

**Universität Karlsruhe (TH)**  
Forschungsuniversität gegründet 1825



# Praktikum Ingenieurmäßige Software-Entwicklung

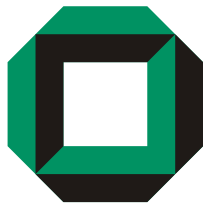
## Palladio Component Model – Part IV (PCM)

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Lehrstuhl Software-Entwurf und –Qualität

Institut für Programmstrukturen und Datenorganisation (IPD)

Fakultät für Informatik, Universität Karlsruhe (TH)



# Outline



## 1. Introduction

- a. Roles, Process Model, Example
- b. Solver (Simulation, Analytical Model)

## 2. Component Developer

- a. Repository
- b. Component, Interface, Data Types
- c. SEFF

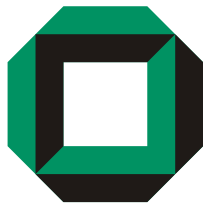
## 3. Stochastic Expressions

- a. Constants, PMF, PDF, Parameter Characterisation
- b. Parametric Dependencies

Lecture 1

Lecture 2

Lecture 3



# Outline



## 4. Software Architect

- a) System (Composed Structure)
- b) QoS Annotations on System Interfaces

## 5. System Deployer

- a) Resource Types, Resource Environment
- b) Allocation

## 6. Domain Expert

- a. Usage Model
- b. Parameter Characterisations

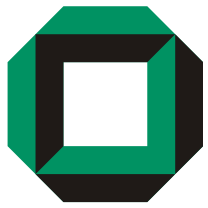
## 7. Solver, Result Interpretation

## 8. Comprehensive Case Study

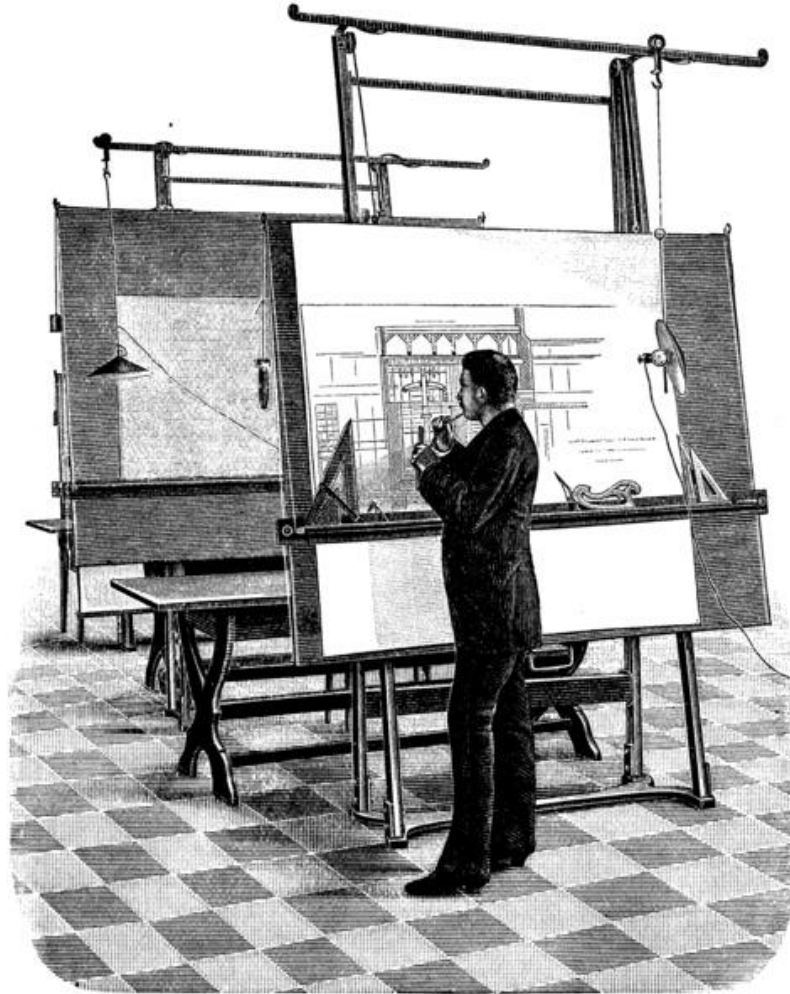
## 9. Outlook

Lecture 4

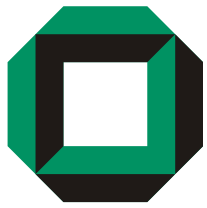
Lecture 5



# Software Architect



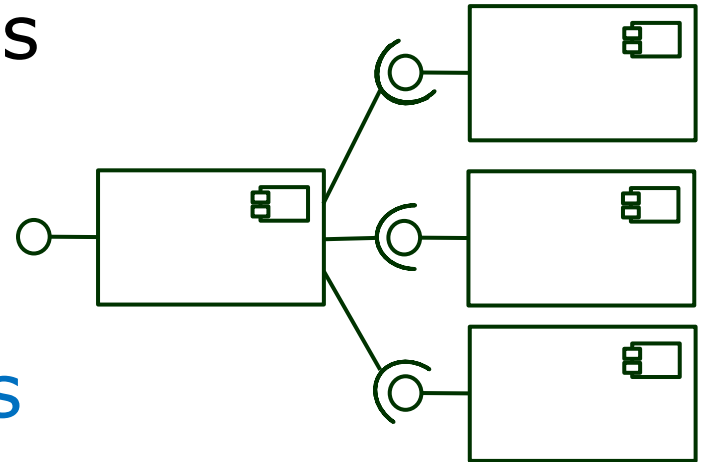
[<http://commons.wikimedia.org/wiki/Image:Architect.png>]

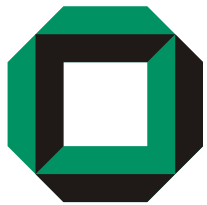


# Software Architect: Tasks (1/2)



- Specifies an **architecture** (boxes and lines) from existing components and interfaces
- Specifies new components and interfaces
- Uses architectural **styles** and architectural **patterns**
- Analyses architectural specification and makes **design decisions**

