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Universität Paderborn

Conceptual Modelling of Styles for Mobile Systems

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 International Graduate School
Dynamic Intelligent Systems



Motivation

- Unlike distribution, **mobility is hardly transparent** to application developers
- Various “kinds” of mobile systems
 - with different **network organizations** (nomadic, ad-hoc, ...)
 - based on different **platforms** (Wireless Corba, J2ME, ...)
 provide different functionality to applications
- We need to understand *what* can be done, and *how*,
 - for building applications: **What happens if I do XYZ ...**
 - for designing middleware: **How do I add QOS support ...**
... in this network / on this platform?

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Example

- What will happen if new QoS requirements arise from client application?

QoSOfferedByWLANNetwork
ServiceType:InternetConnection
Speed: 11Mbps;
Price: 0.03€/ Min;

WLANConnection

QoSRequiredByClient
ServiceType:InternetConnection
Speed: 10Mbps;
Price: 0.05 €/Min;

GPRSConnection

QoSOfferedByGPRSNetwork
ServiceType:InternetConnection
Speed: 56Kbps;
Price: 0.01€/KiloByte;

Access Point

BTS

GPRSBaseStation

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Requirements

Styles of Mobile Systems should capture the structure and operation of a class of mobile systems

- precisely (with formal, executable models)
- understandably (to software engineers)
- at a high level of abstraction (to relate to application requirements)

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Outline

- Approach: Graph Transformation and UML
- Application: A Style for Nomadic Networks
- Adding QOS-awareness
- Example (revisited)
- (Potential) Benefits

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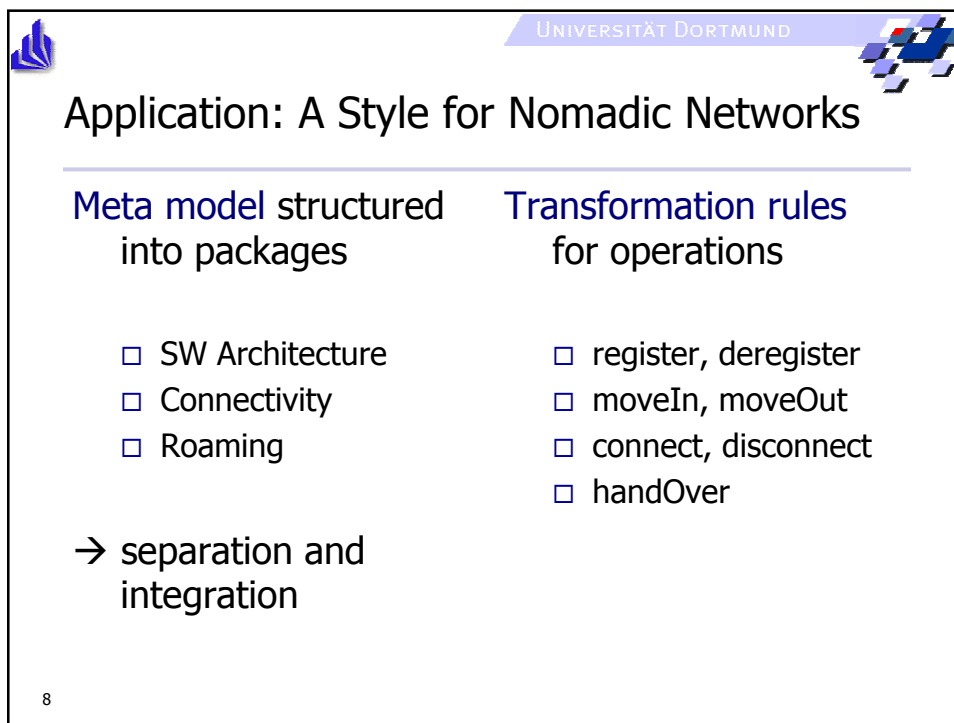
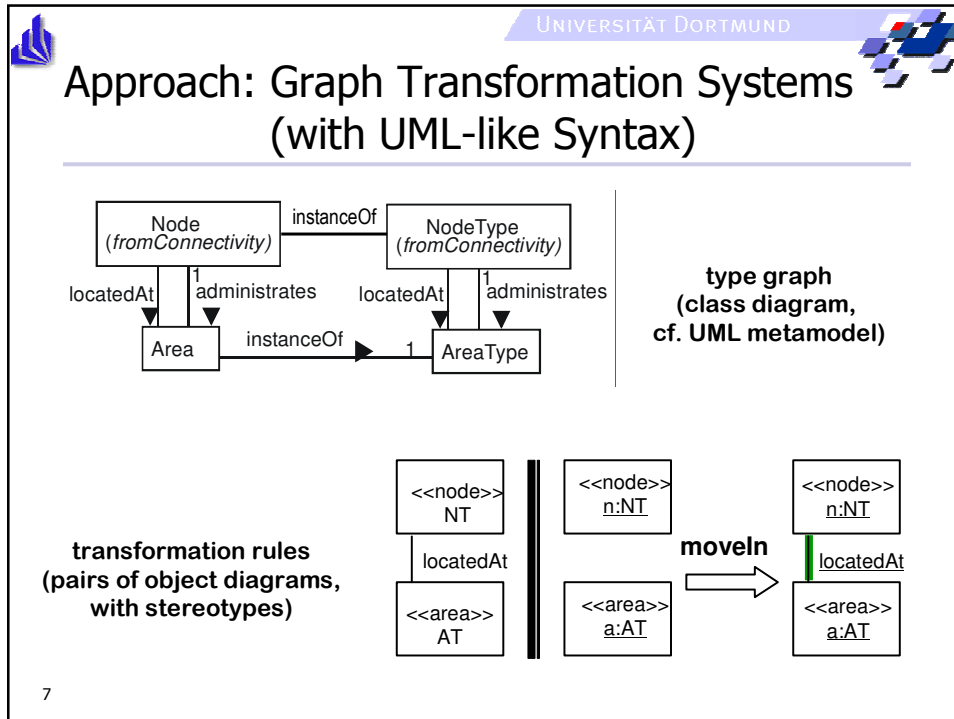



