

Anatomy of Adaptive Services for Ubiquitous Computing Environments

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Overview

- What are Adaptive Systems?
- Example
 - Personalised Information Service
- Multi-model, Metadata Driven Approach
 - Narrative
 - Abstraction
 - Metadata
- Adaptive Services
- Applying a Unified Approach to Adaptive Services
 - Adaptive Service Composition
 - Adaptive Policy Refinement
- Conclusion

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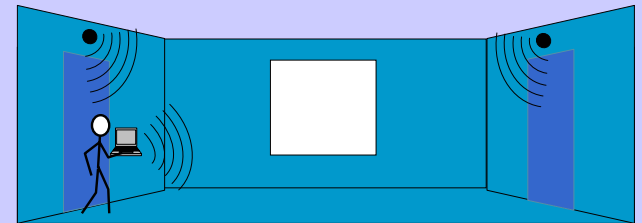
What are Adaptive Systems?

- Adaptive Systems adapt their output according to a variety of inputs
- Primarily they adapt structure and/or constituent elements to tailor output
- Traditionally such systems have used customised cores with embedded rules
- Adaptive Hypermedia
 - Personalise & Contextualise 'content experience' of a user

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Example – Personalized Information Service

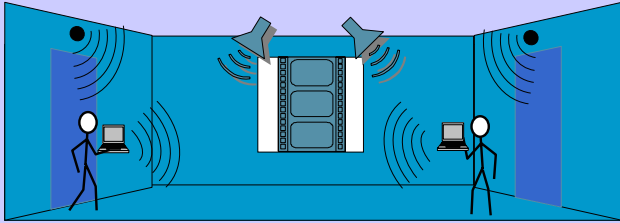


1. A Researcher arrives at a University for a meeting
 - A personalized information service delivers a map of the university to his mobile device showing a route to the meeting venue
2. Upon entering the venue the Researcher requests his communication services are transferred to his wireless laptop
 - As the researcher is at a meeting the personalized information services ensures all incoming communications are discrete

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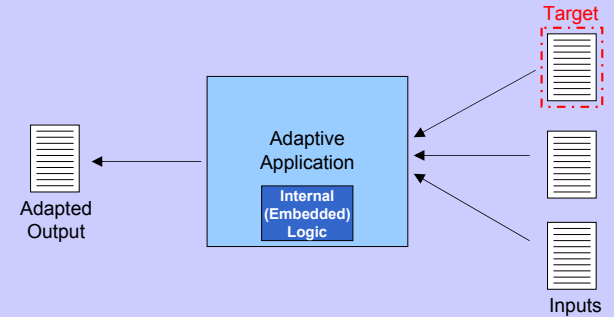
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Example



3. As part of the meeting the Researcher wishes to give a presentation and distribute copies to the other meeting attendees
 - A new service is composed that will –
 - Retrieve the presentation
 - Project it through the local projector
 - Send/Print copies for other attendees
 - The Researcher prefers to distribute his presentations as PDFs or "3 to a page" printouts

Traditional Approach - Adaptive Application



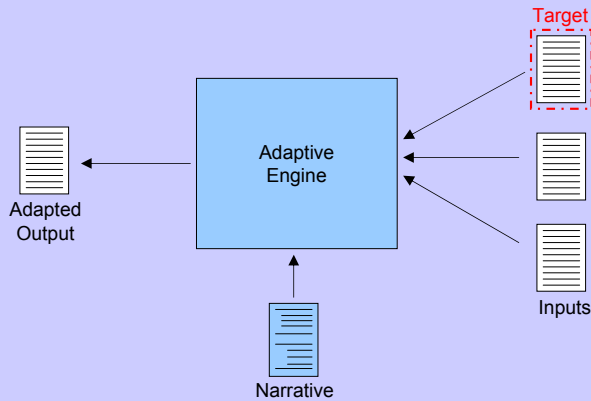
Adaptive Systems – Components

- Target(s) of Adaptivity
 - User Needs, System/Service Requirements, Device Capabilities, Network Parameters, Environment Facilities etc.
- Source(s) of Data
 - Metadata may be used to describe –
 - User model, service capabilities, environmental factors
- Adaptive Mechanism
 - Adaptive Engine vs Customised Core
 - Narrative vs Embedded Rules

Adaptive Mechanism

- Adaptive Applications
 - Application logic embedded in Core
 - Difficult to update and maintain
 - Very application specific!
- Generic Adaptive Engine
 - Uses Narrative to describe Adaptation
 - Engine may be used to produce a wide range of Adaptation effects
 - Both Engine and Narratives may be reused

Adaptive Engine & Narrative



Multi-Model, Metadata Driven Approach

- Approach supports reusability through separation of concerns
 - Reusable Strategies
 - Reusable Generic Adaptive Engine
 - Reusable models (User Models, Service Descriptions, Environment Models, Context, Ontologies, etc.)
- Unified approach to Adaptive Service creation
- Three features of approach that support use (and reuse) in Ubiquitous Computing Environments –
 - Narrative, Abstraction & Metadata