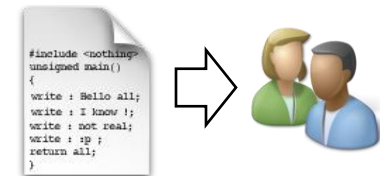


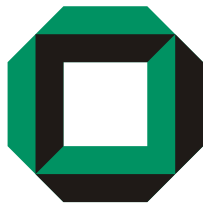


# Software Architect: Tasks (2/2)

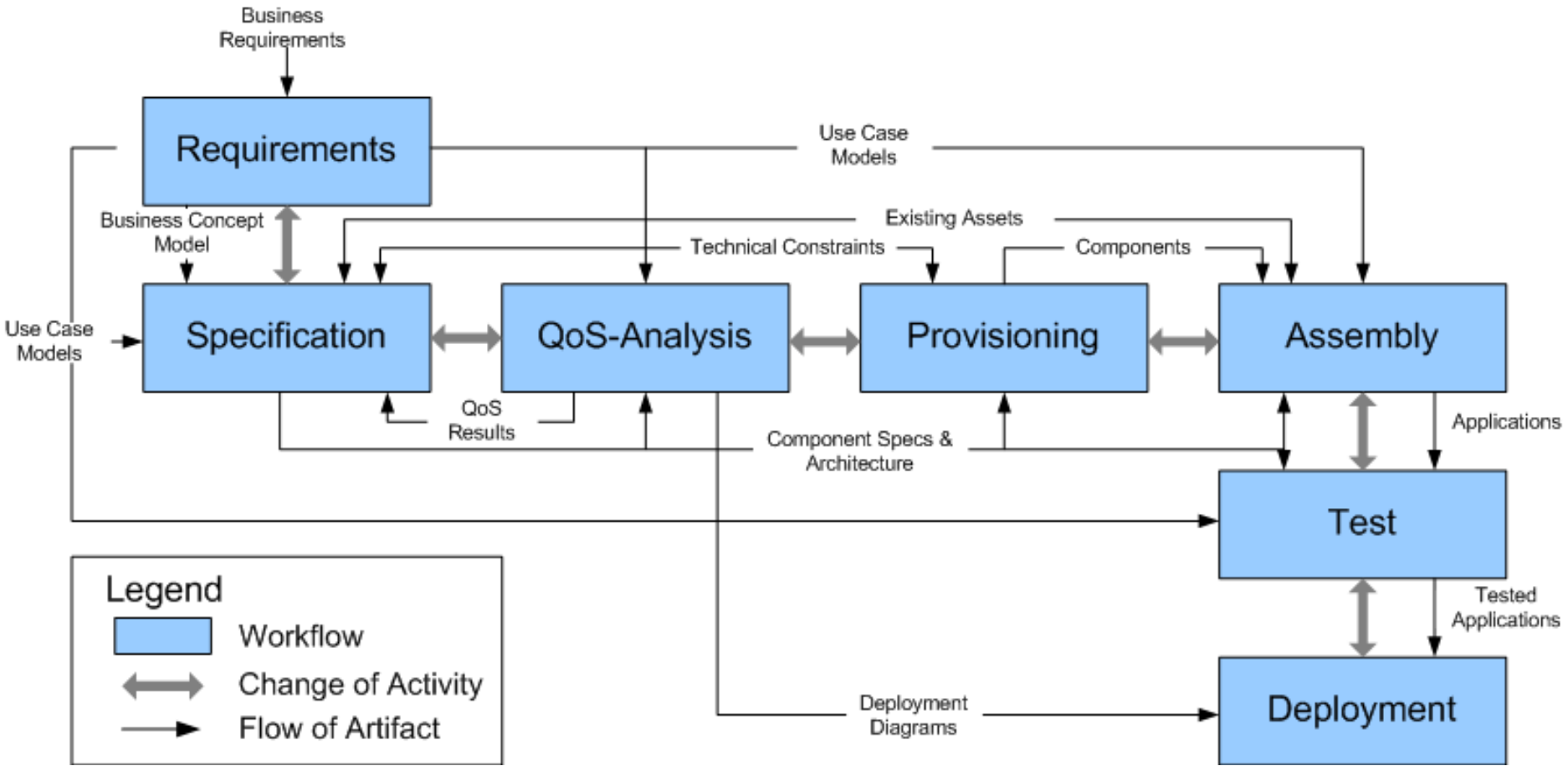


- Conducts **performance prediction** based on architectural specification
- **Delegates implementation** tasks to component developers
- **Guides** the whole development process

