

A Component-based Approach for Adaptive, Dynamic Web Documents

TRENDS IN TODAY'S WEB

- Enormous growth of published information
- Rapid change from a presentation to a cooperation and communication medium
- Ubiquitous access via different multimedia devices, e.g. cellphones, PDAs, notebooks, TabletPCs, etc.
- Need for up-to-date delivery of adapted content

Deficits

- Coarse-grained Web implementation model, lacking support for separation of content, structure and layout
- No support for describing adaptivity in a fine-granular way
- Existing Web engineering approaches aim at reusing design concepts instead of fine-grained adaptable implementation artefacts

Declarative Document Components

- Composition of Web sites of configurable declarative document components
- Components: XML-documents or document fragments representing adaptable Web content on different abstraction levels (Figure 1.)

Media Components

- Encapsulate media assets by attaching technical (MPEG7) and content management metadata.
- Text, structured text (e.g. HTML), images, sound, video, java applets, or even whole documents (such as HTML-pages)
- Also dynamically generated Web content when metadata is delivered, too

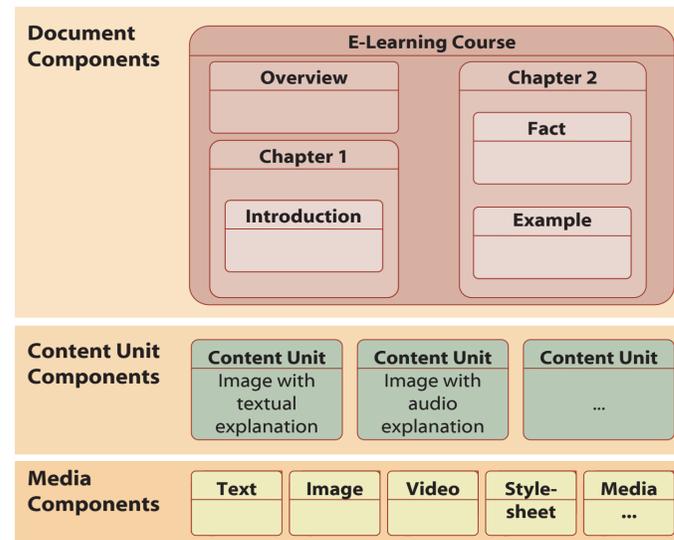


Figure 1. The Document Model

Content Units

- Combine media components belonging together semantically - e.g. image with textual description
- Spatial adjustment of media components described by client-independent layout properties

Document Components

- Parts of Web presentations playing a well defined semantic role (e.g. news column, product presentation or even a Web site.)

- Document Components reference content units, or aggregate other document components
- Hierarchy of document components describes the logical structure of a Web site and is strongly dependent from the application context
- Spatial adjustment of subcomponents described by client-independent layout descriptors

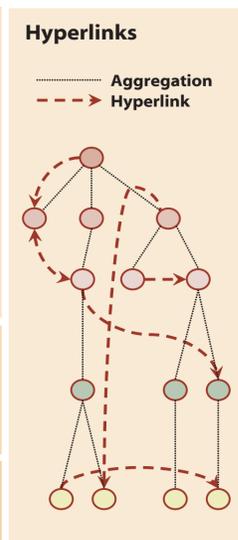
Hyperlink View

- Spanned over all component levels
- Uni- and bidirectional typed hyperlinks based on the standards XLink, XPath and XPointer

Supporting Adaptivity

Modeling adaptivity on each abstraction level:

- Adaptation of media components with respect to various client capabilities or other technical preferences by providing alternative media instances with varying quality
- Adjustment of type, number and arrangement of inserted media components on the level of content units
- Adaptation of document components resulting in different component trees for different users and devices
- Personalized navigation by adaptation of the hyperlink view



Defining adaptive behavior by component variants on each abstraction level:

- E.g. image object component including two variations for color or monochrome displays, or document components with varying number, structure and arrangement of subcomponents
- Selection methods parameterized by variables from the user model

- are chosen by the component author during the authoring process
 - and carried out by transformer stylesheets during document generation
- This separation of component variants (in the component) and the adaptation logic (in stylesheets) allows for reuse of components in different adaptation scenarios
 - Reuse of both low-level concepts (content) and high-level concepts (adaptation logic)

DOCUMENT GENERATION

Document generation is based on a stepwise pipeline concept in order to achieve code reuse and higher performance through caching mechanisms. The document generator was realized over the pipeline-based publishing framework Cocoon.

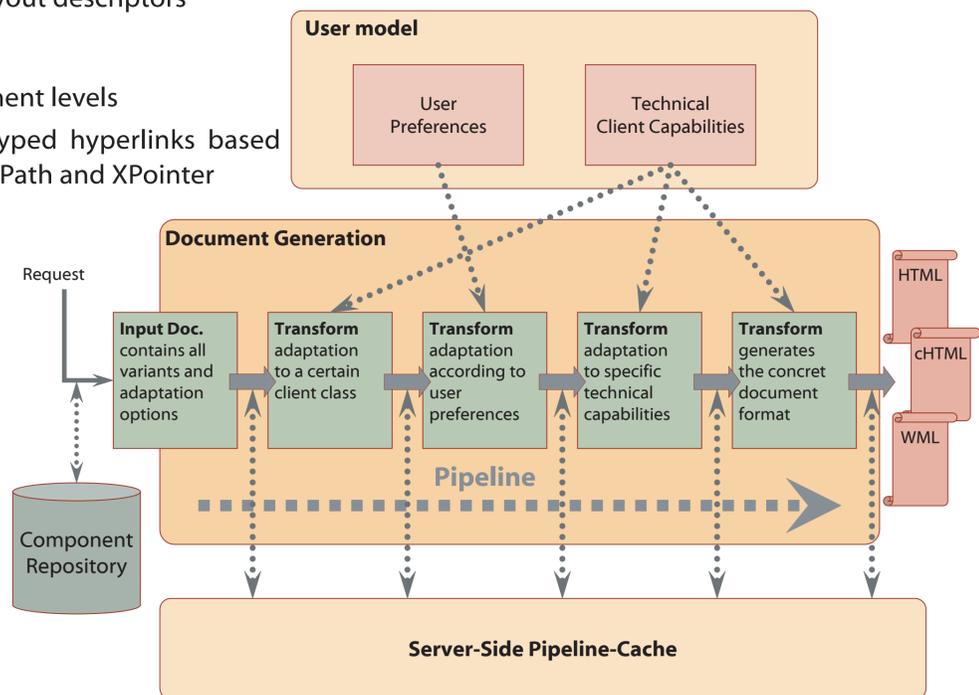


Figure 2. Stepwise Document Generation

- A complex document encapsulating all possible presentation forms is dynamically assembled from the component repository
- It is subdued to a series of transformations, each considering a certain aspect of adaptation by performing conversions to the document (selection and configuration of components)
- Finally, a Web document in a specific output format (HTML, WML etc.) is generated

Figure 2: Possible pipeline with three steps

- Adaptation to a client class (Desktop PC, notebook, PDA, cellphone, etc.)
- Adaptation according to semantic user preferences
- Adaptation to specific technical capabilities, such as bandwidth, display resolution, color depth, interaction capabilities

FUTURE WORK

- Refinement of metadata schemas for representing user models and client information
- Detailed performance analysis of the pipeline-based document generation

Authoring process

- Concepts for effectively designing adaptive multimedia Web applications
- Adoption of existing hypermedia design models for adaptive, component-based Web sites
- Design and implementation of a component repository for storing, retrieving, configuring, and publishing adaptive content components

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