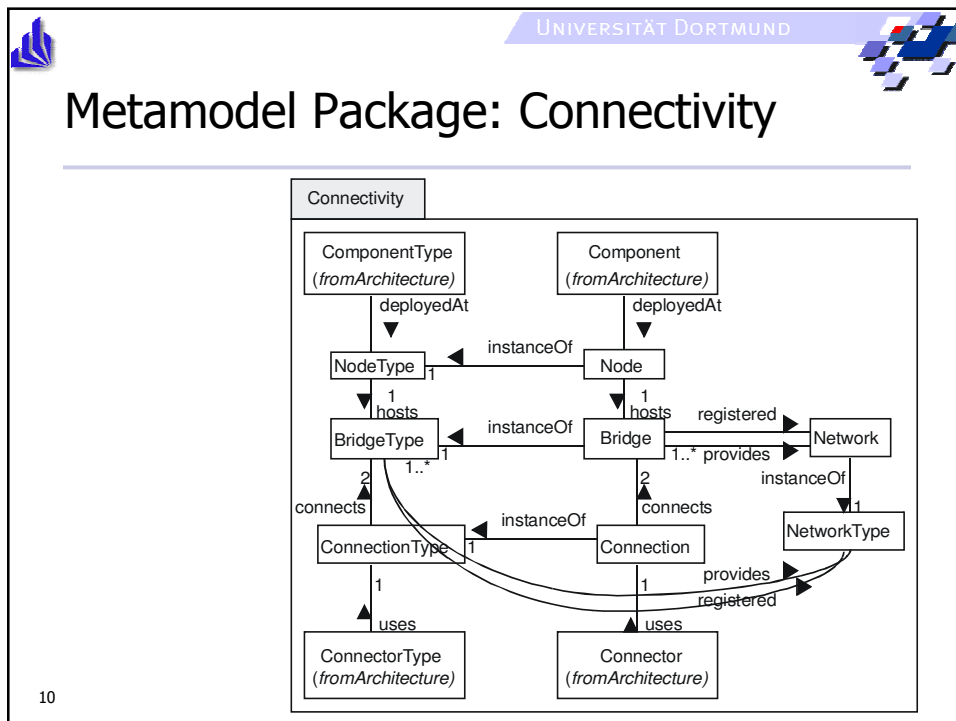
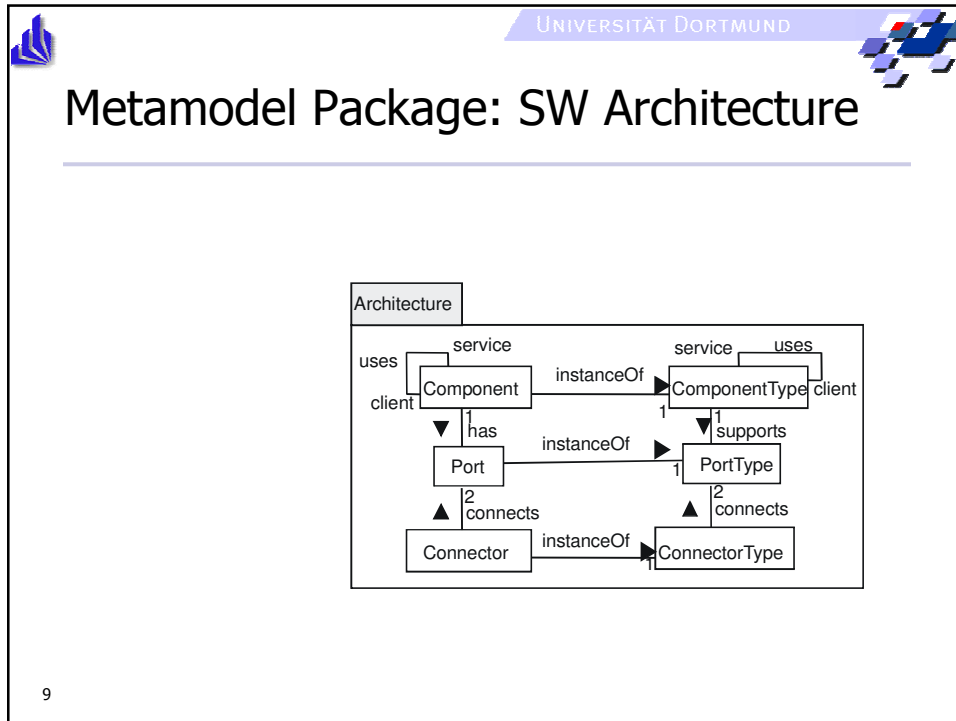
Approach: Graph Transformation Systems