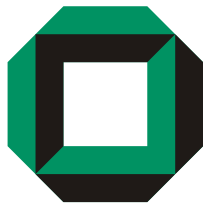




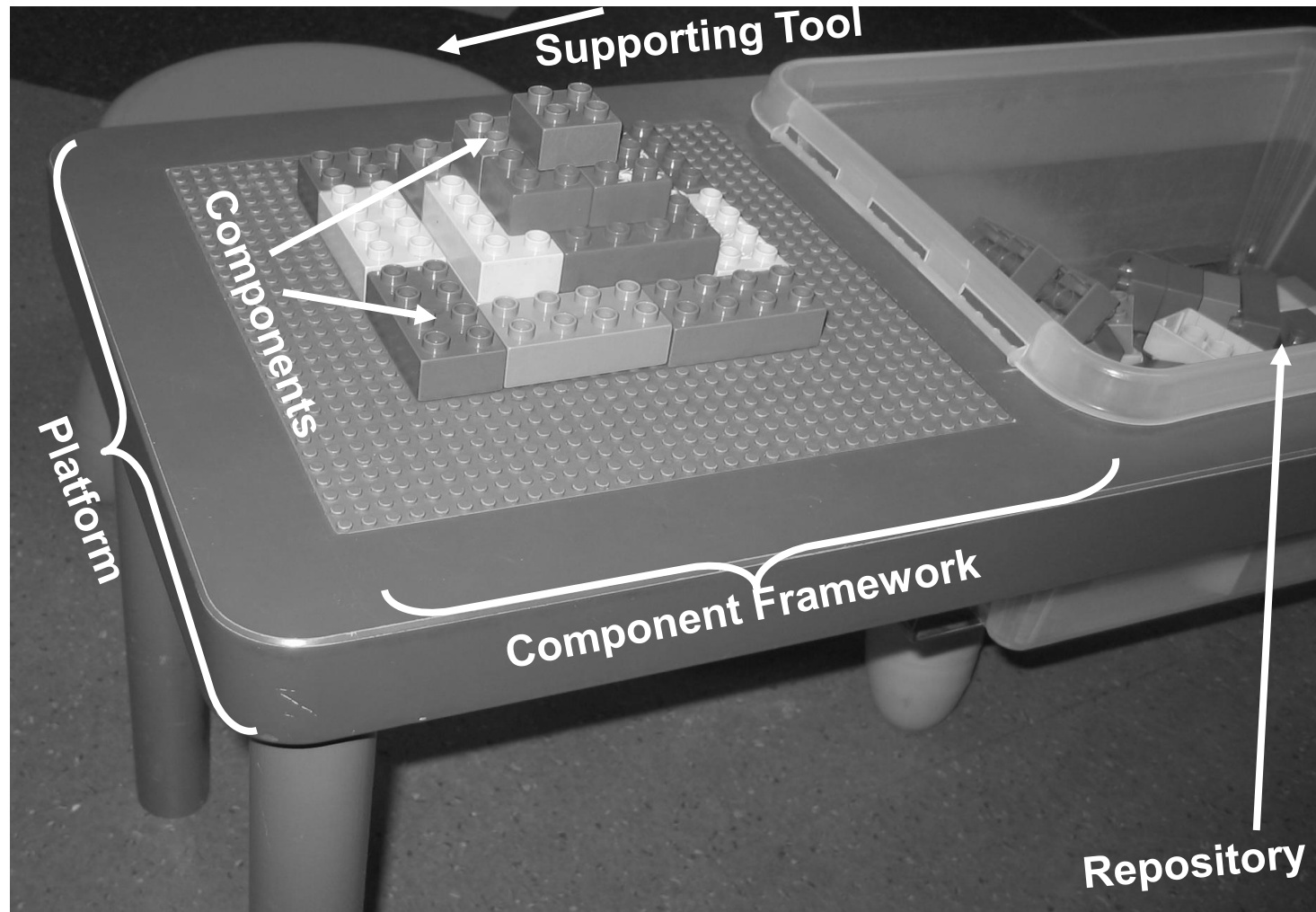
# CBSE Development Process



[Cheeseman2000, Koziolk2006a]

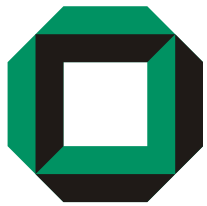


# Specification Process

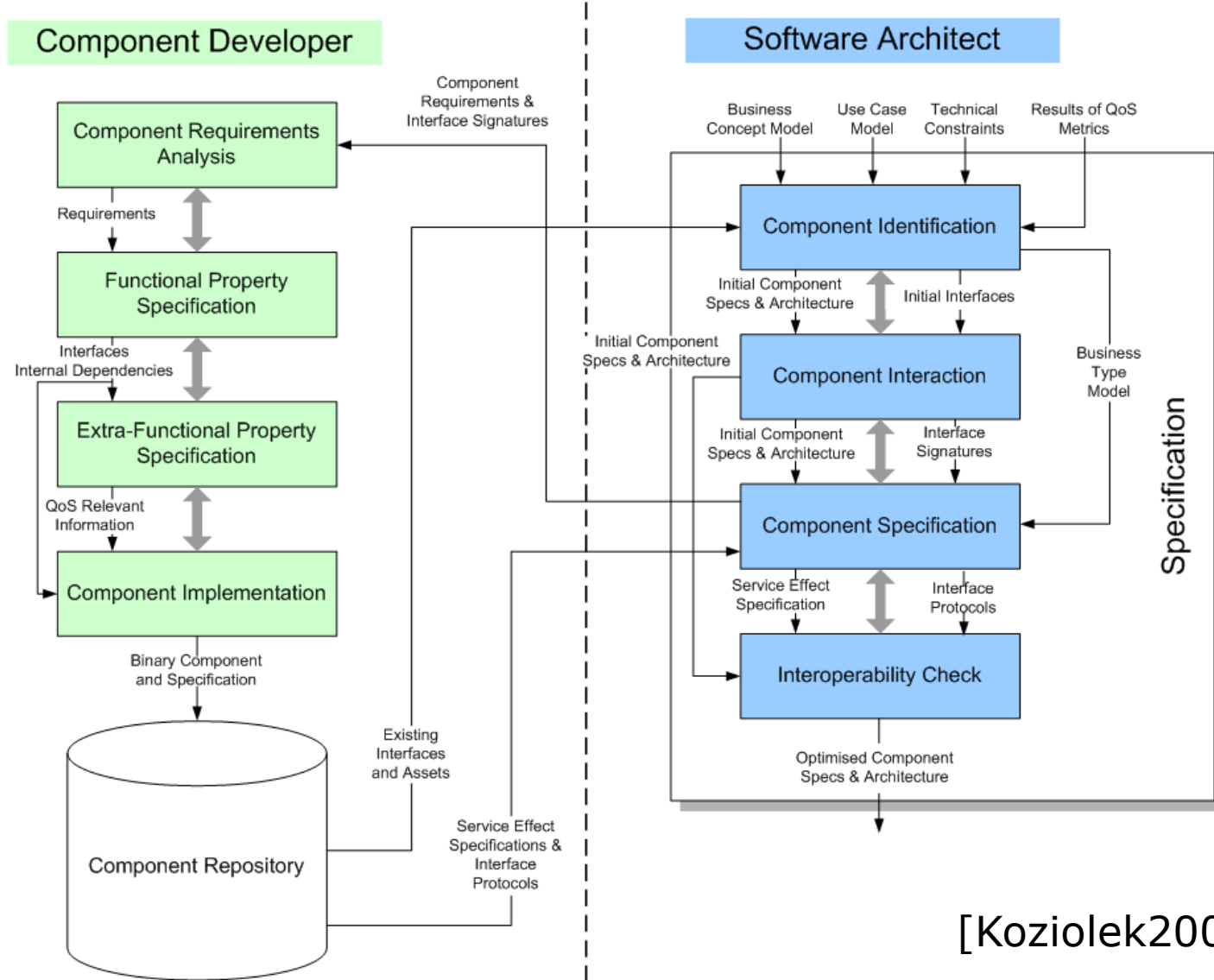


[Grunske2007]

