

Detecting and Resolving Conflicts between Adaptation Aspects in Multi-staged XML Transformations

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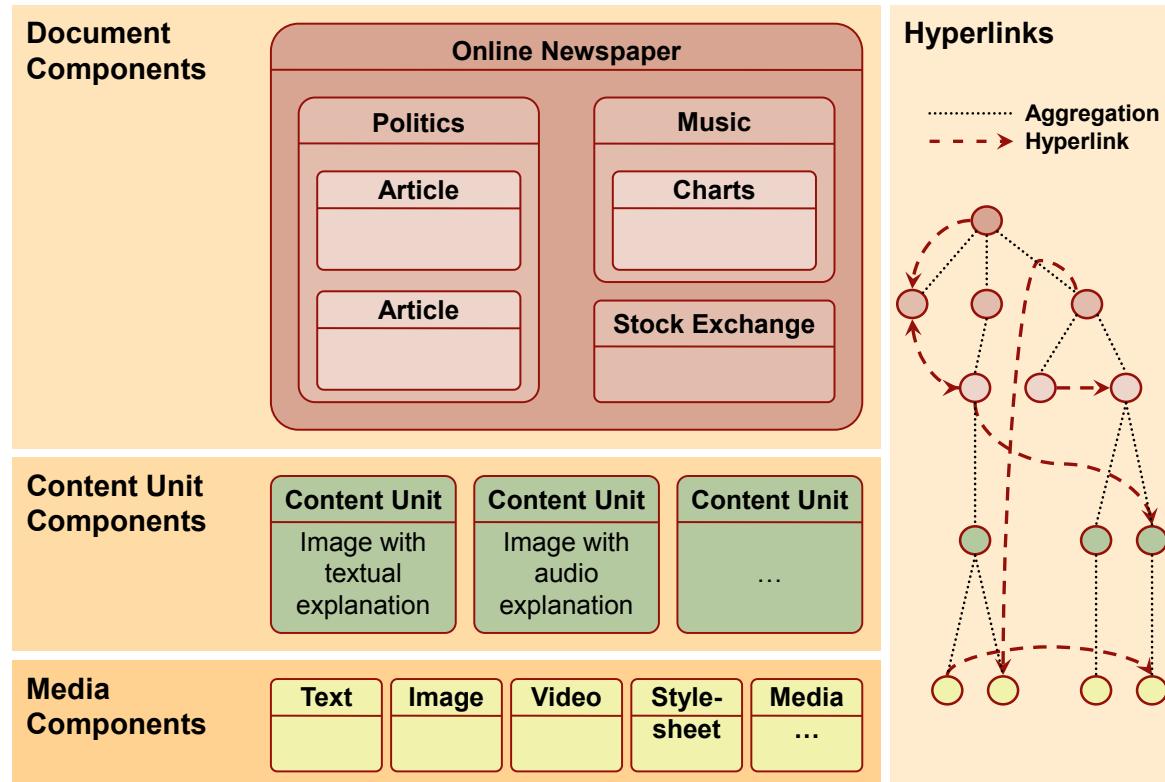
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DocEng'11, Mountain View, 22-09-2011

Outline

1. Background and Motivation
2. HyperAdapt Toolbox
3. DALE Aspect Language
4. Aspect Interaction and Conflicts
5. Conclusion and Outlook

