messages

- Nexus Messages consist of 6 bit TCODE (Transfer Code) followed by message specific number of packets
- Packet may be
 - Fixed – constant size as defined by spec
 - Variable – min (1 bit) value required
 - Vendor Fixed– constant size per target
 - Vendor variable - variable size /message
- Messages can be Sync or Non-sync
 - Sync message include full address
 - Non-Sync include only relative change
- Each message contains a source packet
 - Indicates source IP block of message
 - Allows simple Multi-core Nexus support on per message basis
- Each message contains optional timestamp

Program Trace - Indirect Branch Message			Direction: from target
Minimum Packet Size (bits)	Packet Name	Packet Type	Description
0	TSTAMP	Vendor-variable	Number of cycles message was held in the buffer or the full timestamp value. For targets that do not implement timestamping (or use pins for timestamping), this field may be omitted. Refer to 4.11.2 - Timestamping via AUX .
1	U-ADDR	Variable	The unique portion of the branch target address for a taken indirect branch or exception.
1	I-CNT	Variable	Number of instruction units executed since the last taken branch.
0	B-TYPE	Vendor-fixed	Branch type. For targets that do not need to differentiate branch types, this packet can be omitted (see Table 5-8).
0	SRC	Vendor-fixed	Client that is source of message. For targets with only a single client, this packet can be omitted.
6	TCODE	Fixed	Value = 4

Fixed and variable packets required for minimum packet definition
 Vendor packets are where target differentiation/value is added