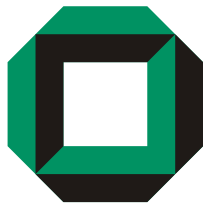




# Specification Process



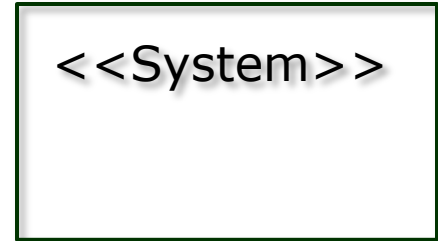
[Koziolek2006a]

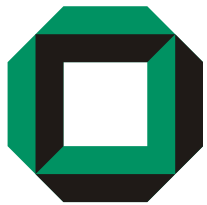


# System

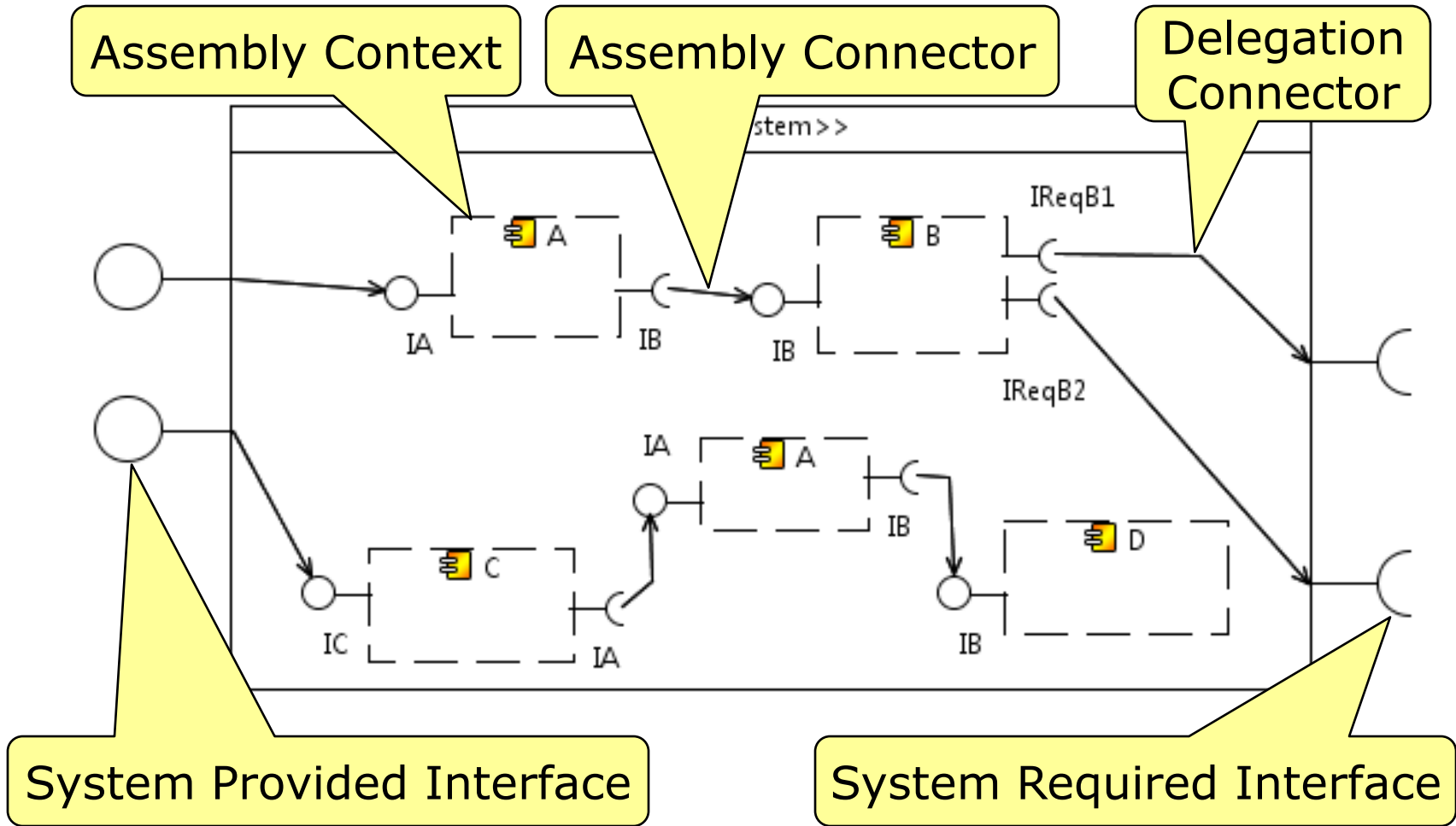


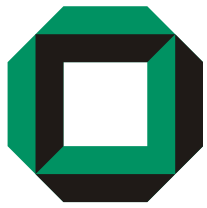
- Models the **component-based architecture** to be analysed
- May include components from different **repositories**
- Provides an interface for users
- Excludes uninteresting services and connects to them via system required interfaces
- Is a **prerequisite** for the system deployer to allocate the components





# System Specification





# System Specification PCM Bench



PCMBench - QoS2007\_MediaStore/MediaStore.system\_diagram - Eclipse SDK

File Edit Diagram Navigate Search Project PCM Bench Run Window Help

Tahoma 9 B / A 100%

PCM Project View Project Explorer MediaStore.seff\_diagram MediaStore.system\_diagram

MediaStore.repository\_diagram  
MediaStore.resourceenvironment  
MediaStore.resourcetype  
MediaStore.seff\_diagram  
MediaStore.system  
MediaStore.system\_diagram  
MediaStore.usagemodel

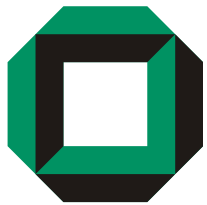
Resource View  
file:/D:/Diss/svn/code/Palladio.Examples/trunk/QoS/...  
file:/D:/Diss/svn/code/Palladio.Examples/trunk/QoS/...  
file:/D:/Diss/svn/code/Palladio.Examples/trunk/QoS/...

