Synopsys
FPGA and Simulink-Based Design Solutions for Automotive

Synopsys Automotive Seminar – Japan
May 2012
Market Overview & Trends
Automotive FPGAs

- Multiple vendors offering automotive-qualified devices
  - Altera, Xilinx, Lattice

- Increasing FPGAs portion of vehicle ASIC applications
  - Application flexibility, field updates
  - Rapid prototyping and/or short time-to-market requirements

- “FPGA SoCs” will accelerate expansion
  - Integrated FPGA+ARM CPUs address MCU, DSP, applications
  - Increased integration, lower cost, lower power
  - Addresses higher demand for apps which require high perf. DSP, imaging, and graphics: Infotainment, Networking, Driver Info/HMI, etc.
## Automotive FPGAs – Addressable Applications

<table>
<thead>
<tr>
<th>Infotainment</th>
<th>Driver Info/HMI</th>
<th>Driver Assistance</th>
<th>Vehicle Networks</th>
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<tbody>
<tr>
<td>• Head units:</td>
<td>• Hybrid Instrument Clusters</td>
<td>• Night Vision</td>
<td>• Gateway Controller between Networks</td>
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<td>- GPS navigation</td>
<td>• Voice Recognition</td>
<td>• Lane Departure Warning</td>
<td>• MOST</td>
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<td>- Audio/Video</td>
<td>• Echo Cancellation</td>
<td>• Park Assist</td>
<td>• FlexRay</td>
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<td>• Rear seat entertainment</td>
<td>• Head Up Displays (HUD)</td>
<td>• Reverse Guide Monitor</td>
<td>• CAN</td>
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<td>• DVD/MP3 Players</td>
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<td>• Adaptive Cruise Control</td>
<td>• APIX</td>
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<td>• Game Consoles</td>
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<td>• Collision Warning</td>
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<td>• Integrated Mobile Phones</td>
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<td>• Active Occupancy Detection</td>
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<td>• Digital/Satellite Radio</td>
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<td>• Driver Alertness Monitor</td>
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<td>• USB Plug &amp; Play</td>
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Source: Strategy Analytics
Challenges in Automotive Electronics
A Distributed Embedded System

Today: More than 80 microprocessors and millions of lines of code!

Growing complexity, effort and risk for design, simulation, and verification

How Model-Based Design & FPGAs Can Help

• High-Level Models (i.e. Simulink)
  – Complete system model
  – Executable specification
  – Faster design and verification
  – Easier debugging

• FPGA Implementation
  – Integration
  – Cost and power reduction
  – Higher performance
  – Improved features & differentiation
FPGAs for Advanced Applications

Example: Advanced Driver Assistance Applications

• Advanced Driver Assistance: still in an early development phase
  – hardware and algorithms are in flux
• Increasingly used to differentiate vehicle models and vendors
• FPGAs offer flexibility, re-programmability
  – Real-time rapid prototyping
  – Overall risk reduction
• FPGAs can meet performance requirements with parallel processing
  – Sensor fusion increases processing power requirements
  – More camera-based driver assist systems will be deployed

[Chart showing global production of driver assistance systems over years 2007-2015]

Source: Strategy Analytics
How Can Synopsys Help?

**High Quality FPGA Design and Implementation Flows**

- **Synphony**
  - High-Level Synthesis

- **Synplify**
  - FPGA Synthesis

- **Identify**
  - RTL Debugger

**Fastest Time to Results**

**Unmatched Engineering Productivity**

**New Technologies for High Capacity 28nm FPGAs**
Synplify FPGA Logic Synthesis Solutions Delivers the Best Quality Of Results (QoR)

- Proprietary optimization algorithms - over 30 patents
  - RTL Architectural Optimizations
  - Ultra High Capacity
  - Fast Runtime
  - Better QoR than FPGA vendor tools