Nexus access under JTAG

IR Nexus_Enable command

DR Nexus Reserved Register Select

DR Nexus Message to IPMR register

parse message in register

DR Nexus Message to OPMR register

scan out data in register

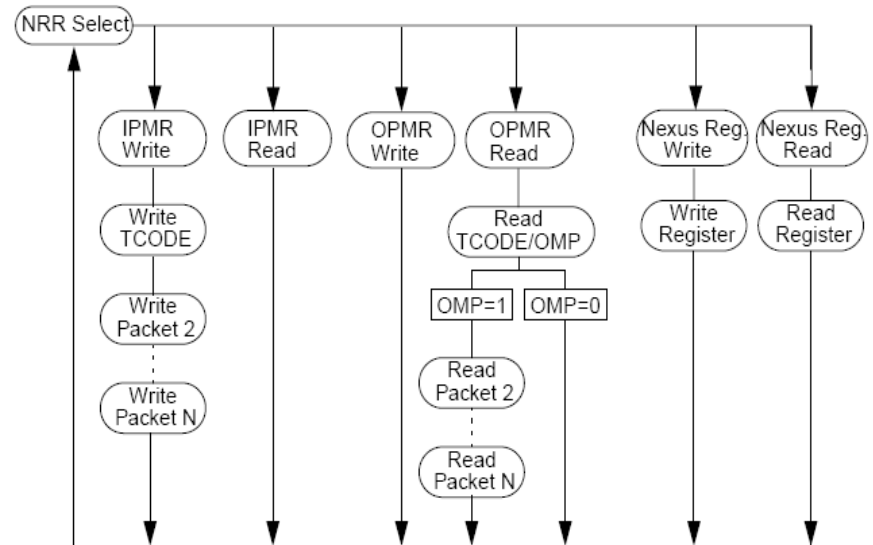
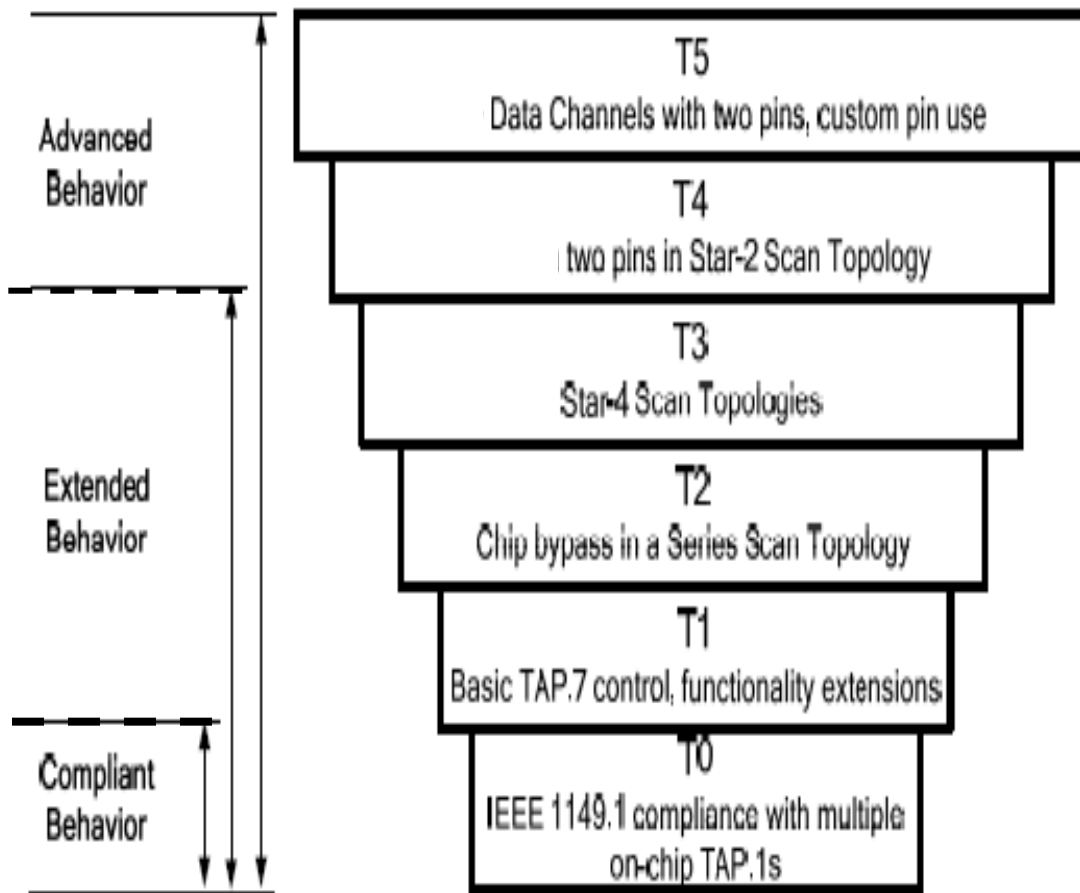


Figure 9-4 IEEE 1149.1 Controller State Diagram for Public Messaging

5001 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**

1149.7 Feature List

Extended - Operation within Star-4 Topology						T5
Directly addressable, TCA and CIDs						
Star-4 Drive Conflict Prevention						
Series/Star Scan Equivalence (SSDs)						T4
Extended Series Performance						
Coupling/Decoupling of STL						
Start-up With STL Decoupled						
Extended - Optional Functions						
TAP.7 Power Control						
Test Reset Generation						
Functional Reset Request						T3
Extended - Control Levels						
Control Level Two – Cmds. and Regs.						
Control Level Three Reserved.		T1				
Control Level Four/Five Scan Paths			T2			
Control Level Six and Seven DTS Use						
1149.1 Compliance						
IEEE 1149.1 compliance at start-up						
Multiple Embedded TAPs		T0				
Coupling/Decoupling of Embedded TAPs:						
Inclusion and exclusion of DR Scan Paths						

Advanced - Data Channels																	
Data Channel 1																	
Data Channel 0																	
No Data Channels, don't go offline																	
BDX/CDX Transfers																	
Advanced - Operation within Star-2 Topology																	
One of Four Start-up Options																	
Compatibility between different feature sets																	
TS or DTS Clock Source																	
Test reset equivalent Escape Sequence																	
Star-2 Drive Conflict Prevention																	
2/4 pin (With or without TIDC/TDOC pins)																	
Programmable function TDIC/TDOC pins																	
Scan Formats:																	
– Minimal Number are Mandatory																	
– Very Optimized for Debug																	
– Optimized for Debug																	
– Optimized for Test																	
– Optimized for Non-Compliant IP																	
Extended - Operation within Star-4 Topology																	