Outline

Properties Error Log

Advanced

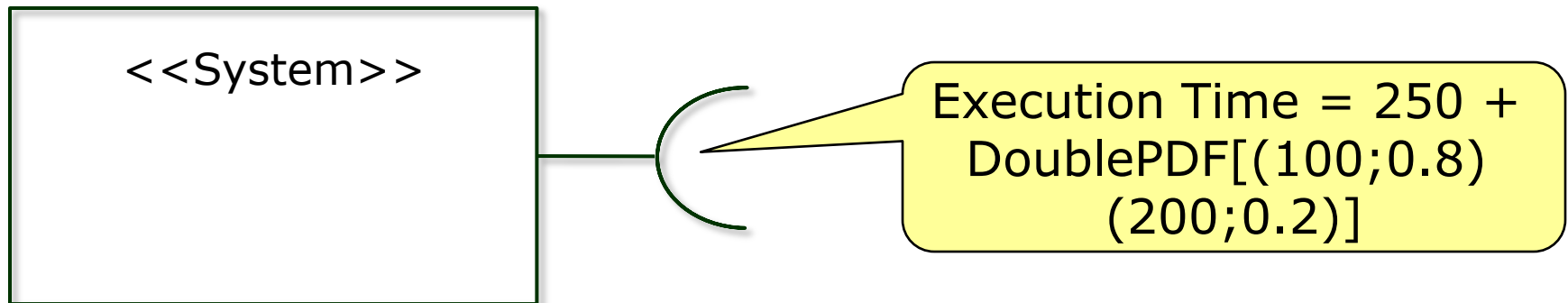
Property	Value
EMF	
Entity Name	aName
Id	_UejgQKYSEduWZfldHy3B1Q
Required Interface Required Role	Interface_QW4WtKYGEduWZfldHy3B1Q
View	
Layout Constraint	

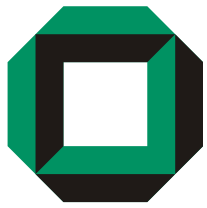


# QoS Annotation



- **System Required Interfaces:** connection to functionality not modelled in the system
- Example: web service, unknown component
- Execution time specification necessary





# QoS Annotation



Java - Experiment\_MediaStore/MediaStore.system - Eclipse SDK

File Edit Navigate Search Project PCM Bench Run System Editor Window Help

Package Explorer Hierarchy

- DBAdapter.queryDB.seff\_diagram
- DigitalWatermarking.watermark.seff\_diagram
- MediaStore.allocation
- MediaStore.downloadFromDB.seff\_diagram
- MediaStore.noname.seff\_diagram
- MediaStore.repository
- MediaStore.repository\_diagram
- MediaStore.resourceenvironment
- MediaStore.resourcetype
- MediaStore.system
- MediaStore.system\_diagram
- MediaStore.usagemodel
- MediaStore.usagemodel\_diagram
- MediaStore2.allocation\_diagram
- SolvedDSolverExample1.actualallocation
- SolvedDSolverExample1.allocation
- SolvedDSolverExample1.repository
- SolvedDSolverExample1.resourceenvironment

\*MediaStore.system

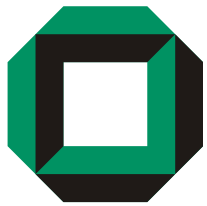
Resource Set

- platform:/resource/Experiment\_MediaStore/MediaStore.system
  - MediaStore\_System <System> [ID: \_01sxQKYTEduWZfldHy3B1Q]
    - AssCtx\_MediaStore <Component: MediaStore> <AssemblyContext> [ID: \_Fr88sKYUEduWZfldHy3B1Q]
    - AssCtx\_WebGUI <Component: WebGUI> <AssemblyContext> [ID: \_G1w5kKYUEduWZfldHy3B1Q]
    - AssCtx\_DigitalWatermarking <Component: DigitalWatermarking> <AssemblyContext> [ID: \_HChuEKYUEduWZfldHy3B1Q]
    - AssCtx\_DBAdapter <Component: DBAdapter> <AssemblyContext> [ID: \_Jmq4KYUEduWZfldHy3B1Q]
    - AssCtx\_AudioDB <Component: AudioDB> <AssemblyContext> [ID: \_JoJoEKYUEduWZfldHy3B1Q]
    - aName <ProvidedDelegationConnector> [ID: \_brD4UKYUEduWZfldHy3B1Q]
    - aName <AssemblyConnector> [ID: \_eyva8KYUEduWZfldHy3B1Q]
    - aName <AssemblyConnector> [ID: \_f1MtkKYUEduWZfldHy3B1Q]
    - aName <AssemblyConnector> [ID: \_fdzxMKYUEduWZfldHy3B1Q]
    - aName <AssemblyConnector> [ID: \_f6a0sKYUEduWZfldHy3B1Q]
    - aName <ProvidedRole> [ID: \_alLOUKYUEduWZfldHy3B1Q]
    - aName <QoSAnnotations> [ID: \_ZVm7tBkGEfyl-ZQREQIVUg]
      - System Specified Execution Time 1000 <SystemSpecifiedExecutionTime>
  - platform:/resource/Experiment\_MediaStore/MediaStore.repository
  - platform:/resource/Experiment\_MediaStore/MediaStore.resourcetype