Narrative

- A Narrative describes a strategy
 - May be expressed as a Rule Base, an AI technique or as a piece of programming
- Embodies an abstract approach
- The narrative has –
 - Access to data/metadata sources (local and remote)
 - Facilities to compare data/metadata
 - Ability to create output(s)

Abstraction Mechanism

- Enables narratives to describe strategies abstractly
 - Narrative does not need to reference *actual* objects (models, services, policies, etc.)
- Abstract references fulfilled at run-time through the candidacy architecture
- Facilitates –
 - Reuse through abstraction – An object is not tied to its usage in a particular narrative. Nor is the narrative constrained to using only particular objects
 - Selection through candidacy – Most appropriate candidate object may be selected at run-time

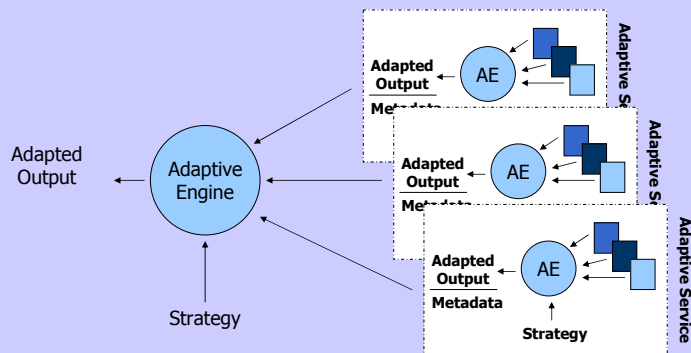
Metadata

- Appropriate and accurate information about the target of adaptivity and sources is required
- For example –
 - User Requirements
 - Service Descriptions
 - Current Context
 - Ontologies

Adaptive Services

- Representing Adaptive System as a Service
 - Appropriate interfaces for data/metadata interchange
 - Interface for narrative/strategy access
- Using Adaptive Services as data/metadata sources
 - Linking/Chaining Services

Linking Adaptive Services

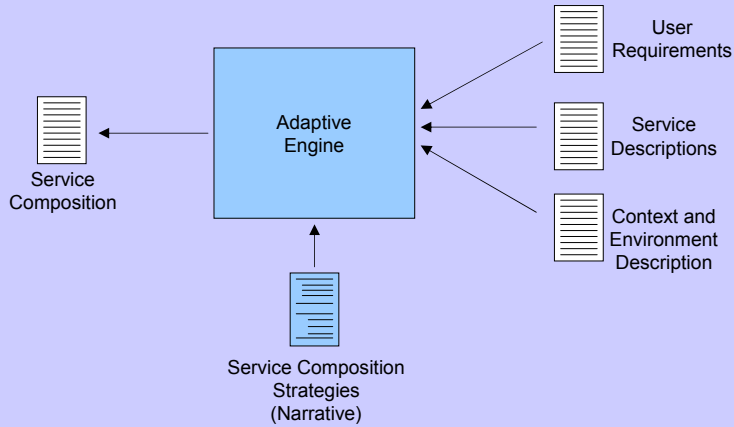


Applying the Unified Approach

1

- Adaptive Service Composition
 - Compile-time creation of tailored conglomerate services
 - Composition usually based on –
 - User requirements
 - Types of services available
 - Restrictions applied by the environment
 - May be just-in-time
 - Compositions may be reused
- Used in Ubiquitous Computing Environments to create new services to meet User needs

Adaptive Service Composition

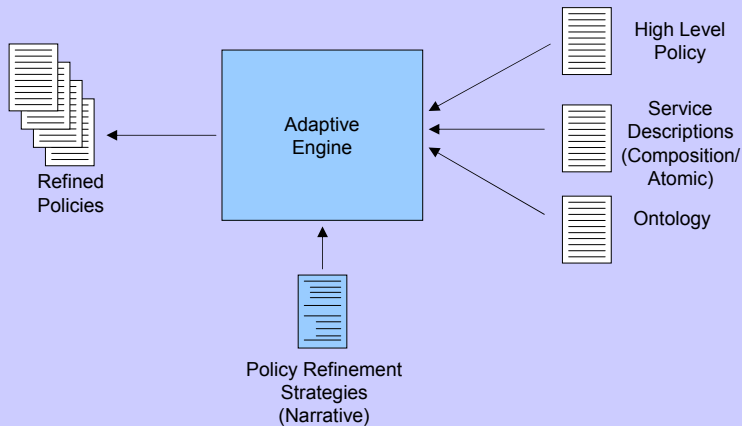


Applying the Unified Approach

2

- Adaptive Policy Refinement
 - Decomposition of a high level policy into policies that may be enacted upon constituent services
 - Facilitates fine tuning of conglomerate services
 - Occurs at run-time
 - Supported by appropriate semantics
- Used in Ubiquitous Computing Environments to manage and tune services as context or requirements change

Adaptive Policy Refinement



Conclusion

- Adaptivity may be leveraged to create customised services
- It may also be used to facilitate the management of composed services
- A Generic Adaptive Engine offers –
 - Ease of Reusability
 - Ability to be applied in many areas
- Adaptive Services offer extensible solutions that may be linked together