Debugging Continues to be the Most Time Consuming Effort by **50%**

And it’s getting worse. **WHY??**

- **Same Debug Methodology for 20+ years**
- While there has been very good progress in improving all other areas of verification, very little has been done in **Debug automation**.
- **Increasingly larger SoC designs and many iterations producing Terabytes of Data**

*Finding the source of the bug is becoming like finding “a needle in a hay stack”*

### Today’s Verification Effort

- **Debug**: 50%
- **Coverage analysis**: 25%
- **Test planning**: 10%
- **Test creation**: 5%
- **Test execution**: 10%

Source: Verification engineer survey by Cadence
What would you do if you were given 25% of your TIME back? 

*Cadence set out to do exactly that*

**But HOW ???**

- **Debug platform architected from the ground up**
  - Leveraging the latest in s/w database architecture as its foundation of a common framework for performance, extensibility, and scalability

- **Platform extensibility, scalability, and integration**
  - User-selected Apps covering various functional verification tasks to view and debug from IP-to-SoC level across functional teams

- **Patented Root Cause Analysis (RCA) Technology and BIG Data Techniques**
  - Leverage patented RCA technology together with BIG Data techniques to quickly find the source of the bug

*Today’s Verification Effort after cutting Debug Time in ½*

- **TIME Savings**
  - Debug: 25%
  - Coverage analysis: 10%
  - Test planning: 5%
  - Test creation: 10%
  - Test execution: 25%

... and more to come
Introducing Cadence® Indago™ Debug Platform
Finding the Source of the Bug after One Debug Run is NO Longer a Dream

Traditional Debug Flow
- Code
- Sim
- **DB**
- **Debug**

Indago™ Debug Flow
- Code
- Sim
- **DB**
- **Debug**

Leveraging BIG Data concepts and RCA

Waveforms only

Duplicate data collected every iteration

Iteration 1
Iteration 2
Iteration …N

“Cadence’s Indago Debug Analyzer App has improved our debug productivity up to 50 percent because it helps us find the root cause of the bugs faster with features like reverse debugging. We believe the Indago Debug Platform will enable us to continue to deliver for applications including consumer electronics, fitness tracking, wearables and IoT.”

Robert Richter, Senior Expert, ASIC Development, at Bosch
Key Benefits of Cadence® Indago™ Debug Platform

A Paradigm Shift in Debug Methodology Cutting Debug Time in ½

- 2X debug productivity improvement with Indago through:
  - Patented Root Cause Analysis technology
  - BIG Data concepts for intelligent automation
  - Integrated Analysis GUI scalable from IP-to-SoC level debug

- 3 Indago platform Apps addressing specific debug tasks
  - Debug Analyzer: RTL/GL and Testbench
  - Embedded Software Debug: Synchronized ESW/HW
  - Protocol Debug: Interface protocol functional validation

- Supports Cadence and 3rd party verification engines
  - Debug Analyzer: Phased RTL/TB support through next several releases
  - Embedded SW: Today (unmodified TARMAC trace files)
  - Protocol Debug: Today (for supported protocols)
The Indago™ Root Cause Analysis (RCA) Engine
Mature, intuitive and ubiquitous

• The entire Indago Debug Platform is built on top of a mature RCA engines
• The Indago RCA Engines have existed for 8 years
  – Previously only available in advanced CAST analysis tool
  – Now being leveraged by all Debug Apps
• Access to the underlying engine appears in almost all GUI components
  – Click on any variable to traverse time and space to show cause of the variable change
  – Click on a source line to be taken through time to the last/next time that line executed
  – Intuitive RCA component to provide users with a guided tour through a bug scenario
  – Can traverse through language barriers
• Indago provides unparalleled RCA capabilities in our industry
Competitors Debug Solutions

RCA on RTL Only

• Competitors provide RCA on RTL/GL design only
  – RTL only one piece of the debug picture

• Engineers are forced to debug with severely limited visibility into other aspects of the environment
Indago™ Root Cause Analysis
RCA across all aspects of the simulation

Causal Relationships to explore

Jump to RC of value changes
Indago™ Root Cause Analysis
Direct Access RCA buttons

• Direct Access RCA buttons are present in many Indago debug components
  – SmartLog, Source Viewer, Variables, Active Threads, Time Tables, Search Results, etc.
• Allows immediate access to a debug point of interest
  – Variable change, last/next time a source line executed, last/next time a message was printed
  – After clicking, debug location is updated and all components update accordingly
Indago™ Root Cause Analysis

Root Cause Analysis Component

• RCA Component provide a list of causal relationships to explore for any scenario
  – Seamless language traversal from TB to RTL
  – Saves entire debug decision tree
  – Can revert back to previous point or launch new investigation
  – Users no longer lost in the debug process
Indago™ Root Cause Analysis
RCA across all aspects = increased recording

Indago Big Data
(when compared to traditional debug)

Causal Relationships to explore
Jump to RC of value changes

Indago™ Root Cause Analysis
RCA across all aspects = increased recording

Indago Big Data
(when compared to traditional debug)

Causal Relationships to explore
Jump to RC of value changes
Indago™ Big Data Analysis

What makes Indago unique

• Recording additional data allows for powerful analysis capabilities such as:

  – **Root Cause Analysis** (RCA)
    – RCA Component
    – Direct Access
  – **Playback Debugger** (forward/backward single stepping)
  – **SmartLog** (All messages saved to DB for querying/filtering as well as read/writing)
  – **SmartPrint** (write new print statement on the fly to the SmartLog DB)
  – **Time Tables** (charting of all accesses to objects over time)
  – **Powerful Searching** (organized, tabbed results)
  – **Call stack analysis** (walk through all stack frames in post process)
  – **Variables Table** (local/global variables accessible as you step)