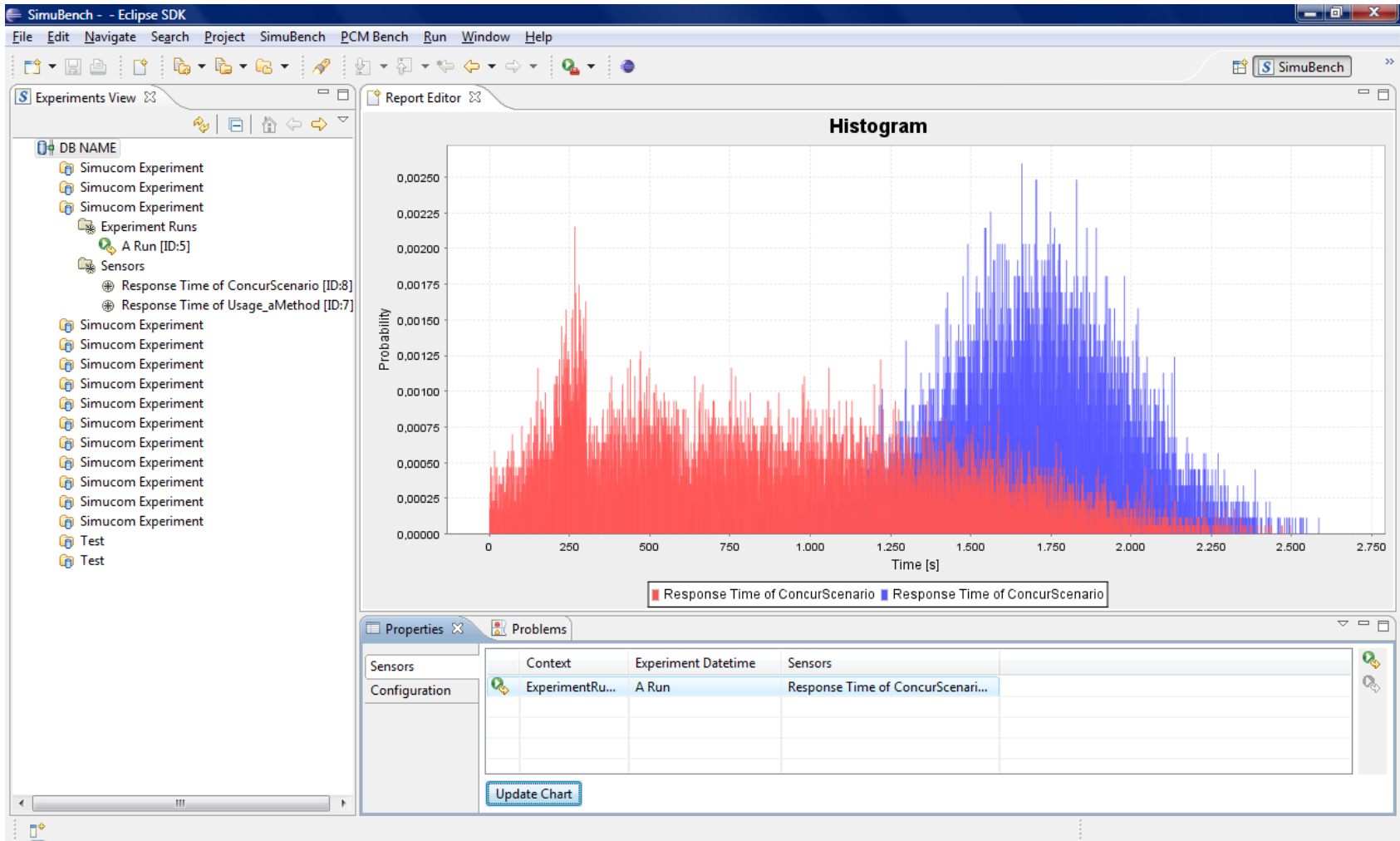
Properties

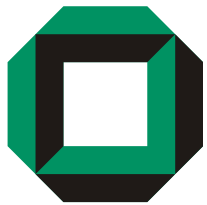
Property	Value
Role Specified Execution Time	aName <ProvidedRole> [ID: _VB3osKYSEduWZfldHy3B1Q]
Signature Specified Time Consumption	Signature encode <Signature>
Specification	1000

The Specification of the Random Variable



# Performance Evaluation





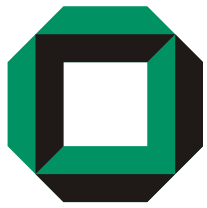
# Design alternatives changing performance



- More hardware
- Faster hardware
- Caching
- Resource Pooling
- Replication
- Load Balancing
- Compression
- Reducing communication overhead
- Reimpl. of a component
- Allocation
- Introduce parallel processing
- Use Performance Pattern
- ...







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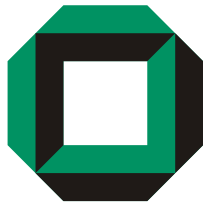
## 7. Solver, Result Interpretation

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## 9. Outlook

Lecture 4

Lecture 5



# System Deployer



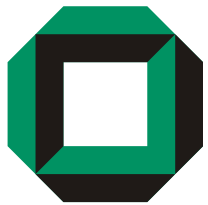
Microsoft  
**.net**



Windows Vista



[<http://www.dorsetforyou.com/>]

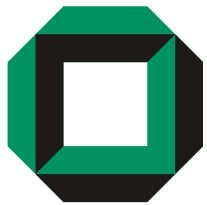


# System Deployer: Tasks



- Models the **resource environment** (e.g., middleware, OS, hardware)
- Models the **allocation** of components to resources
- Sets up the resource environment (e.g., installing application servers, configuring hardware)
- Deploys components on resources (e.g., writing deployment descriptors)
- Maintains the running system

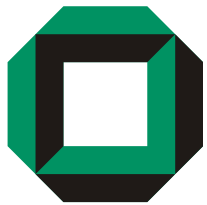




# Resource Types



- **Abstract** specification of resources (e.g. CPU, HD, Net)
- Why?
  - concrete resources (e.g. 2 GHz CPU, 20 MB/s HD, 1 Gbit/s Net) unknown during component specification and implementation
- Thus: component developers provide RDSEFF specifications referring to resource types
- Once the **concrete resource environment** is specified, timing values can be derived



