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Runtime Reconfiguration of J2EE Applications

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Introduction

- Main concern
  - Reconfiguration of component-based systems at runtime
  - Implementation platform: J2EE
- Goals
  - Reducing the down-time of software systems
  - Maximising the set of available services
- Focus of this paper
  - Reconfiguration transparent to clients
  - Controlled runtime redeployment as an extension of hot deployment and dynamic reloading

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Contents

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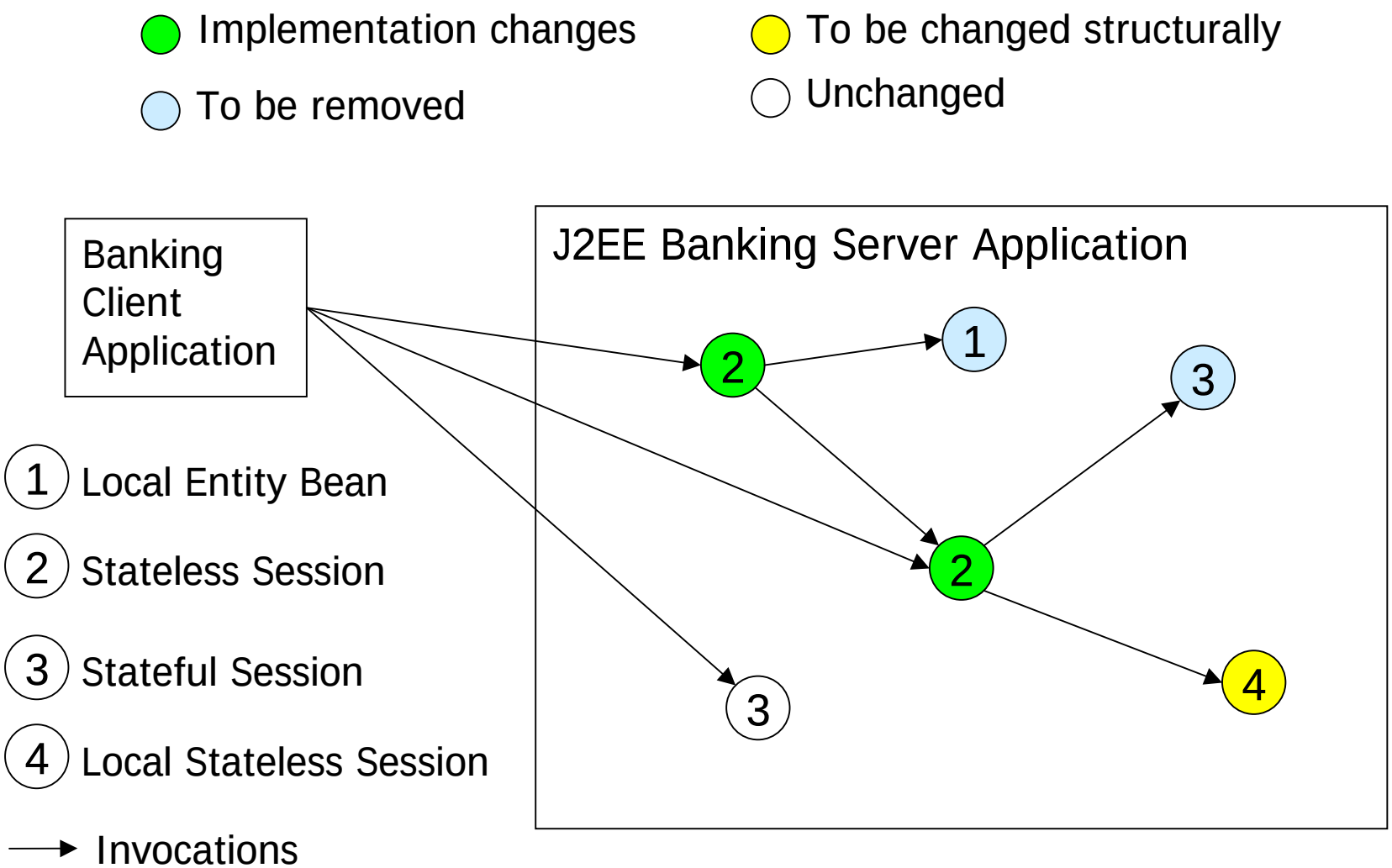
Motivating Example



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Runtime Reconfiguration

- Applying required changes to a running system
- Types of reconfiguration
  - Functional
  - Non-functional
  - Structural (considering both)
- An approach to enabling reconfiguration of component-based systems at runtime
  1. Analyse the running system for a particular time interval (at least the estimated reconfiguration duration)
  2. Create change-request-specific runtime dependency graphs
  3. Halt system parts based on the created graphs
  4. Observe the running system for the actual reconfiguration duration

