Architecture

CSE 403, Winter 2003

Software Engineering

http://www.cs.washington.edu/education/courses/403/03wi/

Readings and References

- References
  - » *Software Architecture*, David Garlan, CMU, 2001
    - http://www-2.cs.cmu.edu/~able/publications/encycSE2001/
  - » *A Practical Method for Documenting Software Architectures*, Clements, et al, CMU, 2002
    - http://www-2.cs.cmu.edu/~able/publications/icse03-dsa/
  - » *Enterprise JavaBeans Specification*, Sun Java Community Process
    - http://java.sun.com/products/ejb/docs.html

Software Architecture

- The software architecture of a program or computing system is the structure or structures of the system, which comprise
  - » software components
  - » the externally visible properties of those components
  - » and the relationships among them.

From *Software Architecture in Practice*, Bass, Clements, Kazman, referenced in Garlan

View

- The architecture of a system describes its gross structure using one or more views
- Structure in a view illuminates a set of top-level design decisions
  - » how the system is composed of interacting parts
  - » where are the main pathways of interaction
  - » key properties of the parts
  - » sufficient information to allow high-level analysis and critical appraisal

Uses of an Architectural Description

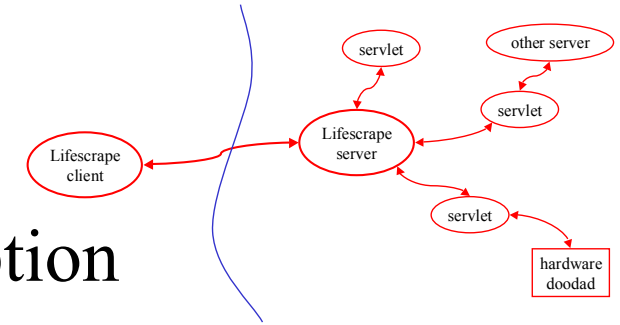
- Understanding
  - » Abstraction means that we can grasp the major elements in a view and the rationale behind them
- Reuse
  - » Reusable chunks must be visible to be recognized, extracted, generalized and reapplied to new areas
- Construction
  - » Some views provide a partial blueprint for development - components and dependencies

More Uses of an Architectural Description

- Evolution
  - » Expose the "load-bearing walls" of the design and distinguish between components and connectors
- Analysis
  - » Consistency, performance, conformance
- Management
  - » Milestone: successful analysis of valid architecture
- Communication
  - » Stakeholders can prioritize explicit tradeoffs

How to describe an architecture?

- "Boxes and lines"
  - » graphical, adaptable, intuitive
  - » traditional architecture description



- Some issues
  - » meaning of the graphical symbols varies
  - » inconsistent or incomplete information
  - » difficult to formally analyze for consistency, completeness, correctness
  - » constraints are hard to show, enforce

Architectural Description Languages

- Formal notations for representing and analyzing architectural descriptions
- Provide a conceptual framework and concrete syntax for characterizing software architectures
  - » also provide tools for parsing, displaying, compiling, analyzing, or simulating the architectural description
- Details of the ADL vary widely depending on the intended application domain
  - » Like metrics - useful but judgement required for use

Multiple views

- A key understanding is that *multiple views* of the architecture are valid
  - » different stakeholders need to see different things
  - » different aspects of the system are best viewed from different points of view
- Code-oriented views
  - » modular structure of the system, layers
- Execution-oriented views
  - » dynamic configurations, performance, reliability

Entities in an execution-oriented view

- System and Software Components
  - » hardware, programs, data blocks
- Connectors
  - » mediate interactions among components
- Configurations
  - » combinations of components and connectors
- Constraints
  - » resource limitations, operating environment