Key points

- Differentiating and value added aspects of Nexus
 - TCODE instructions and pre-defined registers – are decoupled from the Debug Port implementation
- This has historically allowed different access mechanisms
 - JTAG and Parallel Aux ports under a common framework
- Nexus-2010 adds new access port support
 - SERDES (Aurora protocol)
 - Can be treated as very fast AUX port
 - 1149.7
 - Nexus Message can be treated as just another register be read/written
 - Changes to FSM per 1149.7 are local to the Port Implementation

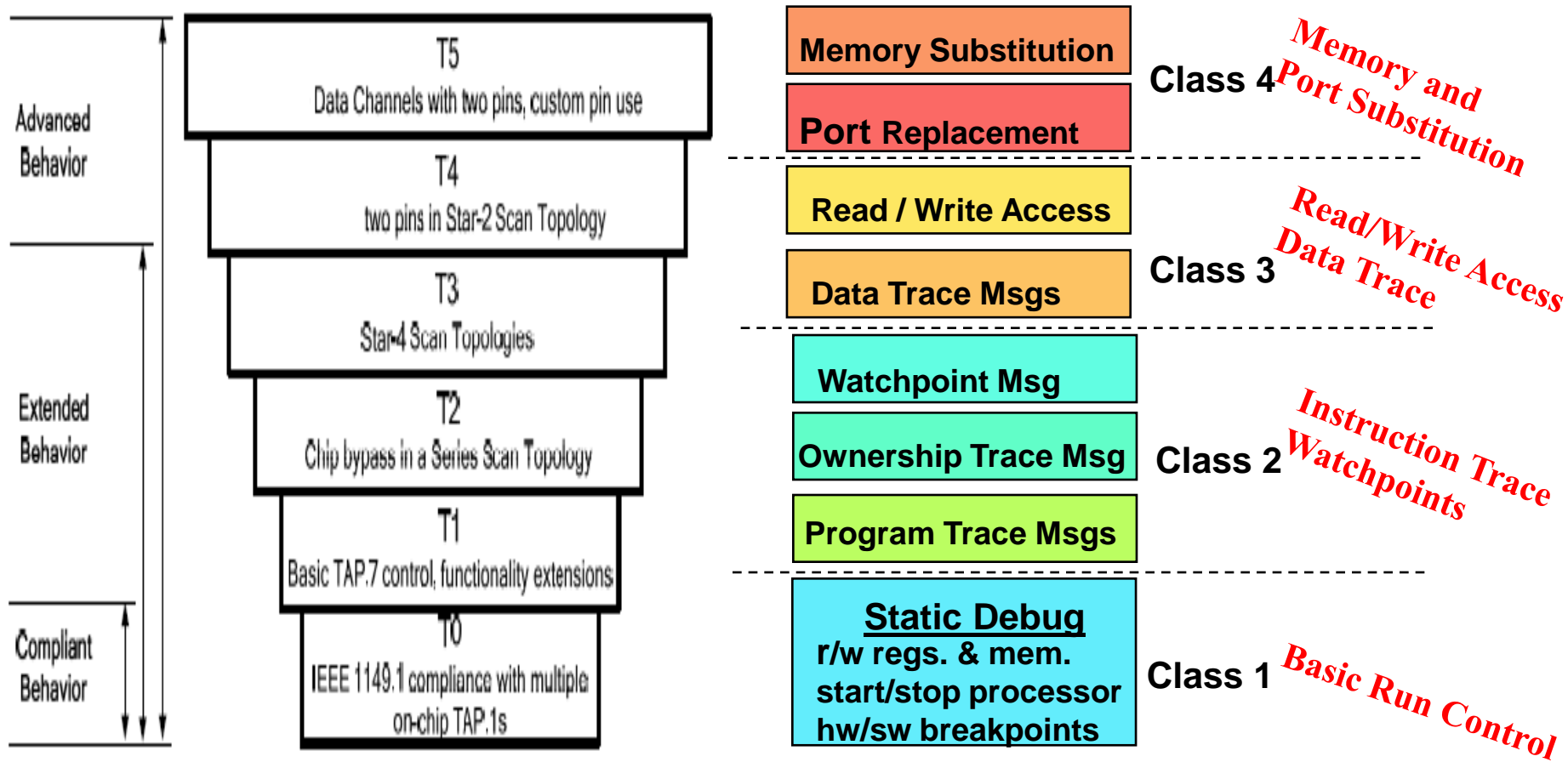
Open Debug Interconnect model

<u>Implementation Layer</u>	<u>Typical Tasks</u>	<u>Location</u>
1. Physical Port Layer	JTAG/Nexus TAP IO, chain and debug block wires JTAG/Nexus TAP FSM (connection level)	Target
2. Data Control Layer	Debug IP specific Commands/Registers/FSM User defined JTAG/NEXUS debug instructions Extended/Optional Debug block registers	Target
3. Debug Driver Layer	Debugger Protocol, clocking (probe specific API)	Probe
4. Data Transport Layer	APIs debug command sets, run control API	Host PC
5. Session Control Layer	Device connection setup & parameters, Remote debug server ex. GDBserver,	Host/PC
6. Debug GUI Layer	Debugger UI, GDB commands, trace viewers Set/observe watch/break/trace points, event triggers, In-the-loop Run control - go/halt/single step	Host/PC
7. Application Layer	Eclipse, other IDE, Global (Multi-tool) data management	Host/PC

Open Debug Interconnect model

<u>Implementation Layer</u>	<u>Typical Tasks</u>	<u>Location</u>
