Freescale Technology Forum


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Tools and Ecosystem for Automotive Development

Gareth Wang
Evaluation Boards

► Freescale
► Axiom
► P&E Micro
► iSystems
► Phytec
Compilers – Supporting Power Architecture for Automotive

Compilers Supporting the 32-bit/S12/S08 family of processors.

► Green Hills Multi

► Wind River Diab

► Freescale CodeWarrior™ tool suite

► Cosmic
Debugger Tools

- Ashling
- iSystems
- Latuerbach
- P&E Micro
- GHS Multi-Probe
- Wind River

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Main Features:

- GUI interface embedded into development tools
- Consistency checking with visual feedback on warnings & errors
- Generates production quality runtime source code based on property settings
- Allows migration of application code from one processor to another more easily
- Provides a SW component packaging mechanism for sale of drivers & source code algorithms

Supported Processors: 430, adding ~60 / year

- HC08, HCS08, RS08 – all 8-bit parts
- HCS12, HCS12X – all 16-bit parts
- DSC – all digital signal controllers
- ColdFire® – all shipping ColdFire v1–v4e parts
- Power Architecture® MPC5121e

Host Platforms: 1

- Windows hosts running CodeWarrior™ IDE (today)
- Eclipse hosted supporting Linux ® and Windows (by 2010)

Scalability Factor: High

- Leverages knowledgebase technology to drive efficiency from similar processors
- Applies models & transforms to produce components

Expansion / Future use:

- Basis for HAL project supporting RTOS partners
- Knowledgebase leverage across Freescale
- Silicon validation models possible
- Eclipse based host systems (Windows, Linux) by 2010

Synopsis:

1. Knowledgebase already leveraged by several technologies and processes in Freescale
2. Supports over 65 new parts each year, with varying packages, etc.
3. Expanding beyond CodeWarrior tools to support init/config functionality for Freescale partners
4. From February 2009, Processor Expert and all its technologies are owned by Freescale
5. This team has built the best test harness for on-target software peripheral tests, exercising hundreds of configurations per part

Team: 28 Brno; 4 GDL; 3 Austin

- 5 research projects (CZ and EU)
- Production team is 20 staff (cost competitive)
**RApplD – Rapid Application Initialization & Documentation**

**Basic Product Highlights**

- GUI-based tool for rapidly, intuitively developing Initialization code
- Automatic report generation of initialization configuration and register settings
- Efficient C and Assembly code generation for a multitude of compilers
- On-line documentation and built-in tool tips for ease of use
- Performs consistency checks to eliminate mistakes and inconsistencies
- Built-in tutorials with sample projects
- Initialization code for single/dual core startup from CRT0 upward
- Interrupt and Exception handler software framework generation
- Ability to define section map and place code into any memory section desired
- VLE/Non-VLE code generation supported

**RApplD V2.2.0.7**
- MPC555x
- MPC556x
- MPC553x

**RApplD1x V1.1.0.9**
- MPC551x

**RApplD563xM V1.0**
- MPC563xM

**RApplD560xB V1.1**
- MPC560xB/C

**RApplD560xP V1.1**
- MPC560xP

**RApplD560xS V1.0**
- MPC560xS
RAppID Pin Wizard Tools

- MPC563xM
- MPC560xP
- MPC560xB
- MPC560xS
- MPC551x
- MPC5668E/G
- MPC5674F

Allows for Function to Pin Allocation

Pre-Sales Support Tool

Hardware/Software Engineers

Target Users

Allocate Functions to Pins

Generate Excel Spread Sheet and html Report

Generates RAppID Init Project for pin initialization code generation later
eTPU Tools

► Ashware eTPU “C” Compiler
► Ashware eTPU Simulator
► Ashware eTPU Debugger

► ByteCraft eTPU “C” Compiler

► Freescale eTPU “C” Compiler

► Freescale eTPU Configuration Tool
► Freescale eTPU Web Interface for eTPU Function download
Automatic Code Generation - Model Based Design Tools

► Mathworks - MATLAB/Simulink/Stateflow
  • Application level Algorithm modeling and simulation.