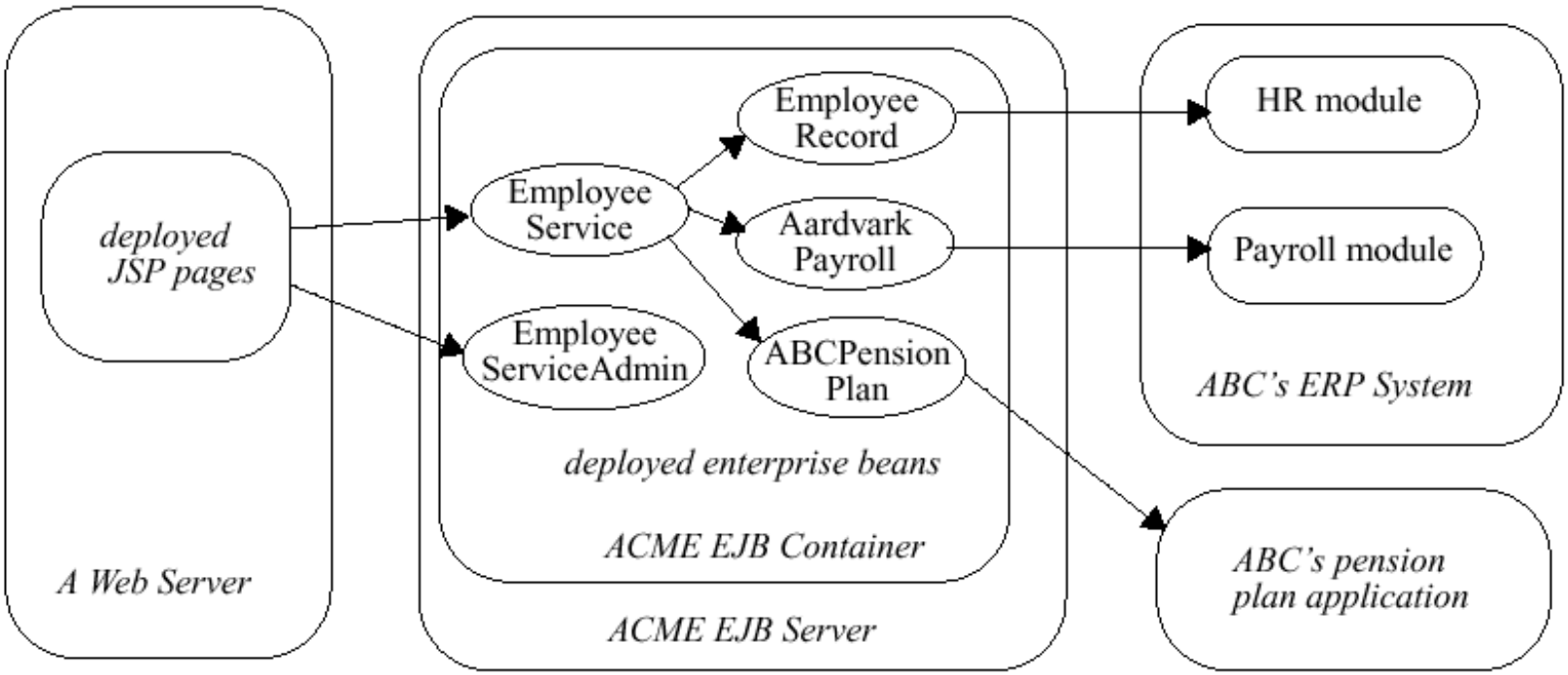
Enterprise Java Bean Examples

- This is the specification of the Enterprise JavaBeans TM architecture.
- The Enterprise JavaBeans architecture is a component architecture for the development and deployment of component-based distributed business applications.
- Applications written using the Enterprise JavaBeans architecture are scalable, transactional, and multi-user secure.
- These applications may be written once, and then deployed on any server platform that supports the Enterprise JavaBeans specification.

Chap 3: Roles and Scenarios

- Discusses the responsibilities of
  - » Enterprise Bean Provider (Aardvark, Wombat)
  - » Application Assembler (Wombat)
  - » Deployer (IT Staff)
  - » EJB Container and Server Providers (Acme)
  - » System Administrator (IT Staff)
- with respect to the Enterprise JavaBeans architecture.