1. Physical Port Layer	JTAG/Nexus TAP IO, chain and debug block wires JTAG/Nexus TAP FSM (connection level) 1149.7 interface fits in here	Target
2. Data Control Layer	Debug IP specific Commands/Registers/FSM User defined JTAG/NEXUS debug instructions Extended/Optional Debug block registers Nexus TCODE architecture fits in here	Target
3. Debug Driver Layer	Debugger Protocol, clocking (probe specific API) Debug tools however will need to support both	Probe

Nexus Feature Classes



No direct correlation between 1149.7 T Classes and Nexus Classes

1149.7 BDX/CDX

Extended - Operation within Star-4 Topology						
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Star-4 Drive Conflict Prevention						
Series/Star Scan Equivalence (SSDs)						
Extended Series Performance						
Coupling/Decoupling of STL						
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IEEE 1149.1 compliance at start-up						
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Scan Formats:						
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Extended - Operation within Star-4 Topology						

CDX /BDX

- Background Data Transport (BDX) - utilize idle bandwidth during TAP IDLE, PAUSE_DR, and PAUSE_IR for transfers
 - Interesting for improving throughput of data intensive trace/calibration operations
- Custom Data Transport (CDX) - implement a custom link protocol to “on the fly” change direction of the data transfers.
 - Interesting since majority of Nexus data intensive transfers are driven from target