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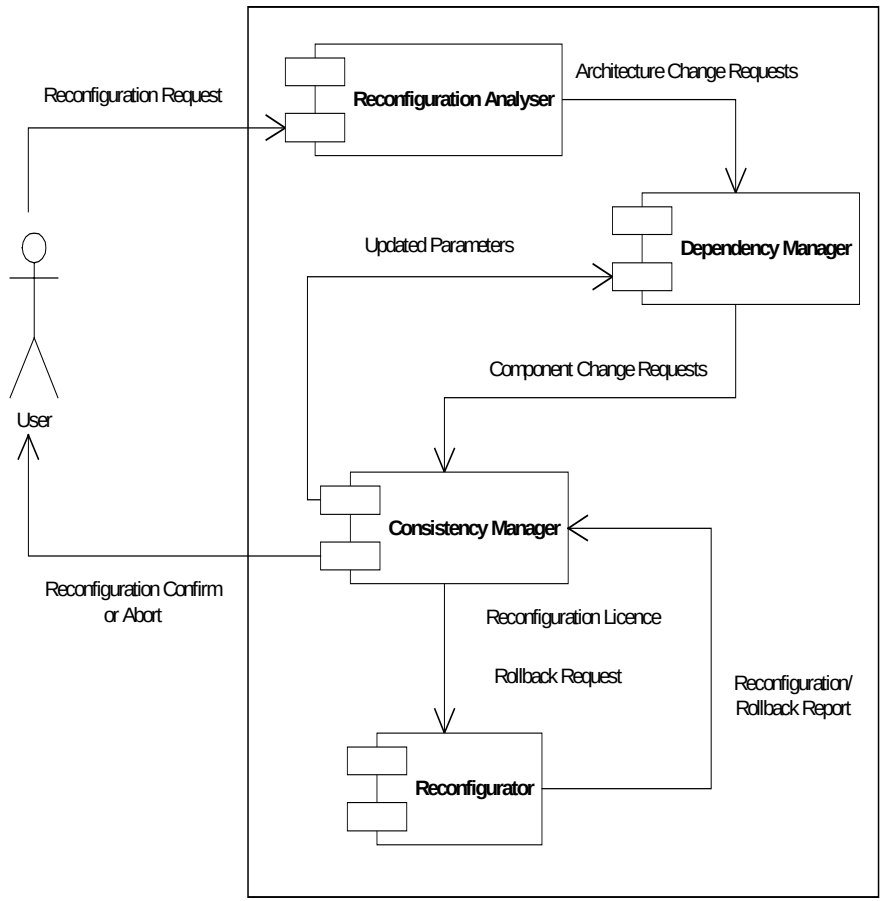
Reconfiguration Manager - PIRMA

- Reconfiguration Analyser
  - Static dependency analysis
  - Component change identification
- Dependency Manager
  - Dynamic dependency analysis
  - Minimal dependency graph calculation
- Consistency Manager
  - Consistency checks
  - Determines reconfiguration point in time
  - Calculate Redeployment points
- Reconfigurator
  - Pause transaction processing at redeployment points
  - Exchange component byte code



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Contents

Deployment API Functionality

- Enumeration of existing deployment units
- Start, stop, undeploy and deploy existing deployment units
- Creation and distribution of new deployment units
- Configuration of existing deployment units

- Redeployment transparent to users (optional)
  - No detailed concept in the specification
  - Not contained in any implementation yet
  - Focus of our project

Our Concept to Redeployment

- Hot deployment and dynamic reloading
  - Exchange Java byte code of component types at runtime
  - Essentially an Undeploy / Deploy operation sequence (container recreation)
- Our Extensions
  - Redeployment is a modification of the running container, rather than recreation
  - Therefore, the system remains reactive
- Controlled redeployment process steps
  1. Suspend transaction processing
  2. Perform module modifications
  3. Resume transaction processing

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Contents

Redeployment Points and Discovery

Redeployment Point Discovery:

Redeployment points are enterprise bean methods that ...

- ... are configured to create, support (with no active transaction) or not support transactions
- ... are publicly available to client code

Redeployment Feasibility Check:

Redeployment point set per request...