Module view of deployed application

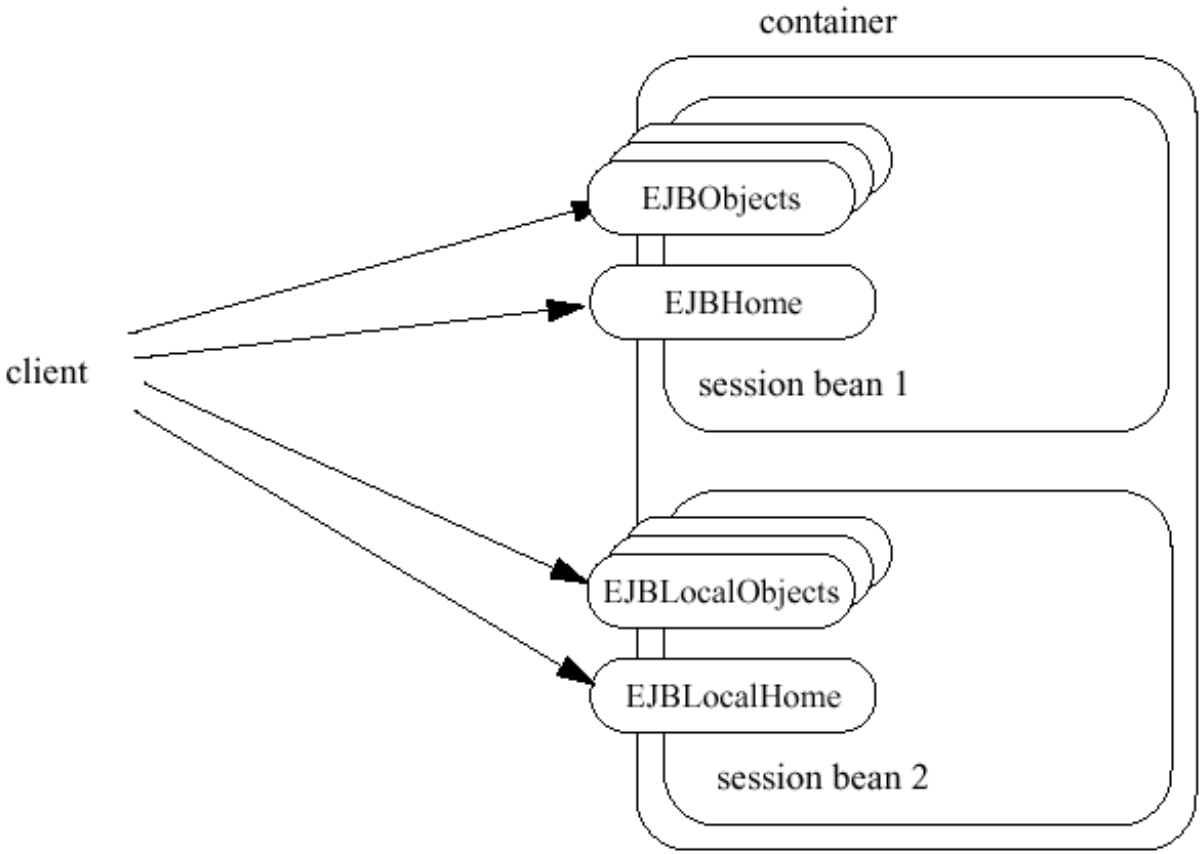


(c) Wombat's application is deployed in ACME's EJB Container at the ABC enterprise.