• Let’s take a closer look at some of these features now …
Indago™ Big Data Analysis
Playback Debugger*

- Allows for instant replay of the debug scenario without re-running
  - Step backward or forwards through time and space
  - Direct Access to any execution point
  - Code coverage visualization
    - Over recording window
  - Single click breakpoints
  - Tabs for multiple source files
  - Quick call stack walking
  - Access to all source files
  - Debug scope shaded background

*Available in ESW and IDA App
Indago™ Big Data Analysis
SmartLog

- Write messages to SmartLog on the fly while debugging
- Messages from all languages (tool messages as well)
- Powerful filtering/querying
- Direct Access
- Colourized messages by type
- Debug Location indication
- Error message indication
- Message waveform visualization
- Verbosity slide control

Can layer filters and save queries for sharing
Error messages automatically highlighted
Configurable columns allow complete control over messaging output
Indago™ Big Data Analysis
SmartPrint*

• Indago allows users to **add a print statement to your log without re-running**
• Saves lengthy debug iterations
  – Traditional debug flow requires adding print statement, recompile, re-elaborate, re-run, remove print statements

*Available in ESW and IDA Apps
Indago™ Debug Platform
Unified Analysis GUI

• Debug data from all sources visualized in the same GUI

  – Eliminates GUI context switching
  – Consistent debug experience
  – Quick ramp up

  – Unified RCA across debug data sources
  – Complete synchronization
  – App specific customization

- Messaging DB
- Embedded SW DB
- TB/RTL Source Execution DB
- VIP DB
- Waveform DB
- Debug DB
Indago™ Unified Analysis GUI
What makes Indago unique

• The GUI itself has many unique features, including:
  – Quick Launch (easy to access supporting debug components)
  – Filtering and sorting in most components (allows users to find information quickly)
  – Debug Stars (set bookmarks for quick return to any debug location)
  – Value Highlighting (visual comparisons/pattern identification through colourization)
  – Debug Location Indication (clear marker in all components)
  – Debug Notes (capture debug information for quick handoff)
  – Debug Handoff (save the state of the entire GUI for quick handoff)

• Let’s take a closer look at some of these features now …
Indago™ Unified Analysis GUI
Filtering and Sorting

• Fast search and filtering is key to finding the right information quickly
• Most all windows in Indago have a consistent filtering solution
  – Can filter criteria for each column
  – Can combine filters to narrow results
Indago™ Unified Analysis GUI
Value Highlighting

• Tag values with a colour or custom name
• All matching GUI values are highlighted
• Quick compare of values
  – No need to write value down
• Recognize patterns within data sets
• Colouring also applied to waveforms
• Very useful for debug handoff

Highlighting also appears in waveform

Highlight unexpected values for debug handoff

Colours help identify patterns within the data

Custom name specific values

Unexpected (State_2)
Indago™ Unified Analysis GUI

Debug Handoff

Value highlighting

Debug Notes

Waveform window state

Highlighting in wave

Debug Stars
Indago™ Apps

• Apps are individual products targeted at a specific debug task
  – Indago Debug Analyzer App: RTL/GL/TB debug
  – Indago Embedded SW Debug App: Embedded SW/HW Debug
Indago™ Debug Analyzer App

- SmartLog Analysis
- Source Viewer with forward/reverse stepping
- Variables Table

Access a wealth of specialized debug components

Synchronized Waveform
Indago™ Embedded Software Debug App

- Step forward/backward in source code
- View disassembly code
- Switch cores in multi-core view
- Go to next/previous execution of any line
- Move time cursor in waveform view
Indago™ Protocol Debug App

Next-generation protocol debug aid

- Simplifies debug by illuminating design and VIP behavior
- Support for 12 popular protocols in 2015, others to follow
- Seamless integration with all major simulators
Indago™ 3rd Party Support
Initial feature set for 15.1

• Indago:
  – Enables synchronized debug of Verilog RTL/GL signals with VIP or Embedded SW on any simulator

• Indago Apps:
  – Debug Analyzer App
    – RTL/GL: Verilog Basic types (No MDA's, No Assertions, No transactions, No SV, No VHDL)
  – Protocol Debug App:
    – Full support for dumping of Indago™ debug DB’s from any simulator
    – Synchronized debug of supported RTL/GL signals together with VIP
  – Embedded SW Debug App:
    – Embedded SW debug DB creation from unmodified ARM TARMAC trace files generated by any simulator
      – Only for currently supported cores
    – Synchronized debug of supported RTL/GL signals together with Embedded SW

• More RTL/GL/TB features will come in phases over the next few releases
Indago™ 3rd Party Debug Flow
All Apps Combined

- Simulator Compile/Elaborate
- Simulate
- Shared Object files
- Any Simulator Flow
- Design/TB Files
- System task calls
- $IndagoDumpVars(…)
- Indago Post Process Debug
- IES Compile/Elaborate
- Indago 3rd Party Debug Flow
- LWD
- Needed if full RTL/GL debug capabilities such as driver tracing desired
- Waves
- VIP
- ESW
- TARMAC trace
- ESW Engine
Summary: New Cadence® Indago™ Debug Platform

✓ **2X debug productivity improvement**
  – Indago Debug Platform CUTS Your DEBUG TIME in HALF
  – Gain more TIME back in your LIFE
  – Customers* are seeing these benefits today!

✓ **3 Apps** addressing specific debug tasks
  – RTL/GL and Testbench
  – Synchronized ESW HW
  – Interface protocol functional validation
  – More Apps to come

✓ **Available Today!**

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*Customers like Renesas, Siemens, and TI presented about their success at CDNLive. ST has a success story published on Cadence.com.*