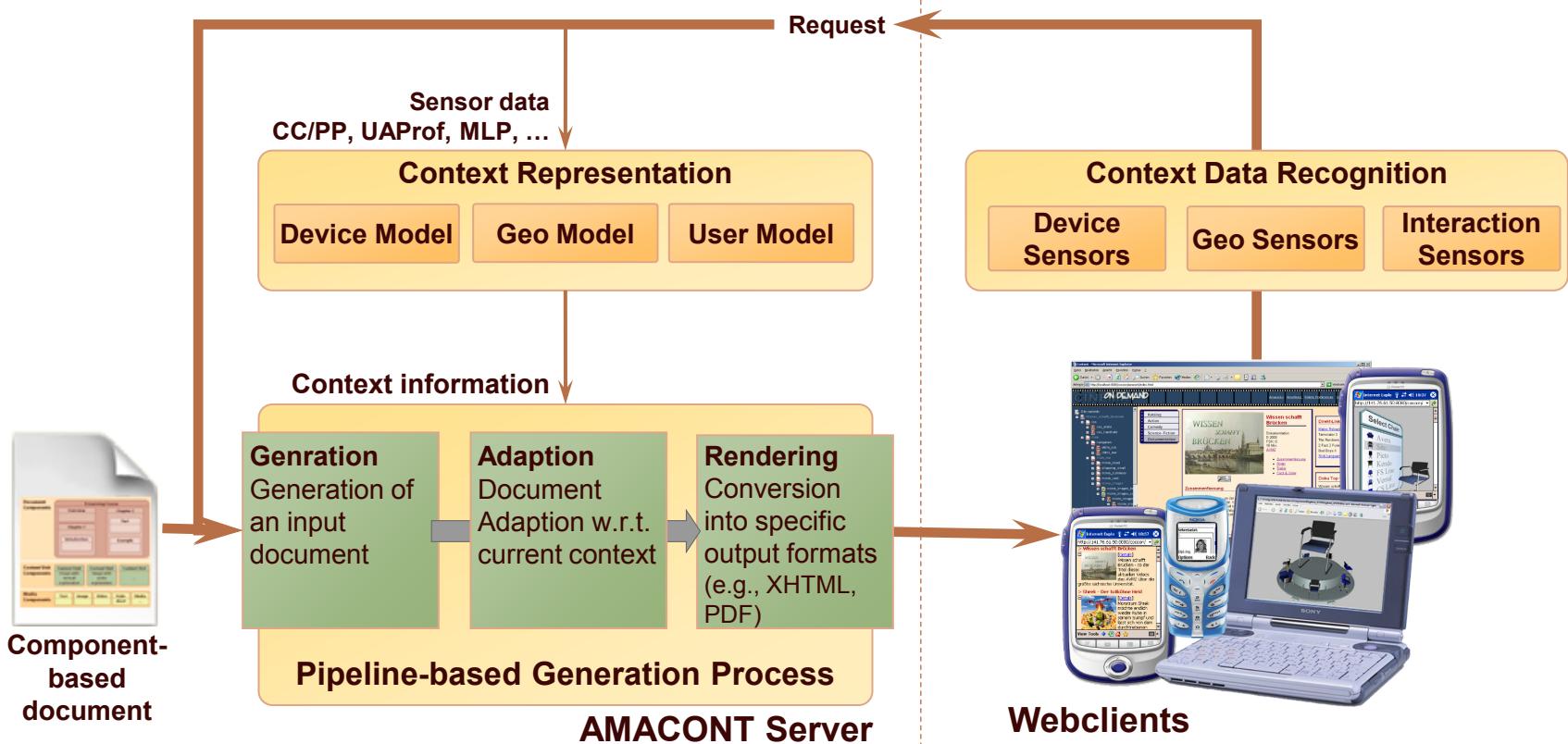
01 Background and Motivation

AMACONT – an XML-based Hypermedia Document Format [Fiala+03]