The Industry Standard in FPGA synthesis

Synplify Pro

- The Ultimate FPGA Implementation Platform
  - Fast mode for improved runtime
  - Enhanced synthesis mode for fast timing closure
  - Integrated RTL Debugger
  - High Reliability
  - Power Analysis
  - Prototyping Support

Synplify Premier
Design for High Reliability

- High Reliability Design Automation
  - Safe State Machine: Error Detection
  - Safe State Machine: Error Correction
  - Triple-Mode Redundancy Conversion
  - Built-in formal verification technology for advanced optimizations

- Benefits
  - Easily create designs with error detection and correction logic
  - Eliminate manual effort and associated risk and delays
  - Increase productivity

High Reliability FPGA-Based Controller
Synphony Model Compiler (SMC)

High Quality FPGA and ASIC Design From Simulink

- Save months in verifying & validating your FPGA or ASIC system hardware
- Increase simulation and system validation productivity from Simulink
- High-level signal processing IP library for easy capture of multirate, fixed-point algorithms
- High-level synthesis creates highly optimized and re-usable hardware for FPGA and ASIC
- Use, simulate and verify RTL natively within Simulink
Higher Verification Productivity from Simulink
Synphony Model Compiler Simulation Technologies

• Capture and verify models
  – Use high-level IP library
  – Use RTL
  – Debug and verify using Simulink tools

• Create optimized hardware

• Generate C-models for system validation:
  – HW-accurate and high performance verification in external system simulators

• Benefits
  – Earlier system validation by months
  – Increased reliability and coverage
  – Higher verification productivity
Verifying RTL in SMC/Simulink Models

- **RTL Encapsulation Features**
  - Fast and easy RTL simulation in SMC/Simulink models
  - No dependency on external RTL simulator
  - Verilog and VHDL support

- **Benefits**
  - Fast verification of RTL, including high-reliability state machines and cycle-accurate control designs
  - Use legacy IP or 3rd party IP that was developed in RTL
  - Easier integrated system verification using Simulink
Quality and Design Portability Advantage

- Target the best FPGA for your product
- New devices are supported for logic synthesis and high-level synthesis, concurrently with vendor availability
- Superior QoR with advanced technology support through entire flow

**Synphony Model Compiler**

**Best QoR**

**DC**
- Built-in support for advanced nodes (i.e. TSMC 45nm & 32nm)
- Use your own custom libraries
- Advanced Timing Mode for real-time characterization and accuracy
- Integrated Power Analysis Flows

**Synplify**
- FPGA device-aware optimizations
- Integrated flow with Synplify Premier
- Advanced Timing Mode for real-time characterization and accuracy
Example Automotive Successes

Automotive controller integration using FPGAs

Prototyping of an adaptive cruise-control system
Example Automotive/Aerospace Success

Automotive controller integration using FPGAs

Use MATLAB/Simulink to develop, verify, and program their complex vehicle state machines and algorithms

Number of controllers/vehicle growing exponentially

Use FPGAs to integrate and consolidate controllers

- Organizational efficiency by adopting FPGA flow which is vendor independent (3 different teams)
- Higher quality of results yields lower area designs, smaller devices, and lower cost
- High quality WW support
- Support for integrated flows from Simulink
Example Automotive/Aerospace Success

Automotive controller integration using FPGAs

High quality FPGA flow enabled fast prototyping and testing over a range of environments

- Fast HW design, simulation and verification using high-level RTL synthesis
- Rapid prototyping and testing with multiple Xilinx Virtex-5 FPGAs

Prototyping of an adaptive cruise-control system
Summary

• Synplify: Maximize flexibility, productivity, and cost with leading vendor-independent FPGA design solutions
  – Synthesis that delivers the industry’s best quality of results
  – High reliability features for demanding control-based designs in automotive, aerospace, and military applications

• Synphony Model Compiler: Achieve highest design quality and productivity for Simulink-based FPGA design and verification
  – High quality model-based FPGA design and verification
  – Unique RTL and C-model simulation technologies for system verification and validation productivity
Predictable Success