- ... has to be complete, meaning it has to cover any execution path accessible from client code
- ... has to be stable. Transaction creation behaviour should not change at runtime

Redeployment Restrictions

- Provides-Interface of public EJB components may not be changed or removed
- Provides-Interface of Stateful Session EJB components may be changed, if the bean provider guarantees serialization compatibility
- Provides-Interface of Entity EJB components are dependent on the underlying data-schema and therefore changes at runtime should be avoided

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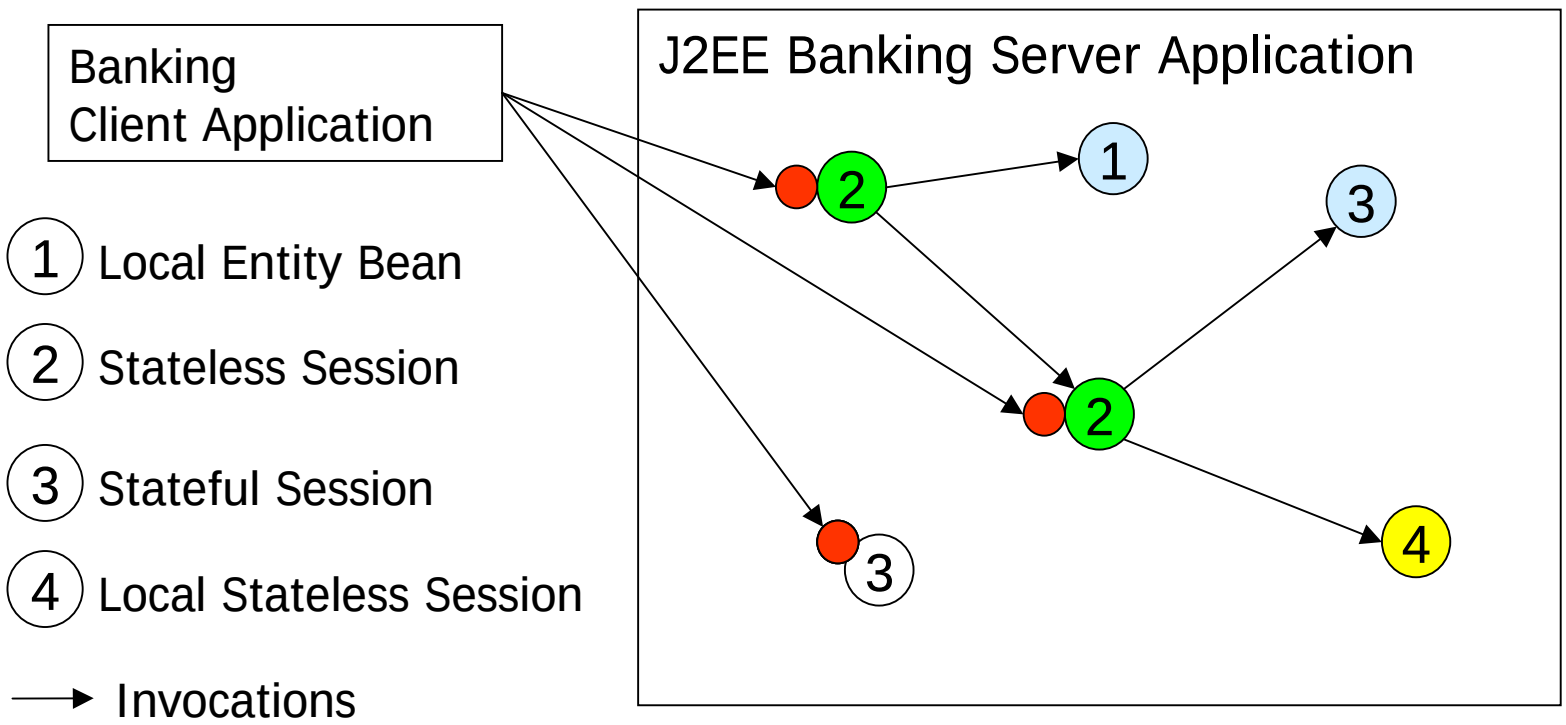
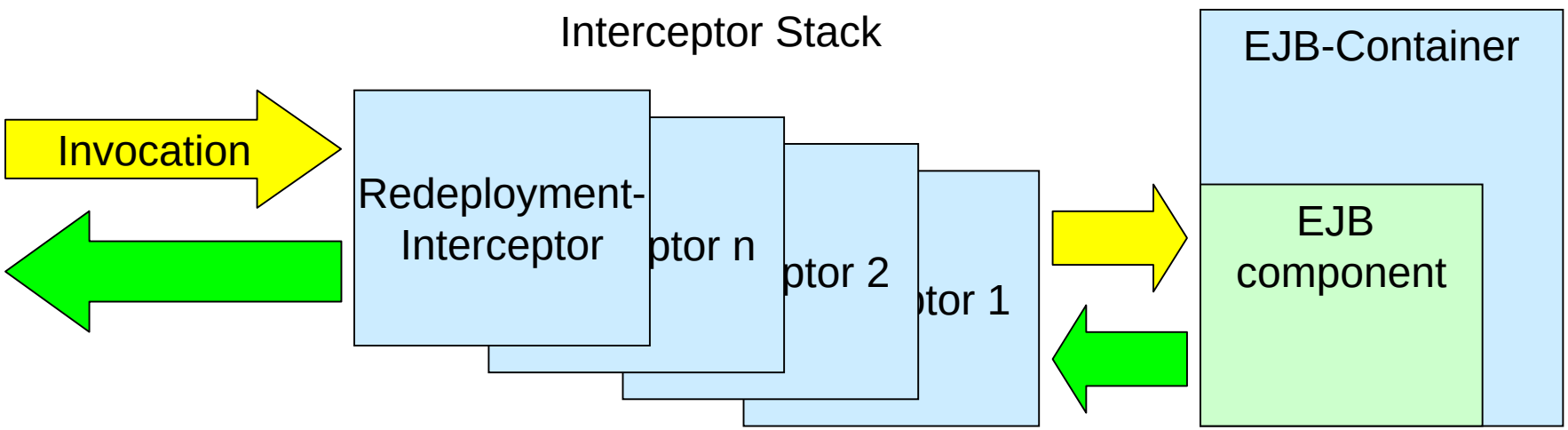
Redeployment Concept - Redeployment Points