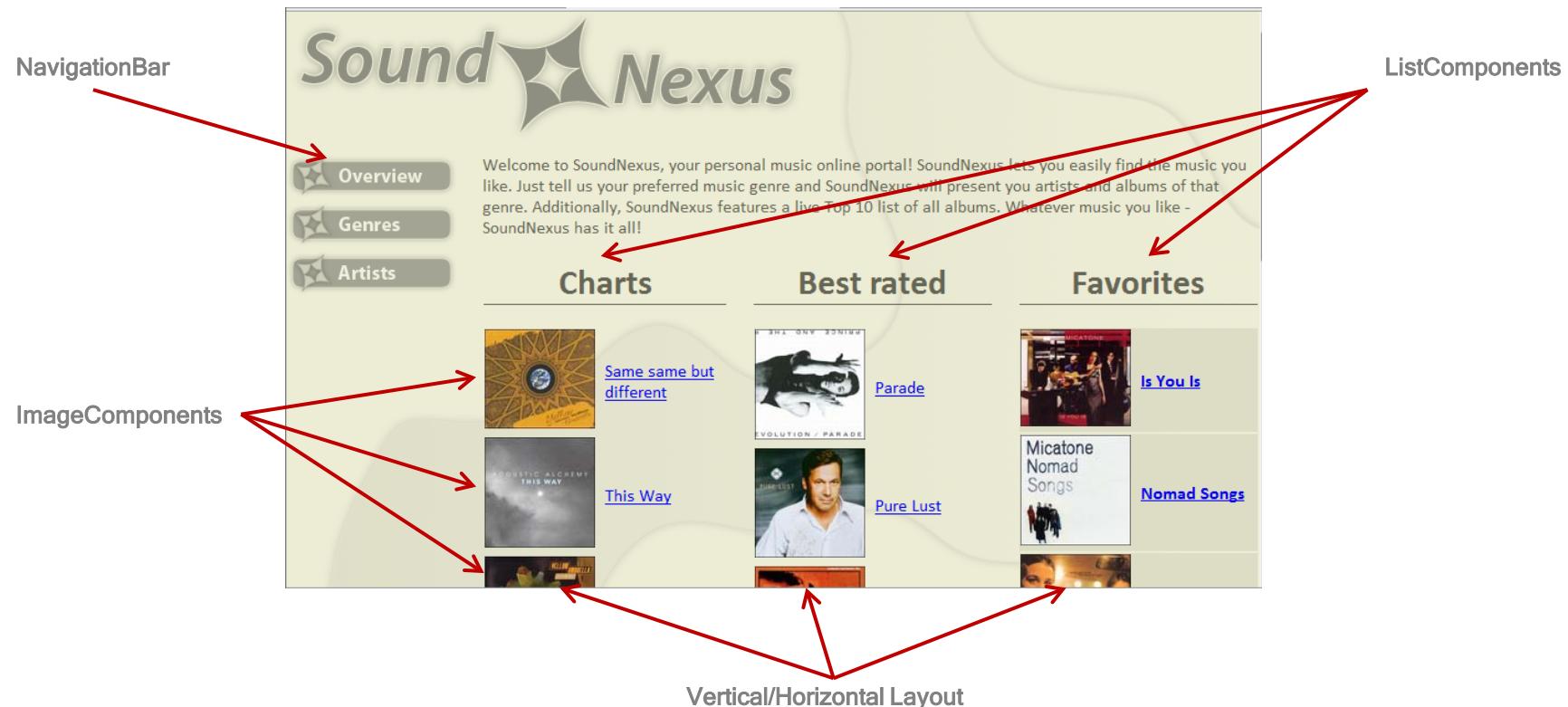
01 Background and Motivation

Adaptive document generation process [Hinz+07]



01 Background and Motivation

SoundNexus – An AMACONT-based Music Database

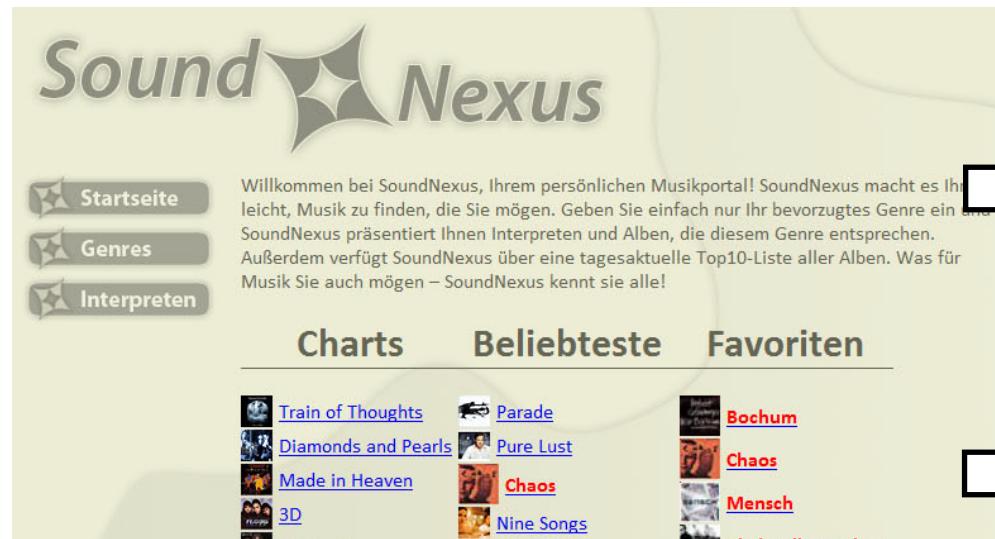


```

<?xml version="1.0" encoding="UTF-8"?>
<aco:AmaWebPageComponent id="ok2hvhrs" xmlns:aco="http://www.hyperadapt.net/amacont/2008/AmaComponent"
layer="DocumentComponent" name="Website" xsi:schemaLocation="http://www.hyperadapt.net/amacont/2008/AmaComponent
http://www.hyperadapt.net/amacont/2008/AmaComponent.xsd" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
template="simple"
xmlns:mpeg7="http://www.mpeg7.org/2001/MPEG-7_Schema"
xmlns:asem="http://www.hyperadapt.net/amacont/2008/AmaSemantics"
xmlns:aada="http://www.hyperadapt.net/amacont/2008/AmaAdaptation"
xmlns:alay="http://www.hyperadapt.net/amacont/2008/AmaLayout"
xmlns:amet="http://www.hyperadapt.net/amacont/2008/AmaMetaInformation">
...
<aco:AmaImageComponent id="bestRatedEntry_img_${query_field('id')}" name="pimg2" layer="Media">
<aco:Hyperlinks>
  <aco:AmaComponentLinkComponent id="bestRatedEntry_img_link_${query_field('id')}" name="h6" layer="Hyperlink">
    <aco:MetaInformation>
      <amet:LinkComponentMetaData>
        <amet:linktype>Navigationslink</amet:linktype>
      </amet:LinkComponentMetaData>
    </aco:MetaInformation>
    <aco:To base="album.ama">
      <aco:Param name="id" value="${query_field('id')}"/>
    </aco:To>
  </aco:AmaComponentLinkComponent>
</aco:Hyperlinks>
<aco:MetaInformation>
  <amet:ImageMetaData>
    <amet:source>images/artists/${query_field('bild_src_small')}</amet:source>
    <amet:alt>Cover: '${query_field('name')}'<>/amet:alt>
  </amet:ImageMetaData>
</aco:MetaInformation>
</aco:AmaImageComponent>
...
</aco:AmaWebPageComponent>

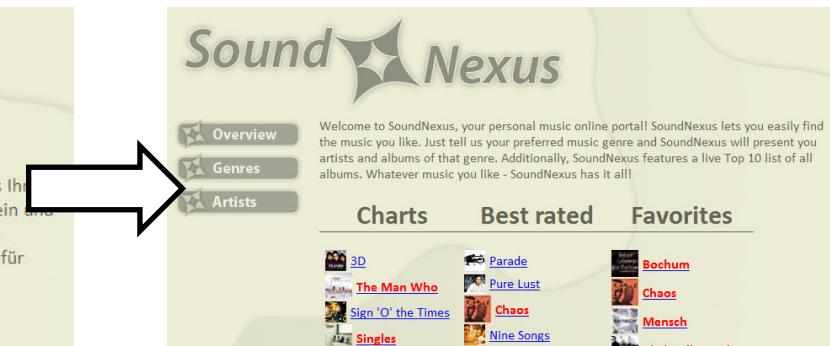
```