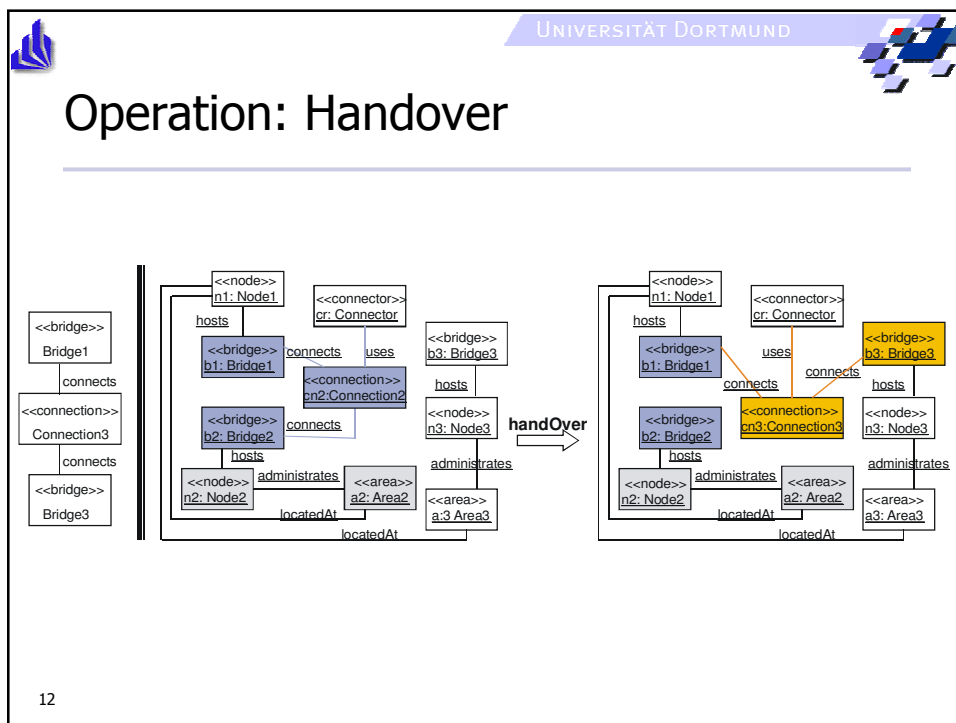
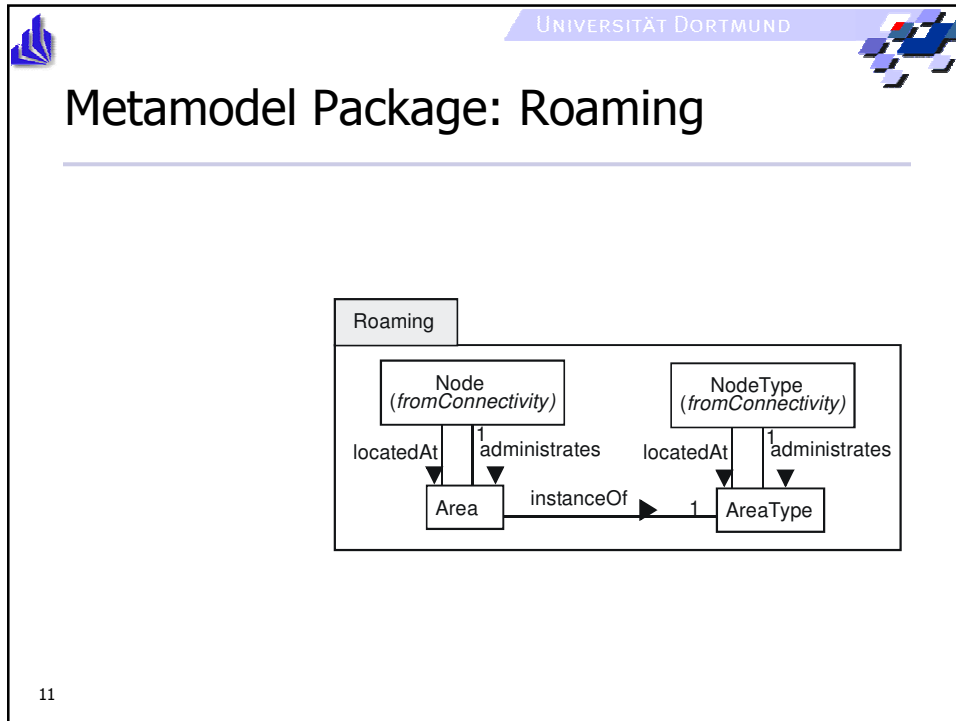
type graph