# Resource Types in PCM



CPU



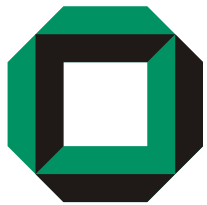
HD



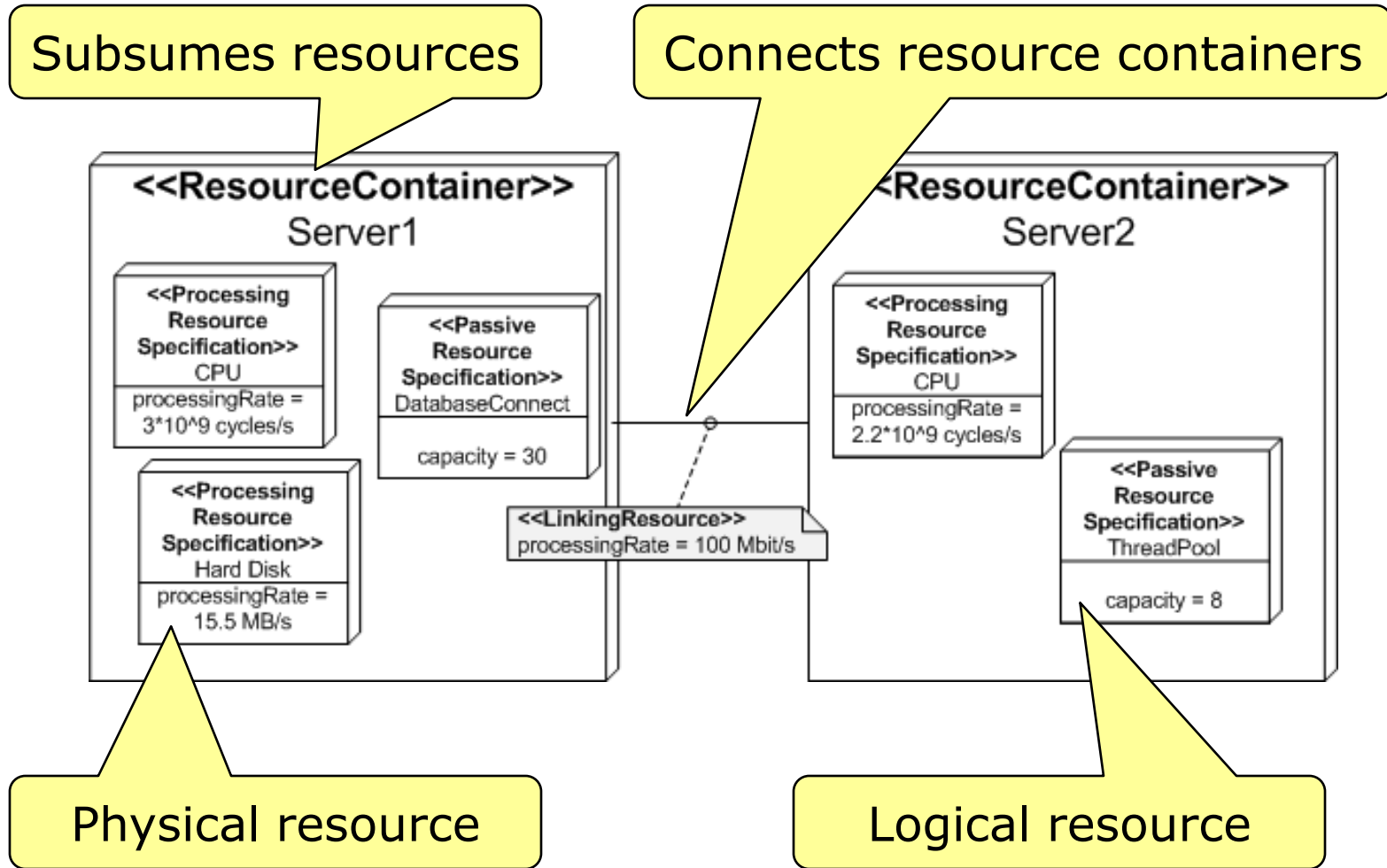
Network

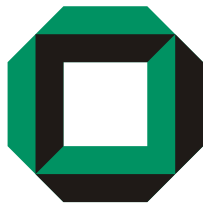


Memory



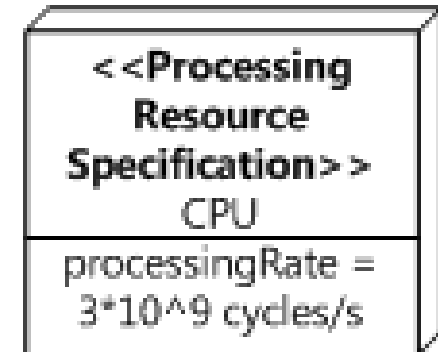
# Resource Environment

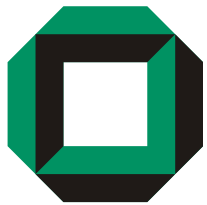




# Processing Resources

- Model CPUs, Hard Disks, Networks, etc.
- Specify a **processing rate** for the resource demands of the RDSEFFs
- Example 1:
  - Processing rate (CPU):  $3 \cdot 10^9$  cycles/s = 3 Ghz
  - RDSEFF: Resource Demand =  $1,5 \cdot 10^9$  cycles  
→ 0,5 seconds execution time
- Example 2:
  - Processing rate (HD): 20 MB/s
  - RDSEFF: Resource Demand = 500 000 Byte  
→ 0,025 seconds execution time

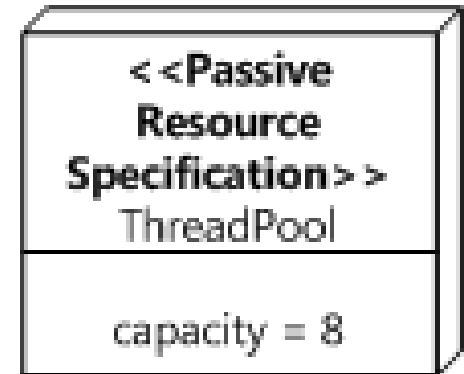




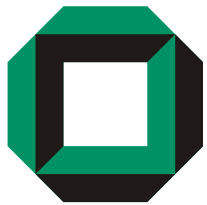
# Passive Resources



- Model logical resources
  - Threads, Semaphores, Database connections, ...
- Are acquired or released in RDSEFFs
- Specify a maximum **capacity**
- Example:
  - Capacity (ThreadPool): 8
  - RDSEFF: AcquireAction(ThreadPool)
    - ➔ Afterwards: #available threads decreased by 1
  - RDSEFF: ReleaseAction(ThreadPool)
    - ➔ Afterwards: #available threads increased by 1