► Freescale Processor Target Based Development
  • Mathworks
    ▪ Link for MULTI support MPC55xx family of processors for Processor In the loop development.
    ▪ On-Target Prototyping/PIL Blocksets for MPC5xx Family of processors.
  • dSpace
  • Freescale
    ▪ RAppID Toolbox for MPC5554 based on-target rapid prototyping to any ECM.
  • Simuquest Quantiphi
    ▪ S12 on-target rapid development environment

► Production Code Generation
  • Mathworks - Realtime-Workshop/Embedded Coder production code generation
  • dSpace – TargetLink production code generation tools, target processor based optimization packages
MATLAB and Simulink Code Generation Support for Freescale Processors

Real-Time Workshop
- Generates tunable code for rapid prototyping
  Real-Time Workshop Embedded Coder

- Generates efficient code for production
  Links and Targets

- Verifies and optimizes code for specific compilers and processors
  - For example, Power Architecture using Green Hills MULTI

You can deploy code on any Freescale processor using Real-Time Workshop and Real-Time Workshop Embedded Coder because they generate standard C/C++ (ANSI/ISO) plus offer target optimization customizations.
RAppID ToolBox Capabilities

- RAppID ToolBox is an add-on library to MATLAB/Simulink that includes:
  - RAppID for initialization
  - Configurable low-level drivers (blocksets) for MPC55xx peripherals
  - Optimized code blocks for SIMD functions
  - Scheduler and hooks to support the Freescale OSEK operating system
- The block-sets are seamlessly integrated into automatic code generators, such as Real-Time Workshop® Embedded Coder
- RAppID ToolBox enables engineers to quickly take control algorithm models directly onto any MPC55xx target board
- The target-optimized code blocks for DSP functions, such as IIR, FIR and FFT, enable engineers to take advantage of the SIMD functionality of the MPC55xx family
- Engineers can use the profiler block function to measure algorithm performance
SimuQuest QuantiPhi MCU Support Packages
Freescale S12, S12X, and MPC56X

► Provides production viable configurable low level drivers
► Intuitive in-model utility for configuring the drivers -- quick enough for prototyping, powerful enough for production.
  • User does not have to understand the details of the micro and its registers.
  • Many settings are determined automatically, but can be overridden by advanced users.
  • Dynamically manages cross-peripheral dependencies and warns of invalid settings.
  • Practically eliminates manual error and expensive debugging and rework.
► Powerful tool for developers using Simulink Models for prototyping through to production
  • Useful for systems, controls, and software engineers.
  • Access to drivers and registers through comprehensive Simulink blocks.
► Enables On-Target prototyping and production ECU code generation from a fully unified model
  • Customized driver code from QuantiPhi’s Simulink blocks is automatically integrated with the rest of the automatically generated code.
  • SimuQuest’s UniPhi data dictionary and architecture tool is included.
AUTOSAR software products from Freescale:

- **MCAL** (Microcontroller Abstraction Layer)
- **OS** (Operating System)
AUTOSAR Development Environment

Application Development Environment
- Application components
  - .c/.h runnable source files
  - .xml runnable description files

AUTOSAR-OS Configuration Tool
- OS .c/.h configuration code
- .xml/.oil OS configuration files

System Level Authoring Tool
- Generates RTE
  - .c/.h source code
  - .xml interface descriptions

AUTOSAR-MCAL Configuration Tool
- .c/.h source code
- .xml MCAL/driver configuration files
Application Development Environment

► Automotive – MATLAB / Simulink / Stateflow
  • Code Generation from Simulink Models with RTW/EC or TargetLink

Block Diagram Model to C Source Code and Description File – Application Runnable
Application Development Environment - Simulink AUTOSAR Support

► Import/export AUTOSAR software component XML files with Simulink
  • Information can be merged back into AUTOSAR authoring tools such as Vector DaVinci products

► Generate runnables with Real-Time Workshop Embedded Coder
  • Code can be integrated with an RTE and executed on processors such as Freescale products
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AUTOSAR-MCAL configuration tool