6.2.2 What a container provides

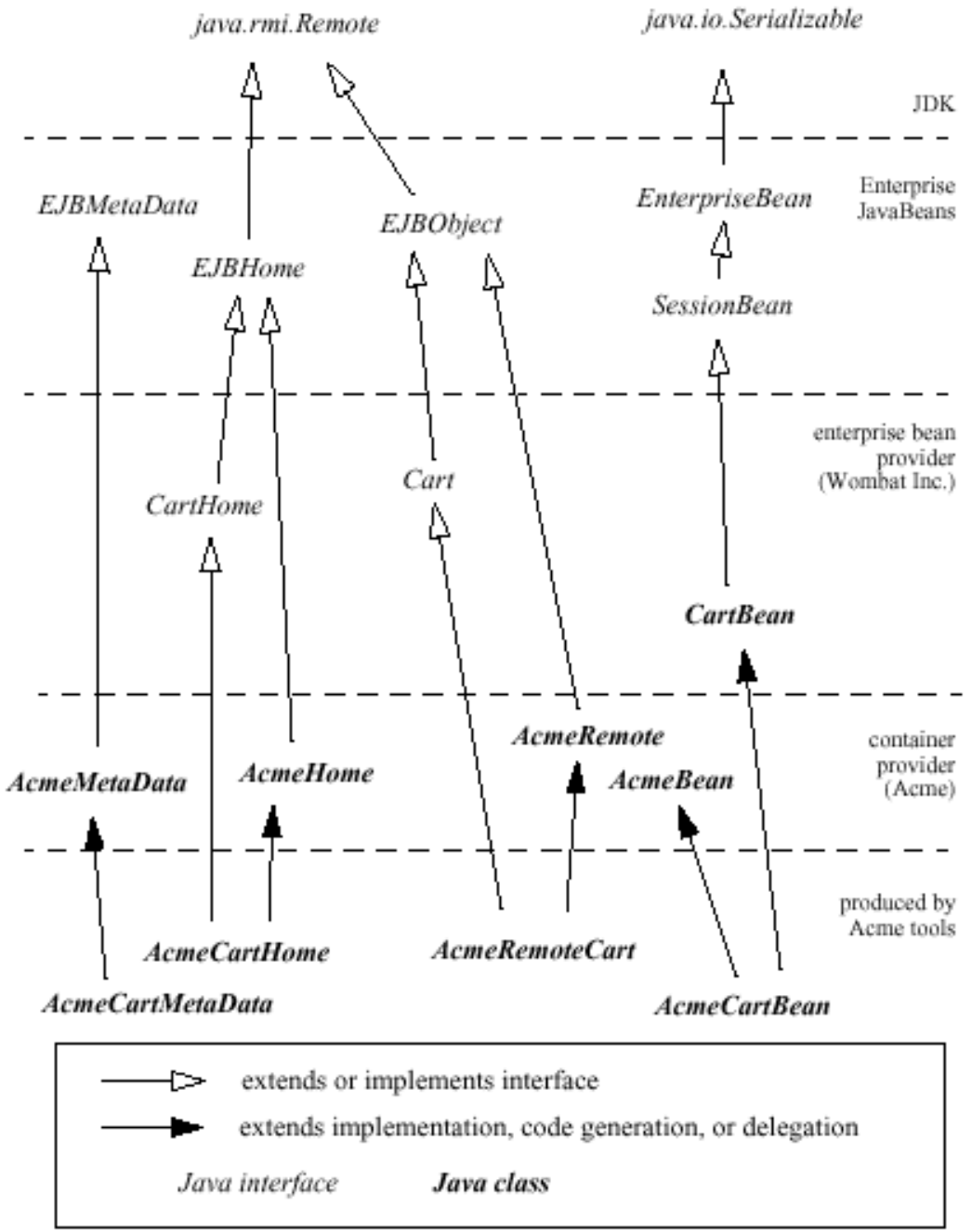
The following diagram illustrates the view that a container provides to clients of session beans that provide local and/or remote client views. Note that a client may be a local client of some session beans and a remote client of others.