Figure 13-1: CDX Burst Transfer

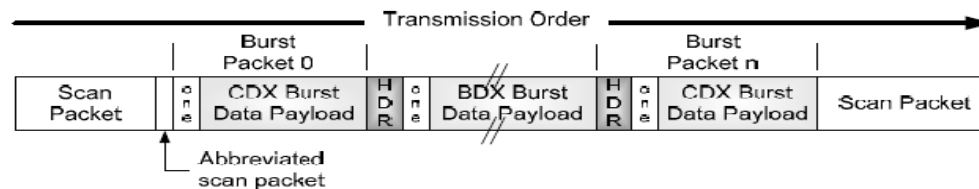
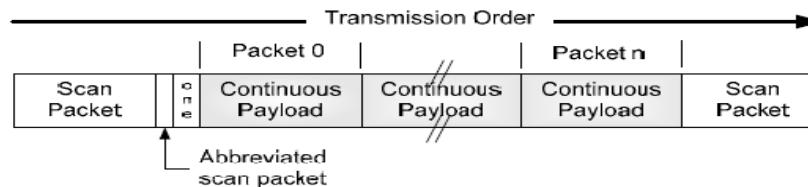
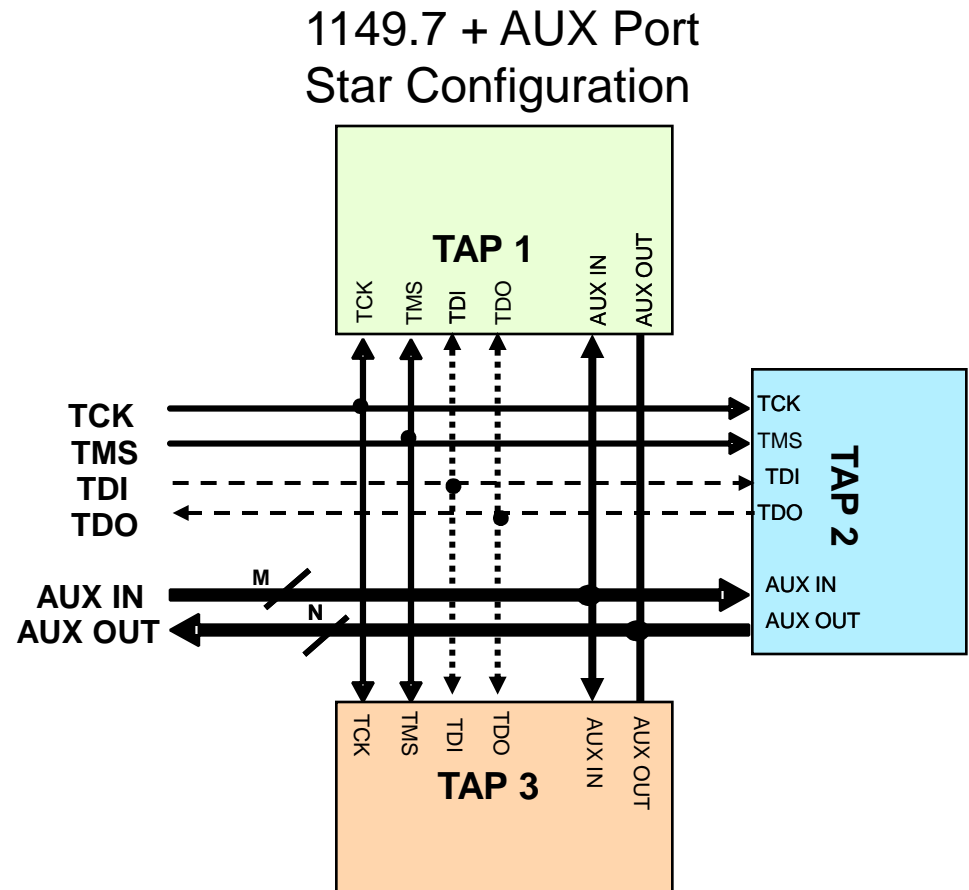


Figure 13-2: CDX Continuous Transfer



IEEE 1149.7 JTAG & 5001 Nexus

- Nexus debug over 2 wire interface as required
- Does not impact Nexus TCODE protocol or Multi-Processor/SoC debug support
- Nexus Aux In and Out ports extend 1149.7 bandwidth options for trace, calibration, mem access, ...
- 1149.7 Star configurations allow direct control/data connection for Nexus ports in different devices
 - **Address cases where synch is needed with AUX ports**
- Nexus operation is compatible with 1149.7 (T0-T5) classes
 - Nexus protocol sits on top of 1149.7 signaling,
 - Potential improved performance using 1149.7 T5 CDX/BDX functions