Background and Motivation



Willkommen bei SoundNexus, Ihrem persönlichen Musikportal! SoundNexus macht es Ihnen leicht, Musik zu finden, die Sie mögen. Geben Sie einfach nur Ihr bevorzugtes Genre ein und SoundNexus präsentiert Ihnen Interpreten und Alben, die diesem Genre entsprechen. Außerdem verfügt SoundNexus über eine tagesaktuelle Top10-Liste aller Alben. Was für Musik Sie auch mögen – SoundNexus kennt sie alle!

Charts	Beliebteste	Favoriten
 Train of Thoughts	 Parade	 Bochum
 Diamonds and Pearls	 Pure Lust	 Chaos
 Made in Heaven	 Mensch	 Mensch
 3D	 Nine Songs	



Welcome to SoundNexus, your personal music online portal! SoundNexus lets you easily find the music you like. Just tell us your preferred music genre and SoundNexus will present you artists and albums of that genre. Additionally, SoundNexus features a live Top 10 list of all albums. Whatever music you like - SoundNexus has it all!

Charts	Best rated	Favorites
 3D	 Parade	 Bochum
 The Man Who	 Pure Lust	 Chaos
 Sign 'O' the Times	 Bochum	 Nine Songs
 Singles		 Mensch



Startseite Genres Interpreten

Welcome to SoundNexus, your personal music online portal! SoundNexus lets you easily find the music you like. Just tell us your preferred music genre and SoundNexus will present you artists and albums of that genre. Additionally, SoundNexus features a live Top 10 list of all albums. Whatever music you like - SoundNexus has it all!

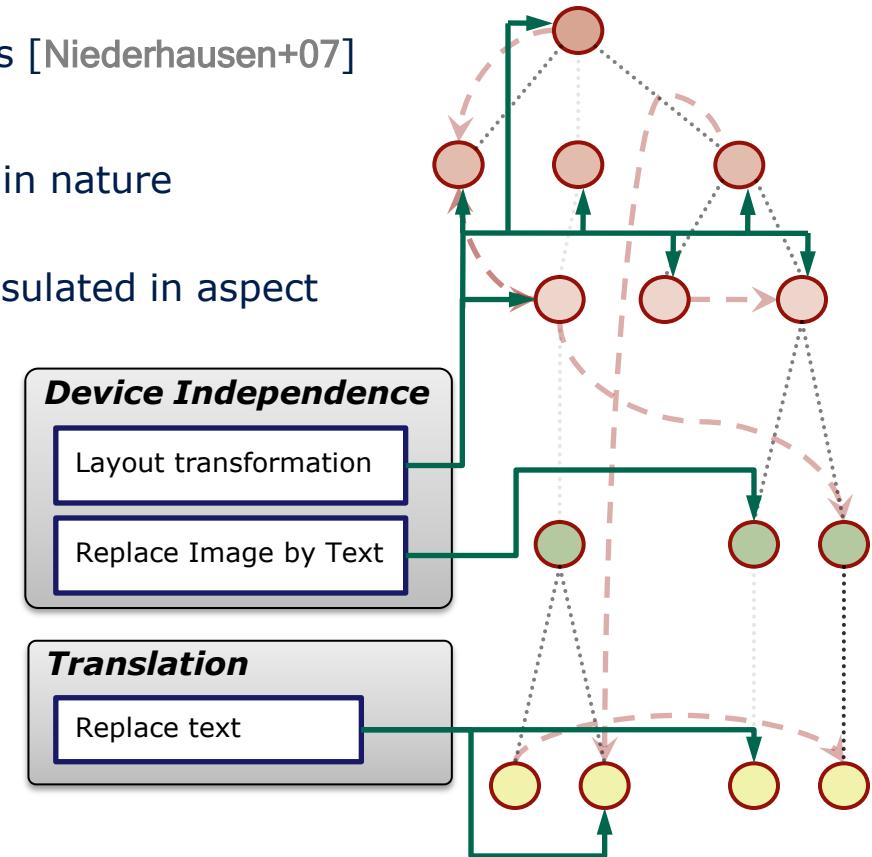
Charts
 Controversy
 The Slim Shady LP
 Golden Age of Grotesque
 Nomad Songs
 Bleibt alles anders
 Good Feeling
 Mensch
 Pure Lust