Client View of session beans deployed in a Container

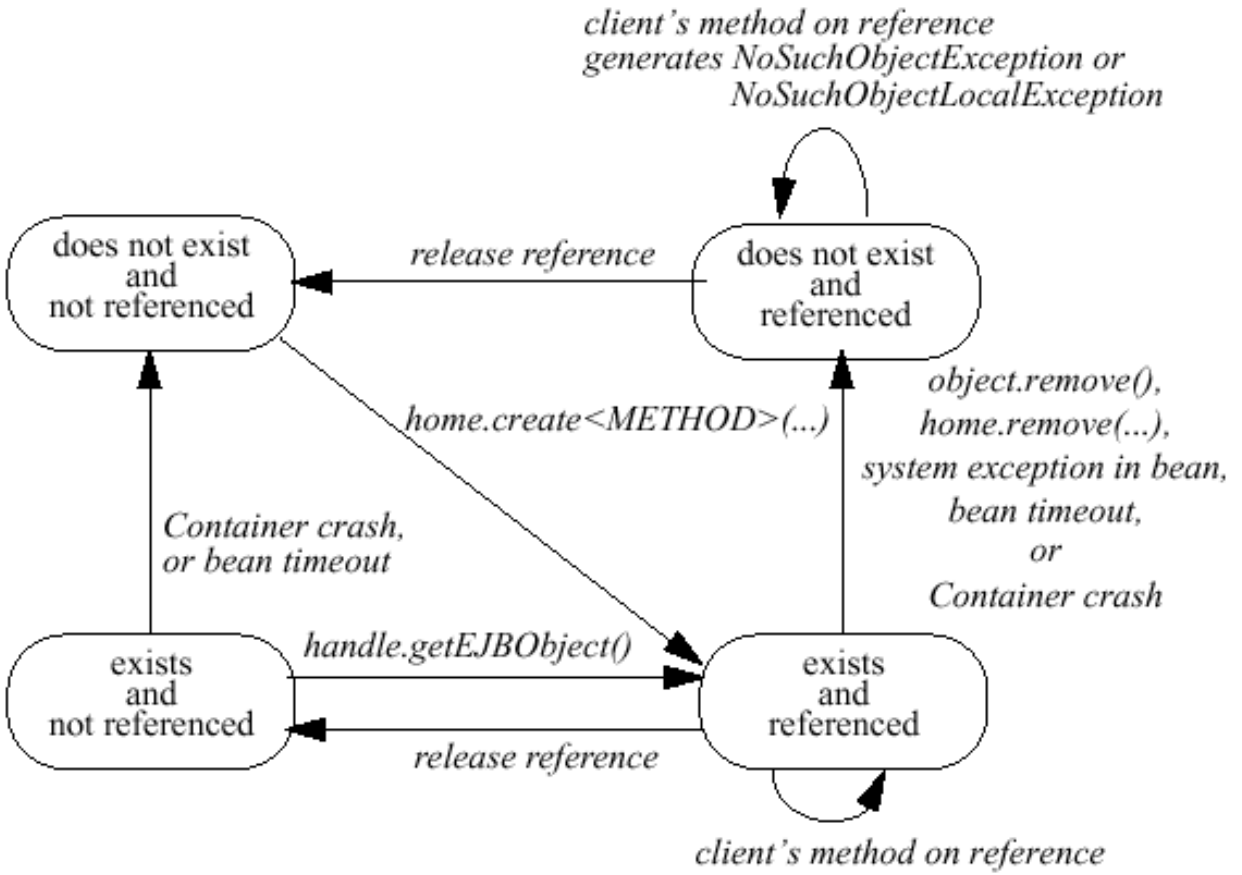


Inheritance Relationships

Figure 21 Example of Inheritance Relationships Between EJB Classes



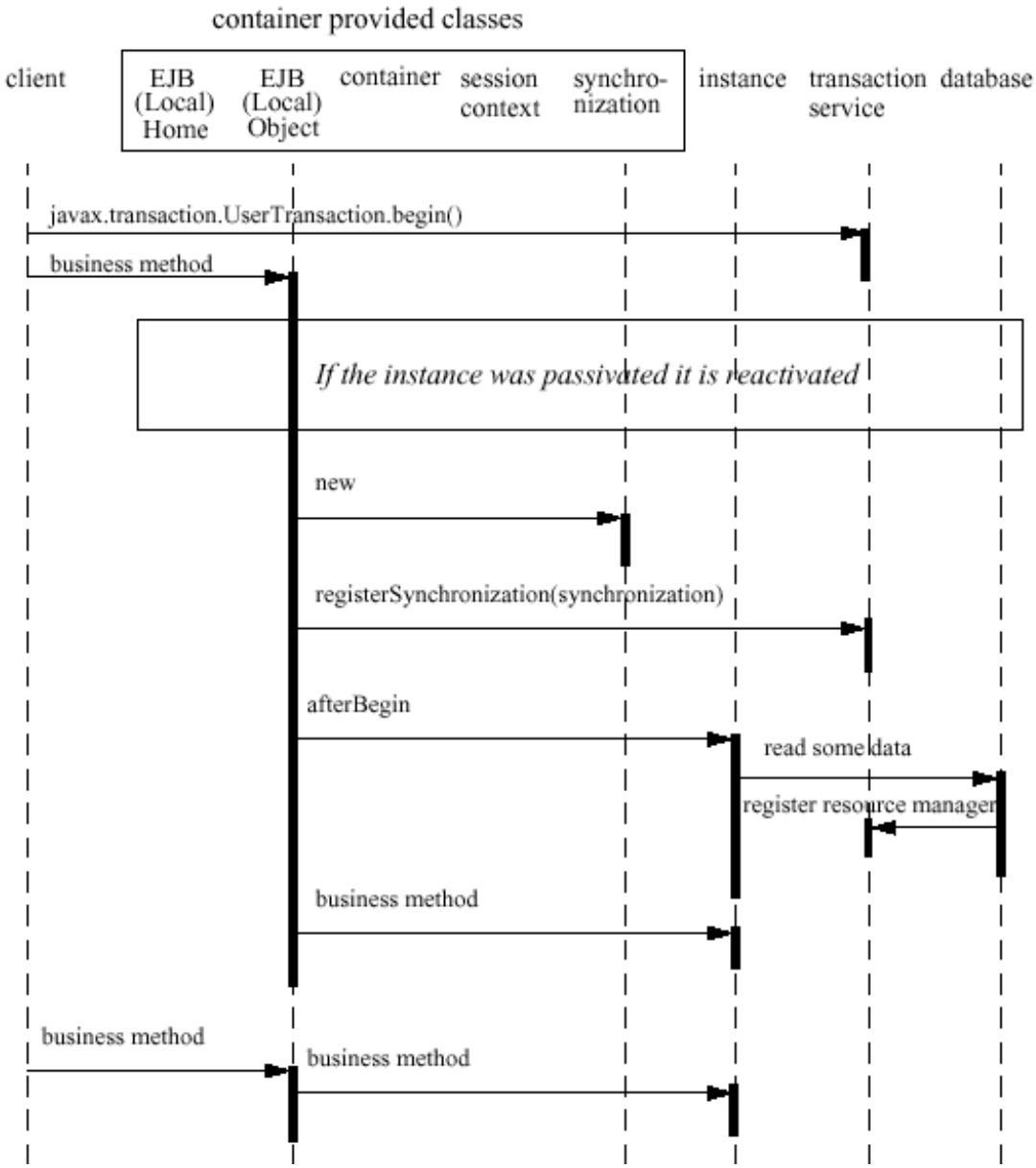
State Transition Diagram



A session object does not exist until it is created. When a client creates a session object, the client has a reference to the newly created session object's component interface.