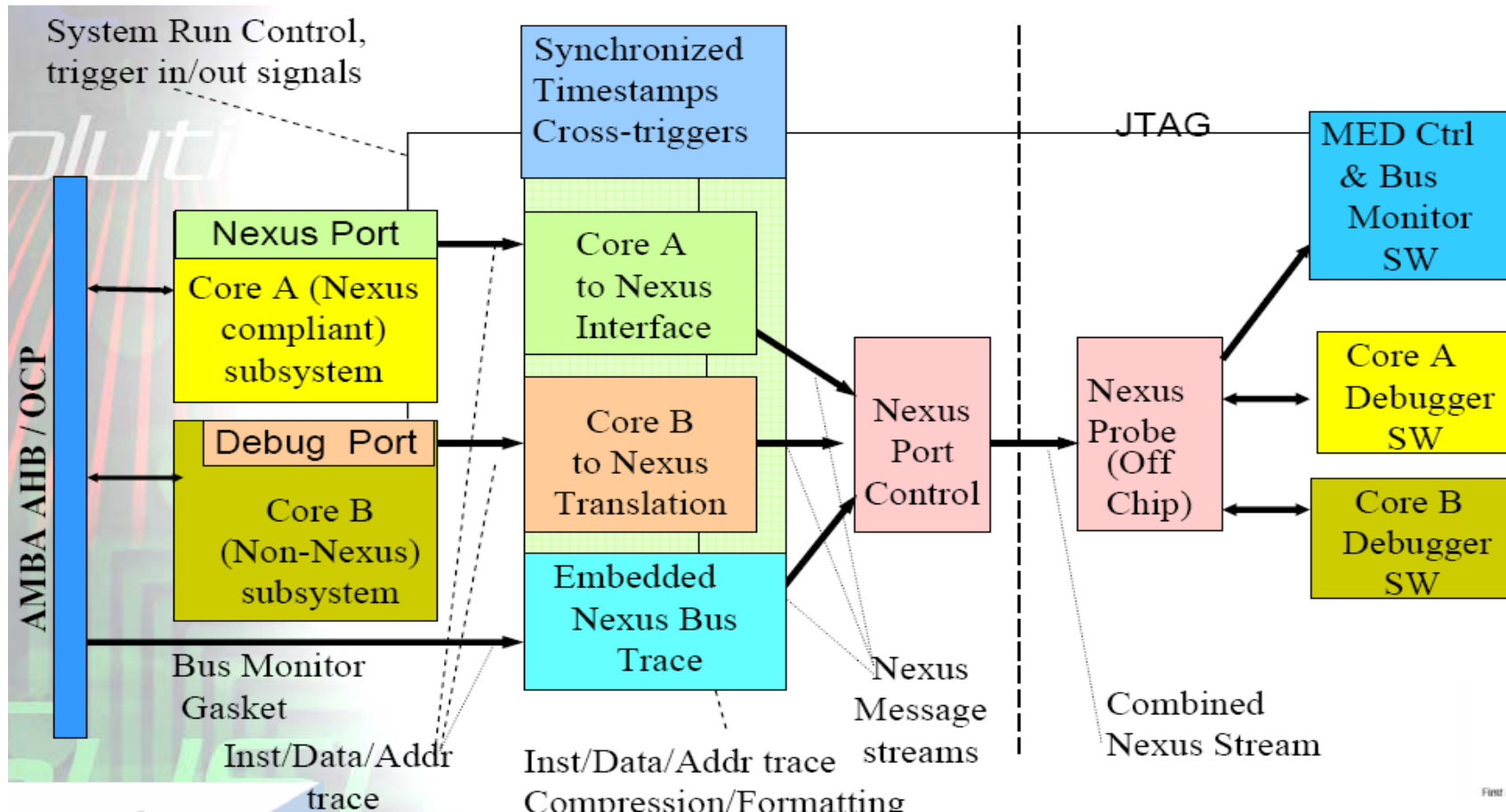


THANK YOU

NEXUS 2010 SPECIFICATON SHOULD
RELEASE IN 4Q2010



REFERENCE - Nexus Example



First 501

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