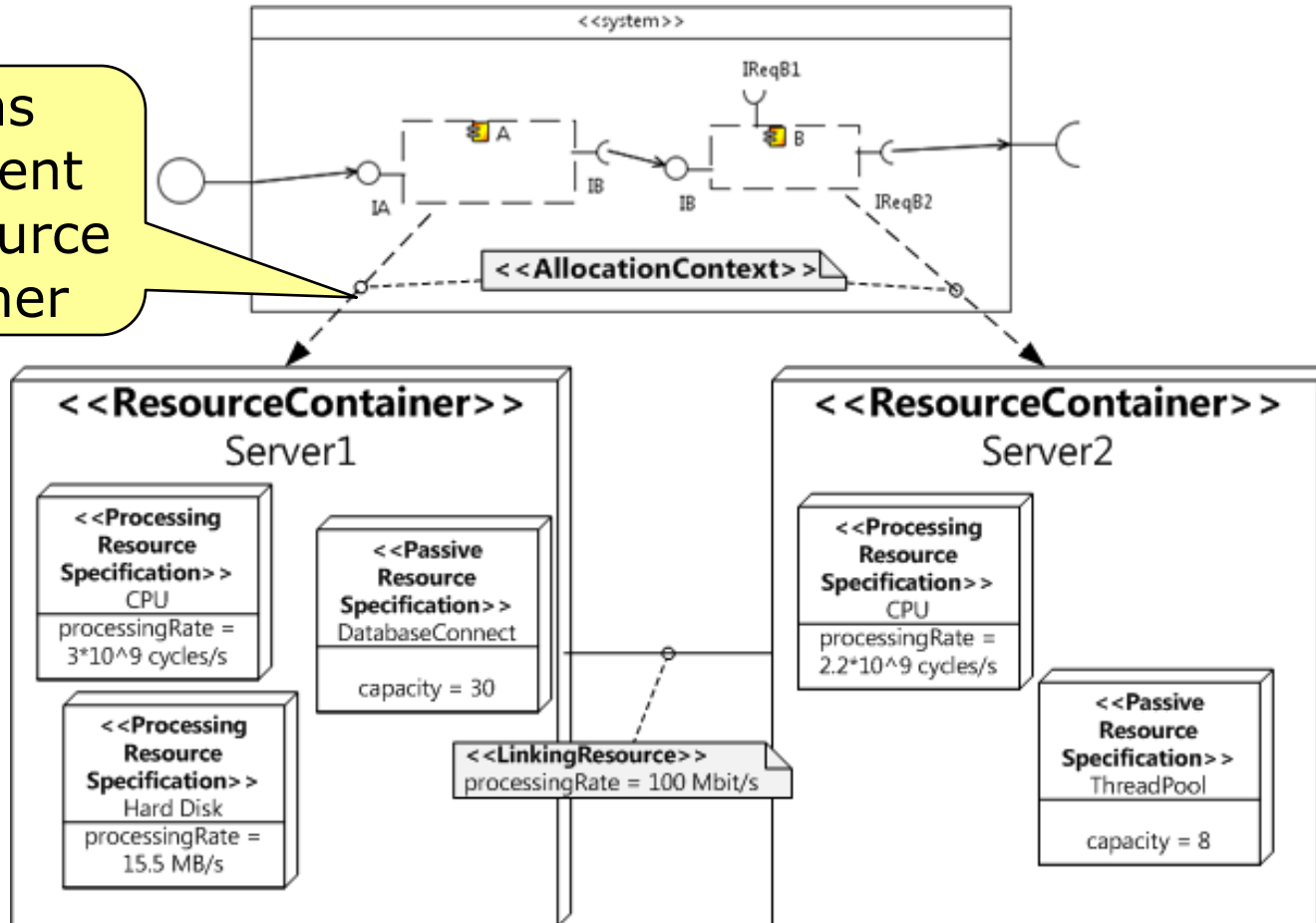


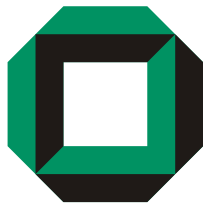




# Allocation

Assigns component to a resource container





# Allocation

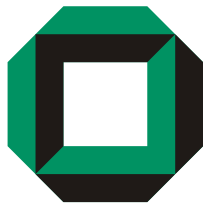


The screenshot displays the Eclipse IDE interface. The main editor shows a UML Allocation Diagram titled "MediaStore2.allocation\_diagram". The diagram consists of several components and their associations:

- AppServer** container:
  - AllCtx\_WebGUI** component with association **WebGUI <AssCtx\_WebGUI>**.
  - AllCtx\_DigitalWatermarking** component with association **DigitalWatermarking <AssCtx\_DigitalWatermarking>**.
  - AllCtx\_MediaStore** component with association **MediaStore <AssCtx\_MediaStore>**.
  - AllCtx\_DBAdapter** component with association **DBAdapter <AssCtx\_DBAdapter>**.
- AudioDB** container:
  - AllCtx\_AudioDB** component with association **AudioDB <AssCtx\_AudioDB>**.

The Properties view at the bottom right shows the properties for the selected component **Context\_cgglMKYXEdUWZfldHy3B1Q**:

Property	Value
Assembly Context Allocation Context	Context_IJmq4KYUEduWZfldHy3B1Q
Entity Name	AllCtx_DBAdapter
Id	_cgglMKYXEdUWZfldHy3B1Q
Resource Container Allocation Context	Resource Container_2mkAAKYVEduWZfldHy3B1Q



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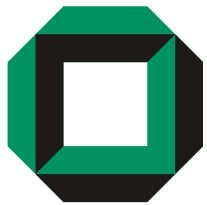
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Lecture 4

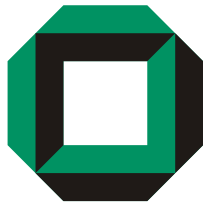
Lecture 5



# Lessons Learned Today



- Software Architect
  - Specification of a system
- System Deployer
  - Resource Types
  - Specification of a resource environment
  - Specification of an allocation



# Switch to Eclipse

