Applying Big Data to Next-Generation Coverage Analysis and Closure

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Biggest ASIC Functional Verification Challenge

Creating Sufficient Tests to Verify the Design (Coverage Closure)

Knowing My Verification Coverage

Managing the Verification Process

Time to Isolate and Resolve a Bug

Time to Discover the Next Bug

Defining Appropriate Coverage Metrics

Other

Biggest FPGA Functional Verification Challenge

- CREATING SUFFICIENT TESTS TO VERIFY THE DESIGN (Coverage Closure)
- KNOWING MY VERIFICATION COVERAGE
- MANAGING THE VERIFICATION PROCESS
- TIME TO ISOLATE AND RESOLVE A BUG
- TIME TO DISCOVER THE NEXT BUG
- DEFINING APPROPRIATE COVERAGE METRICS
- Other

Verification Management

Pain Points

- Managing
  - Data
  - Process
  - Tools

When are we done?

One Project

- Aggressive Schedules
- Different Expertise and Skills
- Multiple Engines/Metrics
- Multiple Time Zones/Locations
- Multiple Methodologies

Who is responsible?

What are the Risks?

Which engine should I use?

Where are we?

Why are we behind schedule?

Where do we start debugging?
Data Management is key
Unified metrics, engines, and infrastructure

- Managing Data
  - Unified coverage
  - Performance & Capacity
  - Comprehensive Infrastructure

- Guiding the Process
  - Current & Historical Analysis
  - Optimization
  - Electronic closure

- Verification automation
  - Multiple Verification engines
  - Throughput efficiency
  - Turn-around time
Unified Questa Verification Management

Data, Process and Tool Automation

- Trend Analysis
- Analysis, Merge, Rank
- Testplan Tracking
- Unified Data
- Unified Analysis
- Unified Engines
- VRM, Verification Run Manager
- Unified Requirements
- Testplans
- Specs & Requirements
- Virtual Prototype
- QUESTA® Formal
- QUESTA® Simulation
- VELOCE® Emulation
- FPGA Prototype
Combining Simulation and Emulation

Analog and Digital flows

- QUESTA® VIP
- QUESTA® Simulation
- VELOCE® Emulation
- Digital
- Functional Coverage, Code Coverage, Assertions
- Functional Coverage

- Analog
- Analog Code Coverage, Analog Assertions, Spice Measurements

- Read/Write API
- Trend
- Merge
- Tests
- Testplan
- UCDB/UCISDB

- VRM
- QUESTA® ADMS
Combining PowerAware Simulation
Coverage, Assertions and VM

Analysis
Power State Coverage, PowerAware Assertions
PowerAware Testplan

Testplan Tracking

Top Level
Sub-plan

PowerAware Testplan
Excel Add-in

Read/Write API
UCDB/UCISDB

Trend
Merge
Tests
Testplan

QUESTA®/VELOCE®
PowerAware

UCDB/UCISDB

UCDB/UCISDB

UCDB/UCISDB
Combining Formal CoverCheck & Simulation

Faster coverage closure

QUESTA® CoverCheck

QUESTA® Simulation

UCDB/UCISDB

Tests

Testplan

Trend

Merge

Read/Write API

Auto-Exclusions

Uncoverable

Coverable

Review

Code Coverage, Functional Coverage

Code Coverage, Functional Coverage
Combining Formal Applications

Static analysis complements dynamic simulation
Combining HLS Design Source

Bringing RTL Coverage to HLS

C++ and SystemC Design Source

Functional Coverage, Code Coverage,
Visualizer Coverage

Analyze and improve coverage with ease

Improved GUI
  • Improved Exclusion Management
  • Easy Navigation

Better capacity and performance
  • Handles the largest of designs
  • Large coverage data

Analyze and debug coverage issues all at once in one tool
  • With help of design and waveform data already available in Visualizer
Closing Coverage with a Plan

- Link verification requirements to coverage items
- Analyze and filter results
Visualizer Coverage Demo

Where we are today
Verification Management Today
Top Verification Management User Requirements

Coverage Analysis
Verification Planning
Regression Running
Metric Platform

Emerging Trends
New Technologies
Emerging Markets

Questa® Verification Management

Desktop
Team
Enterprise & Cloud

Engines
Agnostic
Traceability
Collaboration
Analytics/ML
Cloud

Lifecycle Management

Emerging Markets
New Technologies
Emerging Trends
Collaborative Design Process

Multiple and Dispersed Stakeholders

- Manager
- Designer
- Verification Engineer
- Verification Engineer

HDL & HVL Source

Bug Tracking

Revision Control
Collaborative Project & Requirements Management

Requires Enterprise Application Lifecycle Management (ALM)
Why not Collaborative Verification Planning

Central Repository allows Collaboration Especially needed for Safety Critical and Traceability
Collaborative Run Management & Closure

Central Repository allows a Collaborative approach necessary for Closure
Collaborative data provides a Platform

Data Analytics Central Repository allows Cross Metric Analytics and Visualization
Small Step to the Cloud or Hybrid Cloud
Collaboration and Process Management in the Cloud
Team-Based Verification Management
Web Ready Collaborative Verification Intelligence

Process Guide
- Plan & Requirements-driven
- Safety Critical Flows
- Lifecycle Management

Coverage Analysis
- Code/Functional/Testplan
- Hole, Test & Time Domains
- Coverage Analytics