.c/.h source code
- .xml MCAL/Driver Configuration Files
MCAL Development

Tresos Studio Tools

Configure, generate code and description files

```
/*-------------------------------*/
#include

1) system and project includes
2) named interfaces from external units
3) internal and external interfaces from this unit

#include "Port.h"

#define PORT_PRECONFIG_FILE_SUPPORT

/* The integration of incompatible files
 *---------------------*/
#define PORT_AB_MAJOR_VERSION_CFG_C  2
#define PORT_AB_MINOR_VERSION_CFG_C  1
#define PORT_AB_PATCH_VERSION_CFG_C  0
#define PORT_AB_MAJOR_VERSION_CFG_C  0
#define PORT_AB_MINOR_VERSION_CFG_C  0
#define PORT_AB_PATCH_VERSION_CFG_C  0

#define PORT_GB_MAJOR_VERSION_CFG_C  1
#define PORT_GB_MINOR_VERSION_CFG_C  1
#define PORT_GB_PATCH_VERSION_CFG_C  0
#define PORT_GB_MAJOR_VERSION_CFG_C  0
#define PORT_GB_MINOR_VERSION_CFG_C  0
#define PORT_GB_PATCH_VERSION_CFG_C  0

#error "Software Version Numbers of Port_G are not compatible with Port_A"
#endif

#define PORT_SC_MAJOR_VERSION_CFG_C  1
#define PORT_SC_MINOR_VERSION_CFG_C  1
#define PORT_SC_PATCH_VERSION_CFG_C  0
#define PORT_SC_MAJOR_VERSION_CFG_C  0
#define PORT_SC_MINOR_VERSION_CFG_C  0
#define PORT_SC_PATCH_VERSION_CFG_C  0

#error "Software Version Numbers of Port_S are not compatible with Port_C"
#endif

#define PORT_START_SEC_CONST_UNSPECIFIED
#include "RegMap.h"
#endif

/* This table holds all the parameters of each module. */
```

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Freescale AUTOSAR Basic Software

AUTOSAR software products from Freescale:
- **MCAL** (Microcontroller Abstraction Layer)
- **OS** (Operating System)

AUTOSAR Runtime Environment (RTE)

- Operating System
- System Services
- Memory Services
- Communication Services
- Onboard Device Abstraction
- Memory Hardware Abstraction
- Communication Hardware Abstraction
- I/O Hardware Abstraction
- Complex Driver
- Microcontroller Drivers
- Memory Drivers
- Communication Drivers
- I/O Drivers

Microprocessor
AUTOSAR Development Environment

Application components
- .c/.h runnable source files
- .xml runnable description files

AUTOSAR-OS Configuration Tool
- OS .c/.h configuration code
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System Level Authoring Tool
- Generates RTE
- .c/.h source code
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AUTOSAR-MCAL Configuration Tool
- .c/.h source code
- .xml MCAL/Driver configuration files
AUTOSAR OS Configuration

General configuration of the AUTOSAR OS done in Tresos Studio
AUTOSAR software products from Freescale:

- **MCAL** (Microcontroller Abstraction Layer)
- **OS** (Operating System)
AUTOSAR Development Environment

AUTOSAR-OS Configuration Tool
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AUTOSAR-MCAL Configuration Tool
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System Level Authoring Tool
- Generates RTE
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Application Development Environment
- Application components
  - .c/.h runnable source files
  - .xml runnable description files
System Authoring Tool

System authoring tool ties application runnables to OS tasks, MCAL, and other runnables.

Most tools do NOT simulate. Generates RTE source and description files.

**SystemDesk by dSPACE**
Integrated with EB Tresos Studio

Provides simulation, authoring and RTE generation.
AUTOSAR MCAL Product

- MCAL drivers + Flash EEPROM Emulation, compliant to AUTOSAR 2.1 or 3.0
- AUTOSAR 2.1/3.0 MCAL releases do not contain RAM Test module
- All components configurable in any AUTOSAR-compliant configuration tool
- Including plugins for EB Tresos Studio
## AUTOSAR 2.1 Releases Tools Compatibility

### SW Product / Release

<table>
<thead>
<tr>
<th>SW Product / Release</th>
<th>Tools Compatibility</th>
<th>VLE</th>
<th>EB tresos Studio</th>
<th>Green Hills MULTI</th>
<th>Wind River DIAB</th>
<th>CodeWarrior</th>
<th>Cosmic</th>
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<tbody>
<tr>
<td>S12XE/F/S MCAL 2.1</td>
<td>BETA</td>
<td>VLE</td>
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</table>

(*) BSW components other than MCAL/OS, and integration, by Elektrobit

AUTOSAR 2.1 not supported.

AUTOSAR 2.1 MCAL not supported.

AUTOSAR 2.1 AutoCore not supported.
## AUTOSAR 3.x Releases
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