- Implementation changes
- To be removed
- Redeployment Points
- To be changed structurally
- Unchanged



The JBoss Interceptor Stack

- Each single EJB component is hosted inside an EJB Container
- Each Container is configured with an interceptor stack
- Interceptors in JBoss implement non-functional attributes of EJB components as declared in the deployment descriptor



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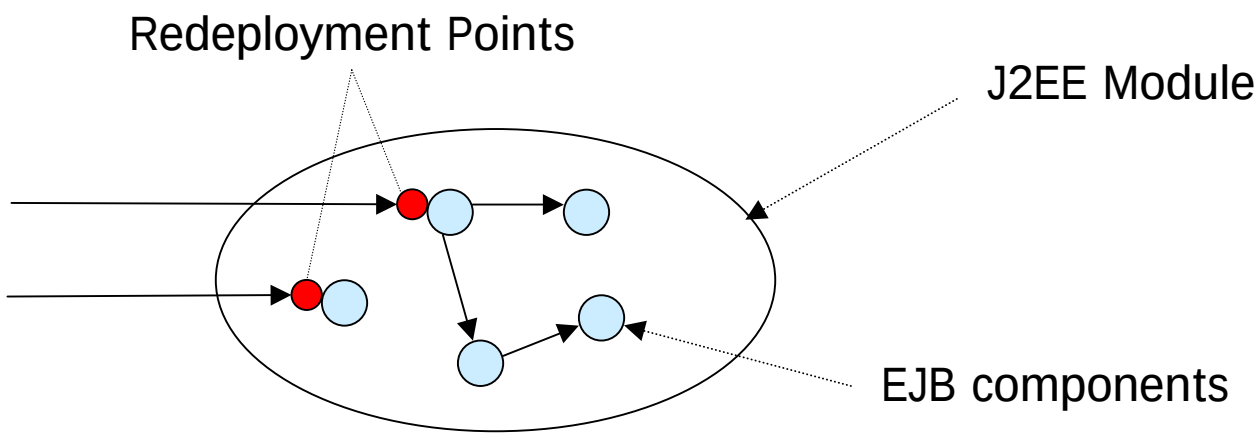
Redeployment Interceptors

- MonitoringTxInterceptorCMT
  - Extension / Modification of the original CMT interceptor
  - Logs transactional behaviour to support redeployment point discovery
  - Suspend transaction processing at redeployment points
  - Trigger replacement of component class definition



Current Work / Open Issues / Future Work

- Current work
  - Minimal runtime dependency graph calculation
  - Designing scenarios for reconfiguration using design patterns
  - Implementation of the Redeployment Interceptors

- Open Issues / Future work
  - Predicting optimal point in time for redeployment to take place
  - Handling long-running transactions
  - Handling loop-back calls efficiently
  - Evaluation by larger case-study

Contributions

- Controlled runtime redeployment as an extension of hot deployment and dynamic reloading
- Redeployment is a modification of the running container, rather than recreation
- Therefore, the system remains reactive
- Reconfiguration is transparent to clients
- This fulfils the requirements of the Deployment API optional functionality