Regression Running
- Creation & Execution
- Monitor & Analysis
- Historical Analysis

Data Analytics
- Dashboards & Analysis
- Cross Metric Analytics
- Machine Learning
Polarion IC Verification Assistant (ICVA)
Phase One Requirement-driven Verification Flow, Available Now

**IC Verification Assistant**
- Polarion Add-on
- Capture Design Spec
- Capture Testplans
- team-based
- Link to Coverage
- Export UCDB Testplans
- Verification Traceability
- Lifecycle Management
- Synergy/Enterprise
- Modern UI Performance

**Capture**
- ICVA Template
- Polarion Workflows

**Assistant**
- Import Coverage Model
- Export Testplan UCDB

**Traceability**
- Implementation
- Verification
Coverage Analyzer

First Application of Next Generation Verification Management Platform

Collaborative Coverage Closure Platform
• UX Design for Ease and Speed of Use
• UCDB Consistence & Backwards Compatibility
• Device & OS independence

Flow Requirements
• team-based shared Coverage Analytics
• Collaborative Verification Process Integration
• Integration with Desktop Debug

Unique Features
• Analytical Navigation
• New Visualizations
• Advanced Analytics & Data Mining
Team-based Collaborative VM Solution

VIQ the Collaborative Web Platform for team-based Verification Closure

Coverage Analyzer

- VIQ Application
- Collaborative & Cloud Coverage/Metrics Gateway
- Platform Independent
- Advanced Analytics & ML
- team-based
- UCDB File and Repository
- Visualizer Integration
- VIQ/Synergy/Enterprise
- Modern Web UI

Coverage Dashboard
- Summary
- DU heatmap
- Bin distributions

Expression Analysis
- Pattern matching
- Generate grouping

Covergroup Analysis
- Hole analysis & clustering
- Transitive exclusions
Coverage Analyzer dashboard

Test Summary
- Chart by count, sim time & cpu time
- Dill-down to test results

Coverage Summary
- Coverage by type
- Link to analyze by type

Covergroup Coverage
- Covergroups grouped by coverage percentage
  - High
  - Medium
  - Low
- Quickly get to problematic covergroups

Bin Distribution
- Quickly drill into specific coverage type
- Quickly navigate to DU/instance

Design Unit Heatmap
- Top 20 DU's negatively effecting coverage
- Can filter on coverage type
- Quickly get to instance/du
Aided Structural Analysis

Find Your Scope
- Searchable
- Sortable & filterable
- Including multi-sort
- Focus on specific hierarchy via charts

Display Your Way
- Toggle between list & hierarchical display
- Toggle between local & recursive coverage
- Toggle between by DU & by Instance coverage
- Toggle chart display

Narrow Your Focus
- Choose specific hierarchy for charting
- Quickly find problem areas without searching
- Filter on coverage types
Source-based analysis

Source Code
- Annotated coverage
- Quick navigation to hits/misses
- Filter hits/misses
- Filter coverage types
- Supports multiple types at once
- Exclude from source
- Linked to Outline

Outline View
- List of all metrics
- Filter coverage types
- Supports multiple types at once
- Linked to source
- Shows test hit info
- Filter hits/misses
- Exclude items

Advanced Analysis
- Pattern matching for conditions/expressions
- Tree representation
- Heatmap of terms
- Exclude entire terms
- Tips
Coverage Analyzer Demo
Covergroup analysis

Covergroup Distributions
- Find biggest bin objects
- See breakdown of coverpoint vs. cross
- Filter types

Simple List View
- All coverpoints and crosses in the covergroup
- Navigate to analyze bins
- Sort & filter
- See test hit data

Where to Start
- See what is your biggest hole
- Coverage increase possible if covered
- Hole analysis

Visualize Relationships
- How crosses & coverpoints are linked
- Navigate directly from network graph
- Select cluster to focus on
Testplan coverage

Testplan Summary
• Overall testplan coverage
• Quickly navigate to the most problematic sections

Testplan Analysis
• Ability to filter/sort on any column/attribute
• Familiar hierarchical navigation
• Navigate to any object

Testplan Analysis
• Find elements not linked to the testplan
• See a breakdown of sections by coverage achieved
Where Are We Going?

Different kinds of data
- Performance profiling
- Engineering resource allocation
- Regression timing/tracking predictability
- Best tests to run in shortest time
- DUT performance

Verification Insight
- Machine Learning
Verification Insight Data Analytics
Common Platform Required for the Maturity of Analytics

Traditional analytics to control and understand

Descriptive Analytics
What happened?

Diagnostic Analytics
Why did it happen?

Predictive Analytics
What will happen?

Prescriptive Analytics
Making it happen

Big Data-fuelled analytics to improve and innovate

Value
Intelligence Maturity
Predictability Within the Verification Process

Building a Verification Metrics Platform

Resource Metrics
- Project
- Software Licenses
- Compute Resources
- Load Balancing

Process Metrics
- Verification Plans
- Requirements
- Bug Tracking
- Revision Control

Functional Metrics
- CT
- Regressions
- Coverage

Data Management

Data Visualization

Data Analytics

Machine Learning
Verification Insight

Web-based collaborative sharing of all data

Single repository optimized for team-based access

Track new metric data along with coverage, regressions, etc.

Apply Data Analytics to turn data into information
Siemens EDA Questa Advanced Verification


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Q&A

Thank You