Beliebteste
 Parade
 Pure Lust

01 Background and Motivation

Adaptation rules as cross-cutting concerns [Niederhausen+07]

- ❑ Adaptation patterns are cross-cutting in nature
- ❑ Adaptation in AMACONT can be encapsulated in aspect modules
 - Avoids tangling and scattering
 - Improves readability and re-use
- ❑ Aspects can be woven statically or dynamically



01 Background and Motivation

Problems with the AMACONT approach:

- ❑ Specific for the AMACONT document model and pipeline-architecture
- ❑ Adaptation aspect interactions are not detected, conflicts are not resolved
- ❑ Joinpoint model considers content, but not the transformation



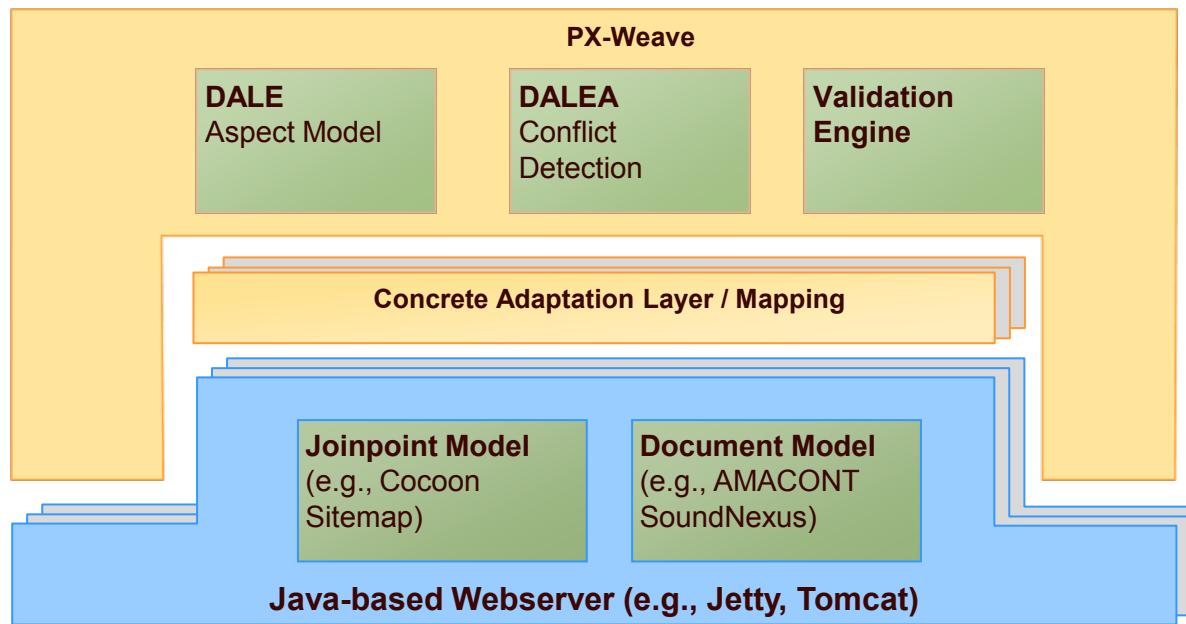
02 HyperAdapt Toolbox

- **Pipe-based XML Weaver (PX-Weave)** – A flexible, schema-aware weaving engine for integrating DALE adaptations into existing XML processing engines.
- **Document Adaptation LanguagE (DALE)** – An XML based language (or model) for generic adaptation aspects for XML documents
- **DALE Analyser (DALEA)** – An analysis tool for discovering and reporting interactions and conflicts to users.

