

Hardware/Software Codesign Overview

RASSP E&F Module Number: 14

Copyright 1995-1999 SCRA

All rights reserved. This information is copyrighted by the SCRA, through its Advanced Technology Institute (ATI), and may only be used for non-commercial educational purposes. Any other use of this information without the express written permission of the ATI is prohibited. Certain parts of this work belong to other copyright holders and are used with their permission. All information contained, may be duplicated for non-commercial educational use only provided this copyright notice and the copyright acknowledgements herein are included. No warranty of any kind is provided or implied, nor is any liability accepted regardless of use.

The United States Government holds "Unlimited Rights" in all data contained herein under Contract F33615-94-C-1457. Such data may be liberally reproduced and disseminated by the Government, in whole or in part, without restriction except as follows: Certain parts of this work to other copyright holders and are used with their permission; This information contained herein may be duplicated only for non-commercial educational use. Any vehicle, in which part or all of this data is incorporated into, shall carry this notice .

See the [RASSP Disclaimer file](#) for additional RASSP Disclaimer, Warranty and Limitation of Liability Information concerning the material, VHDL code and software developed under the RASSP programs or incorporated in RASSP material.

Abstract: The Hardware/Software Codesign Overview module is intended to introduce the hardware/software codesign to the practicing design, software, and systems engineers, and to the senior undergraduate or first year graduate student. The module provides key codesign concepts and attempts to show the benefits of the codesign approach over the current design process.

The module consists of eight sections. The topic is introduced by defining codesign, illustrating its usefulness, and introducing example systems that require this new methodology. Also included is a discussion about the components that make up an ideal codesign environment. The following sections are then dedicated to discussing some of these components in more detail.

The second describes the unified representation for hardware and software that is one of the components for an ideal codesign environment. Several candidate description methods are discussed in some detail. The third section describes techniques used to partition a system into hardware and software components. An automated partitioning algorithm is the ideal way to go, but this is a difficult enough problem that many codesign environments still leave this problem up to the expertise of the user. The fourth section describes the integrated modeling substrate that forms a component of an ideal codesign environment. This modeling substrate allows the complete hardware/software system model to be simulated at any point in the design process, which allows some degree of validation to be performed. The fifth section briefly covers methodologies for hardware and software synthesis from abstract system descriptions.

Finally, sixth section covers industrial approaches to hardware/software codesign, specifically covering the Lockheed Saunders and Lockheed Martin ATL approaches, and the seventh section gives a brief introduction into several codesign systems being developed by universities. Example systems included are Chinook, COSYMA, Ptolemy and POLIS.

Module Objectives:

To educate the hardware, software, and system designer on the fundamentals of hardware/software codesign in a manner that will assist him/her in understanding and employing cooperative hardware/software design techniques for the construction of complex systems, particularly embedded systems.

Specific Objectives:

Provide information on:

- 1) Introduction of Hardware/Software Codesign
- 2) Design Issues, Trends, and Considerations
- 3) Current Hardware/Software Design Process
- 4) Issues and Directions in Hardware/Software Codesign

- 5) Hardware/Software Modeling Concepts
- 6) Hardware/Software Partitioning
- 7) Hardware/Software Synthesis
- 8) Hardware/Software Codesign Systems

Prerequisites:

Prerequisite Modules: None

Prerequisite Knowledge:

Fundamentals digital logic design, both combinational and sequential
Software engineering fundamentals

Syllabus:

- 1) Introduction (25 Slides)
 - a) Codesign Definition
 - b) Motivation for Codesign
 - c) Categories of Systems and the Codesign Problem
 - d) Embedded Systems
 - e) Components of the Current Codesign Process
 - f) Components of the Ideal Codesign Process
- 2) Unified Hardware/Software Representations (12 Slides)
- 3) HW/SW Partitioning Techniques (26 Slides)
 - a) Partitioning Algorithms
 - b) Cost Metrics
 - c) Issues in Partitioning
- 4) Integrated HW/SW Modeling Methodologies (7 Slides)
- 5) HW/SW Synthesis Methodologies (16 Slides)
 - a) Hardware Synthesis
 - b) Software Synthesis
 - c) Interface Synthesis
 - d) Cosynthesis
- 6) Industry Approaches to HW/SW Codesign (4 Slides)
- 7) Hardware/Software Codesign Research (30 Slides)
 - a) Major Codesign Research Efforts
 - b) Chinook
 - c) COSYMA
 - d) Ptolemy

e) POLIS

9) Module Summary

(1 Slide)