Component-Based Software Engineering
Building reliable component-based systems

Overview
www.idt.mdh.se/cbse-book

The Book Organization

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The Book Organization

Part 1: Basic definitions and concepts of component specification
Part 2: Component models and architecture
Part 3: Developing Software Components (development process)
Part 4: Using components (evaluation, test, composition)
Part 5: Software Product-Lines
Part 6: Real-time components, real-time systems and components
Part 7: Case studies – real-time, industrial and office component-based systems

The Book Organization II

Part 1: Component Theoretical parts (definitions) General for components
Part 2: Compositions Processes dependability/reliability
Part 3: Systems Domain specific processes Real-time requirements
Part 4: Complex systems Case studies Specific cases
Part 5: Case studies Safety-critical requirements
Part 6: Case studies Specific cases
Part 7: Case studies Specific cases
PART 1 CONCEPTS OF CBSE

What is a component?

Chapter 1 Basic Concepts in CBSE
- How to define a component?
- Component specification
- Interface
- Contracts
- Patterns
- Frameworks

Chapter 2 Specification of Software Components
- Component Specification
- Interface Specification
- UML Component Specification
- Specifying extra functional components

Part 1 - Interesting questions/additional parts

- What are the relations between objects and components? How does it work in different technologies?
- What are component frameworks in different component models?
- Which types of design patterns can be implemented as components. Examples of some patterns and their implementation in a component technology
- How are interfaces implemented in different technologies?
- UML and component specification (UML components)
Part 2 - Interesting questions/additional parts

- Dynamic software architecture
  - Dynamic replacement of components
  - Dynamic restructuring of resources
- Different ADLs and their relations to components
- Corba
  - Corba component model
  - Corba and R/T corba
  - Minimal Corba
- OSGi component technology
- Containers and Frameworks in different technologies
Part 3 - Developing Software Components

Chapter 5
CBD Life-Cycles
- System & Application development
- Component development
- Different phases and emphasize on parts specific for CBD

Chapter 6
Semantic Integrity in Component–based Development
- Importance of semantics
- Different levels of semantic specifications
- Addressing semantic questions in CBSE literature – a statistic survey

Chapter 7
Role-Based Component Engineering
- Relations class/object – role – framework – components
- Role – parts of interface having a particular “role” in a framework together with other components
- How a role is implemented in OO languages?
Part 3- Interesting questions/additional parts

- Component-based processes
  - Component-based databases – problems and examples
  - How and when to test components
  - Component documentation
  - Component certification

- Semantic integrity
  - UML, OCL and specification of pre- and post-conditions

- Role-Based components
  - Component Frameworks and Roles

Part 4 - USING SOFTWARE COMPONENTS

Chapter 8
Dispelling the Myth of Component Evaluation

- How to evaluate and select components?
- What should we evaluate? Components or component compositions?
- How component properties behave in compositions?

Chapter 9
Component Composition and Integration

- Integration – putting components together (complied to component models)
- Composition – reasoning about compositions attributes
- Predictable assembly from “certificated” components
Part 4 - USING SOFTWARE COMPONENTS (cont)

Chapter 10
Predicting System Trustworthiness from Software Component Trustworthiness

- Predictable assembly
- Can be predict reliability of a composition from
- How to test assemblies?
- Fault injection method – Interface Propagation Analysis - send invalid data between connected components

Part 4 - Interesting questions/additional parts

- Component evaluation
  - Component repositories
  - Component documentations
- Fault injection models
  - Managing exception handlings in components
- Component and system properties
  - Reliability, Safety, Security, etc.
  - Experience from hardware systems and components
Part 5 - SOFTWARE PRODUCT-LINES

Chapter 11
Components in product line architectures

- What is “Software product lines”
- How to make reusable parts in in-house development for different families of products?

Chapter 12
KOALA – component model implemented at Philips
- Requirements, model architecture, interface definitions, experience

Part 5- Interesting questions/additional parts

- Software product lines
  - Overview
  - Process challenges – how to develop platforms
  - Configuration Management and PLA

- Integration principles
  - Type of bindings (functions, libraries, shared libraries, dynamic binding,....)
Part 6- REAL-TIME SOFTWARE COMPONENTS

Chapter 13
Components in Real-Time Systems
- Real-time requirements
- Real-time components (OS)
- Designing real-time component-based systems
- Reusing RT components

Chapter 14
Test of Reusable Software Components in Safety-Critical Real-Time Systems
- Safety-critical systems
- Large costs for testing
- Can we reuse components?
- What is the minimum of tests we must repeat

Part 6- REAL-TIME SOFTWARE COMPONENTS (cont)

Chapter 15
Providing real-time services for COTS components
- Using non-real time system (Windows NT) for real time application
- Can we adjust non-real time systems to use it as a real-time component
- RT characteristics of Windows NT
- Adding a new RT component – what is the behavior of the entire system
Part 6- Interesting questions/additional parts

- **RT components**
  - Interface required for RT components
  - Particular components – how to control a system RT behavior
  - Timing aspects of using indirect (or dynamic) bindings
  - Why component models such as COM, CORBA cannot be used in hard RT systems?
  - RT UML - overview

- **Testing safety-critical components**
  - What is a reliability of a component (hardware/software comparison)
  - Dependability of components in relation of dependability of systems

Part 7 - CASE STUDIES

COMPONENT-BASED DEVELOPMENT IN INDUSTRIAL APPLICATIONS

**Chapter 16**
Component-Based Embedded Systems

- How to use components in small embedded systems?
- Which component model to use?
- Which composition environment?
- Which run-time environment?
- Case study – ABB embedded systems

**Chapter 17**
Architectural Support for Reuse: A Case Study in Industrial Automation

- ABB’s next generation of automation system architecture
- AspectObjects
- Aspect directories
- Flexibility in integration and data mining
Part 7- Interesting questions/additional parts

- Embedded systems and component-based systems
  - Identification of configuration environment/framework and runtime environment
  - OS for embedded systems and possibility of using CBSE for them (example Rubus)
  - OPC overview

Part 7 - CASE STUDIES (cont.)

COMPONENT-BASED DEVELOPMENT IN INDUSTRIAL APPLICATIONS

Chapter 18
A Framework for Integrating Business Applications
- Similar to chapter 16, but standards used AMAP
- Office Information systems
- Issue Management Systems
- Integration of large applications
- From different applications to common Interface

Chapter 19
Industrial Experience with the Dassault Système Component Model
- Reuse, dynamic configuration of applications (CAD/CAM)
- Internal component model
- Problems and experiences
Related topics

1. Basic Concepts in CBSE
2. On the Specification of Components
3. Architecting Component-based Systems
4. Component Models and Technology
5. Component-Based Development Process
6. Semantic Integrity in CBD
7. Role-Based Component Engineering
8. Dispelling the Myth of Component Evaluation
9. Component Composition and Integration
10. Predicting System Trustworthiness
11. Components in PLA
12. The Koala Component Model
13. Components in RT systems
15. Providing RT Services for COTS
16. CB Embedded Systems
17. ABB AIP
18. Application Integration
19. Dassault Système Component Model

Related chapters

A 1,2,6 (Ahmed & Mehdi)
B 1,2,7 (Jari & Baharak)
C 1,2,13
D 1,2,16
E 3,4 (Magnus H)
F 3,5 (Christer & Peter)
G 3,11
H 4,17,19
I 10,14 (Lars & Tobias)
J 13,14,16 (Magnus & Mathias)
J’ 1,2,13,15 (Redu & Tomas)
K 17,18,19 (Robert & Jakob)

Describe them, find relations between them