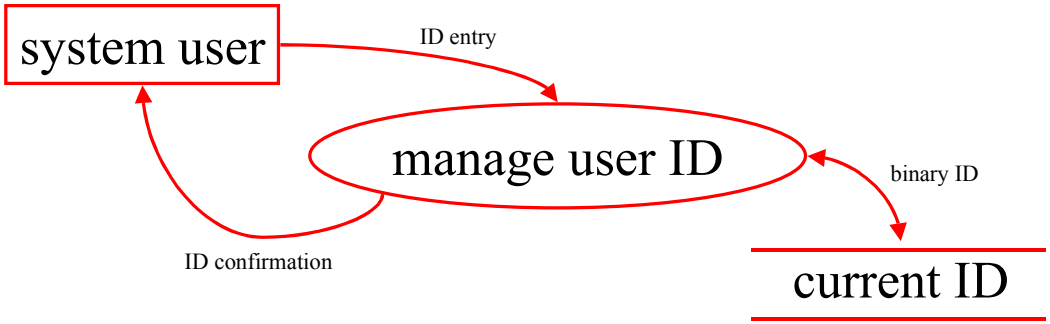
Object Interaction Diagram

Figure 8 OID for session object at start of a transaction.



Data Flow Diagrams (DFD)

- DFDs document a process by documenting the flow of data throughout the process.
  - » square — external data source or sink
  - » arrow — data flow
  - » circle — process input data to output data
  - » parallel lines — data store



Why do boxes and lines persist?