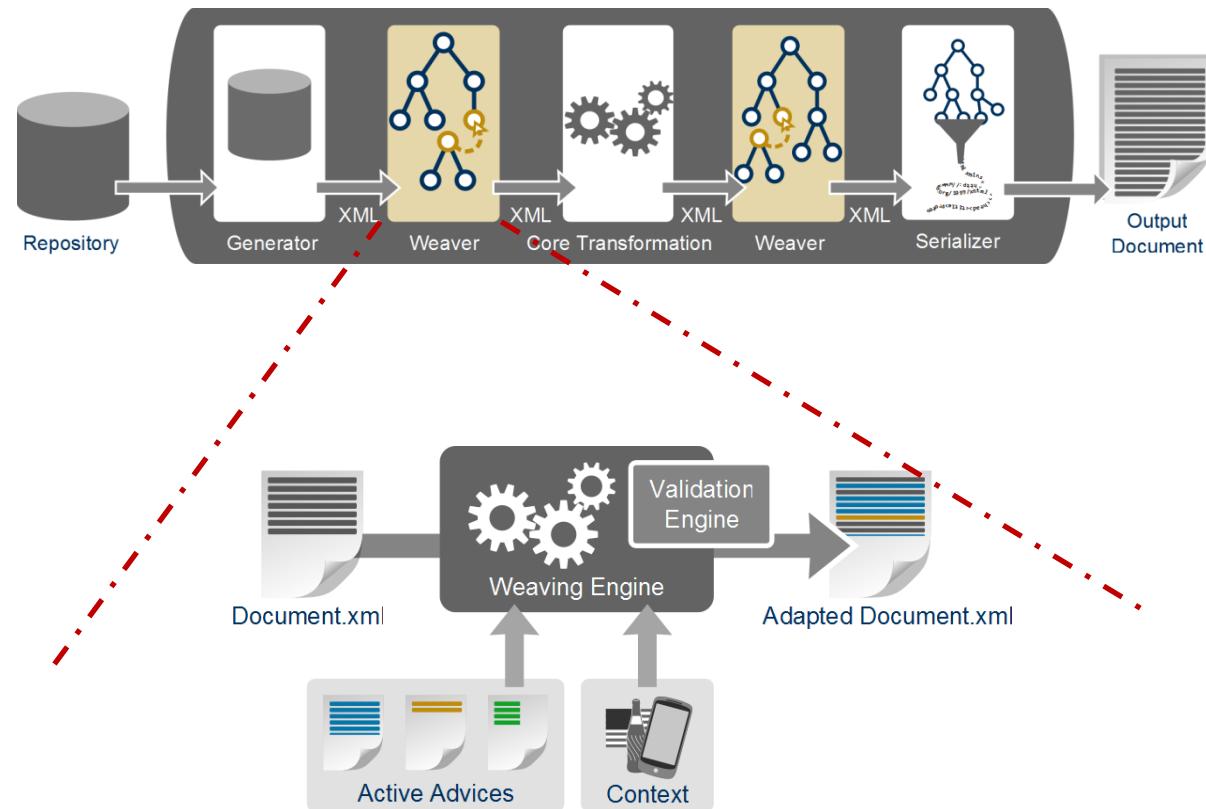
The implementation of all tools was done in Java, using various libraries and frameworks such as Saxon, Oracle xdk, Eclipse and Cocoon.



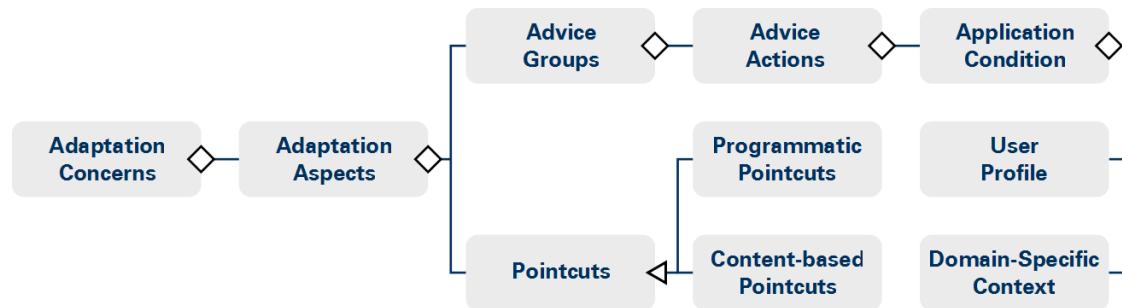
02 HyperAdapt Toolbox



02 PX-Weave Runtime Snapshot



03 DALE Adaptation Aspect Model



- **Adaptation Aspects** implement **Adaptation Concerns** – context-dependent adaptation objectives (e.g., device independence, accessibility, personalization ...)
- **Pointcuts** can be either **programmatic** (matching parts of the underlying transformation) or **content-based** (match the underlying document format)
- Adaptations are specified using a set of well-defined, groupable **Advice Actions** that can depend on Context-specific **Application Conditions** (context modeling is out of scope of this work)

03 DALE Example Aspect

Context parameters

```

<aspect name="DeviceIndependence">
  <interface> <!-- context parameters--> </interface>
  <adviceGroup>
    <depends> <!-- application condition --> </depends>
    <scope>
      <xpath>//aco:AmaSetComponent[@id='a56zuaa']</xpath>
      <before>wstransformer</before>
    </scope>
  </adviceGroup>