**transformation rules
(pairs of object diagrams)**

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Adding QoS-awareness

- monitor properties of resources (like bandwidth of network connection)
- match requirements against properties
- negotiate contract if requirements are not satisfied

QoS

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Handover with QoS

handOver

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Example (revisited)

- What will happen if new QoS requirements arise from client application?

The diagram illustrates a mobile device (laptop) connected to two different network types: WLAN and GPRS. The WLAN connection is provided by an Access Point, and the GPRS connection is provided by a GPRS Base Station (BTS). Three boxes describe the Quality of Service (QoS) parameters for each network and the client's requirements:

- QoSOfferedByWLANNetwork:** ServiceType: InternetConnection, Speed: 11Mbps, Price: 0.03€/Min.
- QoSRequiredByClient:** ServiceType: InternetConnection, Speed: 10Mbps, Price: 0.05€/Min.
- QoSOfferedByGPRSNetwork:** ServiceType: InternetConnection, Speed: 56Kbps, Price: 0.01€/KiloByte.

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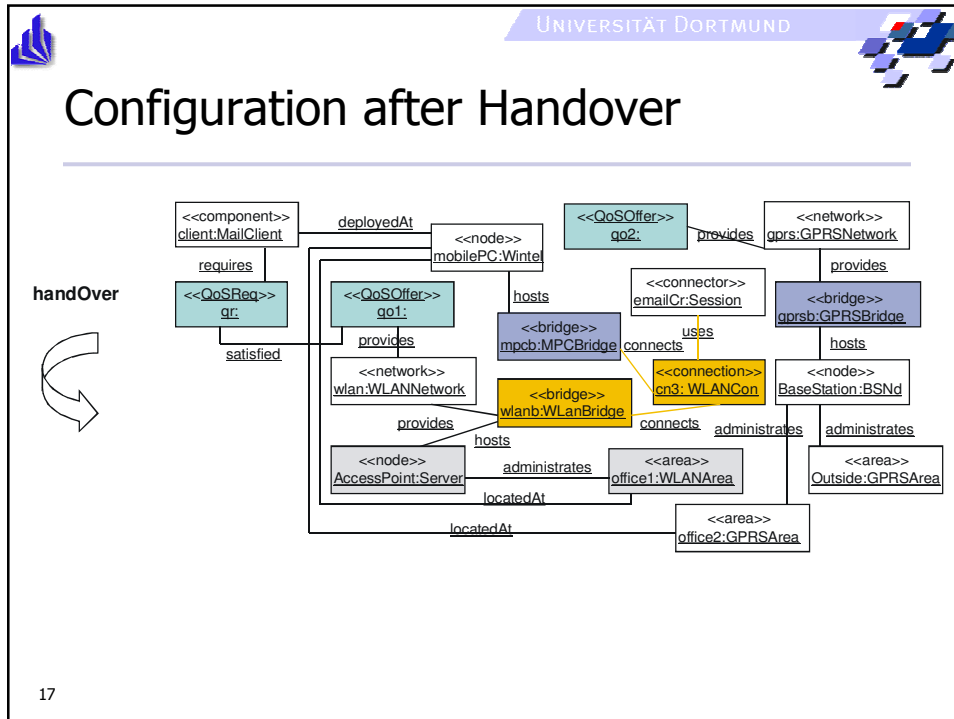
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Configuration before Handover

The diagram shows a complex configuration of network components and their relationships. Key elements include:

- Components:** MailClient (requires gr: QoSReq, satisfied by gr: QoSOffer).
- Nodes:** mobilePC (hosts wlan: WLANNetwork, provides gr: QoSOffer).
- Networks:** wlan: WLANNetwork (provides wlanb: WLANBridge), gprs: GPRSNetwork (provides gprsb: GPRSBridge).
- Bridges:** wlanb: WLANBridge (hosts BaseStation: BSNd), gprsb: GPRSBridge (hosts BaseStation: BSNd).
- Connections:** emailCr: Session (uses cn2: GPRSCon), BaseStation: BSNd (uses cn2: GPRSCon).
- Areas:** office1: WLANArea (located at AccessPoint: Server), office2: GPRSArea (located at AccessPoint: Server).

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- ## (Potential) Benefits
- ### What can we do now?
- classifying mobile systems by modelling styles (and comparing the models)
 - use models for analysis, simulation and testing (of applications or middleware)
 - study refinement relations between styles different levels (Nomadic → Wireless Corba)
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