Boxes and Lines are generally understandable and adaptable

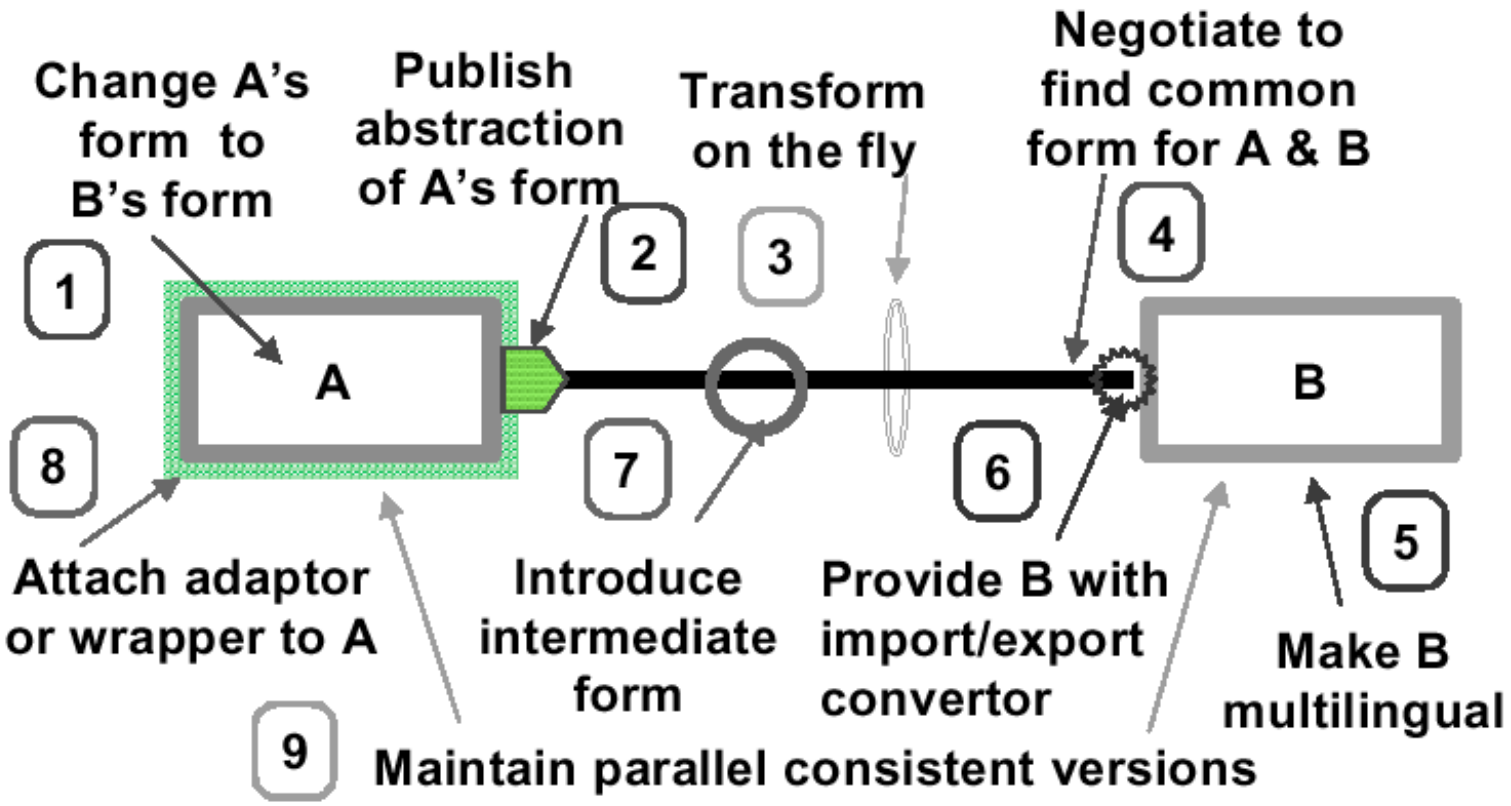


Figure 4: Some mismatch repair techniques, from Garlan, Software Architecture