```

Application condition

Advice actions

```

    <adviceList>
      <changeValue>
        <pointcut> <!-- query location --> </pointcut>
        <value> .... </value>
      </changeValue>
      <delete>
        <pointcut> <!-- images location --> </pointcut>
      </delete>
      <delete>
        <pointcut> <!-- references location --> </pointcut>
      </delete>
    </adviceList>
  </adviceGroup>
</aspect>

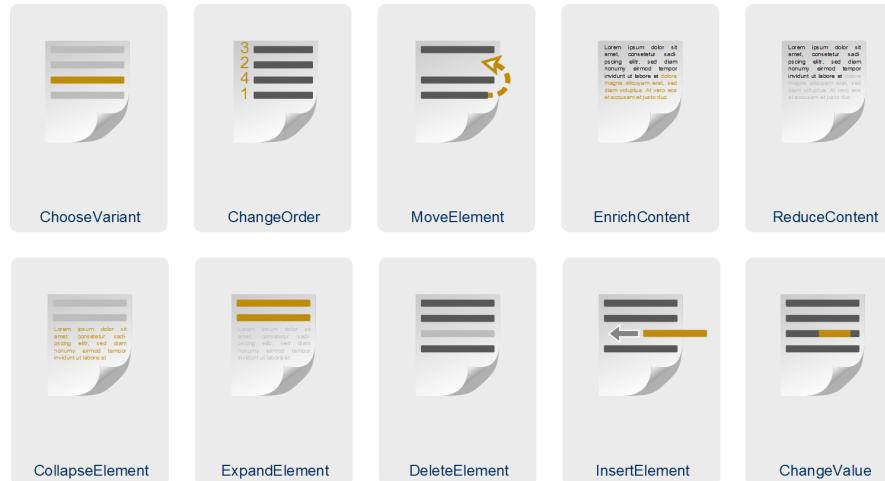
```

Content-based pointcut

Programmatic pointcut

Content-based pointcuts

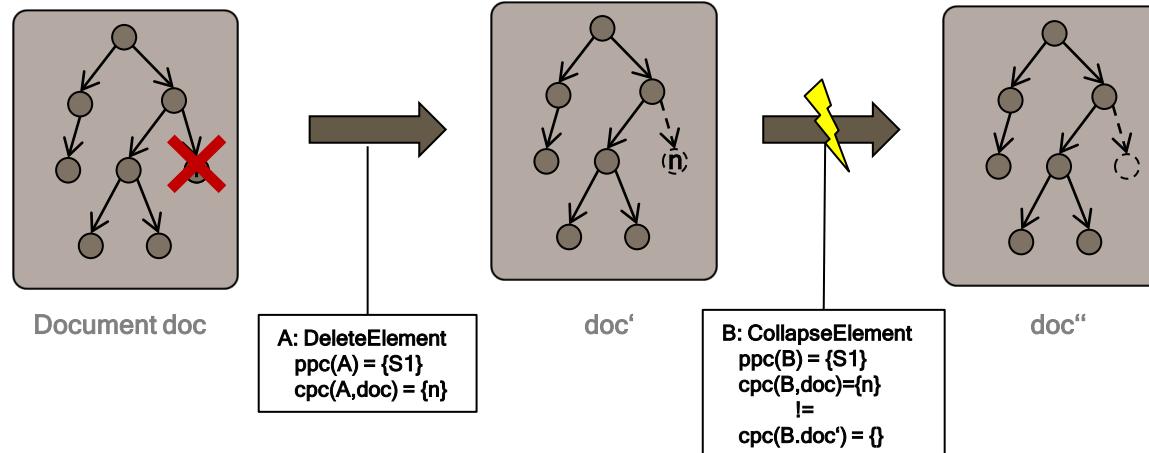
03 DALE Advice Actions



- ❑ A set of moderately powerful adaptation rules with clear semantics
 - influenced by [Brusilovsky01]
- ❑ Sufficient to implement many adaptation concerns

04 Interaction of Adaptation Aspects

- ❑ As with normal AOP, advice actions may interact
- ❑ **Example:** local interaction at stage S1:

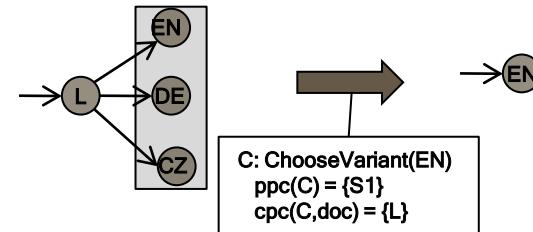


04 Interaction of Adaptation Aspects

- ***a* affects *b*** if
 - both intersect in the set of programmatic joinpoints
 - an application of ***a*** changes the content-based pointcut of ***b***
- ***a* triggers *b* for a node *n*** if
 - ***a*** affects ***b***
 - an application of ***a*** adds *n* to the content-based pointcut of ***b***
- ***a* inhibits *b* for a node *n*** if
 - ***a*** affects ***b***
 - an application of ***a*** removes *n* from the content-based pointcut of ***b***

04 Conflicts

- ❑ An *interaction* causes a *conflict* if an aspect is *triggered* or *inhibited* in unintended ways.
- ❑ syntactic conflict
 - Structural changes in a sub tree avoid a sensible application of an advice
- ❑ semantic conflict
 - An unintended interaction which causes incomplete or wrong adaptation from a developers perspective
- ❑ Syntactic conflicts can be identified immediately, semantic conflicts are not always obvious



04 Detecting Aspect Interaction in HyperAdapt

Interaction detection at development time

- ❑ Static detection is feasible to some extend
- ❑ No presence of a document required
- ❑ No presence of a schema required
- ❑ Basic algorithm is based on DFA construction over regular XPath [Hammerschmidt+05]

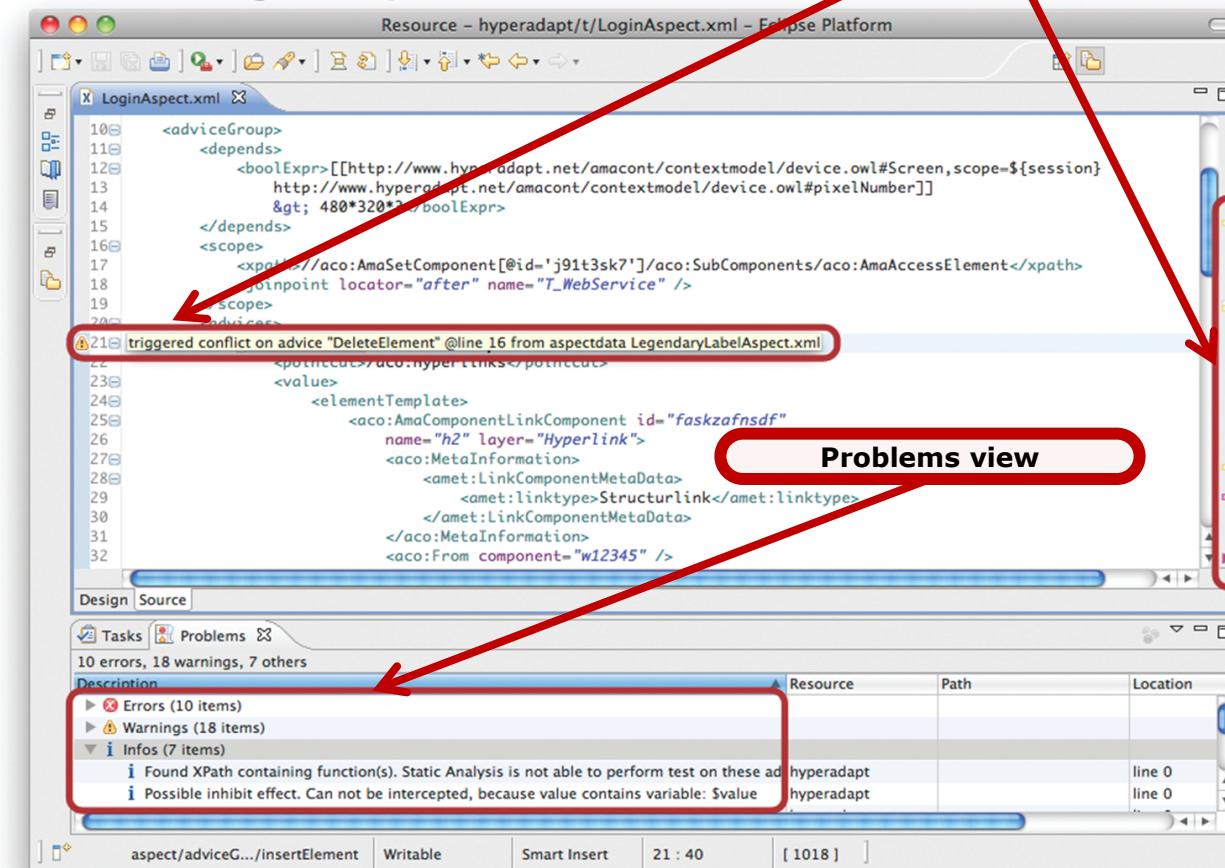
```
LET Advice - a set of advice actions
LET Result - a set of interacting advice pairs, initially empty
FOR a,b ∈ Advice
    IF ppc(a) ∩ ppc(b) ≠ {}
        prod := DFA(cpc(a)) × DFA(cpc(b))
        prod' := DFA(effect(a)) × DFA(cpc(b))
        IF prod ≠ prod'
            Result += Interact[a,b]
    FI
FI
```

04 Detecting Aspect Interactions in PX-Weave

Resource - hyperadapt/t/LoginAspect.xml - Eclipse Platform

Error markers

Problems view



```

<adviceGroup>
  <depends>
    <boolExpr>[[http://www.hyperadapt.net/amacont/contextmodel/device.owl#Screen,scope=${session}
      http://www.hyperadapt.net/amacont/contextmodel/device.owl#pixelNumber]]
      &gt; 480*320*</boolExpr>
  </depends>
  <scope>
    <xpath>/aco:AmaSetComponent[@id='j91t3sk7']/aco:SubComponents/aco:AmaAccessElement</xpath>
    <joinpoint locator="after" name="T_WebService" />
  </scope>
  <advice>
</advice>
21 triggered conflict on advice "DeleteElement" @line 16 from aspectdata LegendaryLabelAspect.xml
<potinccuts>aco.hyperlinks</potinccuts>
<value>
  <elementTemplate>
    <aco:AmaComponentLinkComponent id="faskzafnsdf"
      name="h2" layer="Hyperlink">
      <aco:MetaInformation>
        <amet:LinkComponentMetaData>
          <amet:linktype>Structurlink</amet:linktype>
        </amet:LinkComponentMetaData>
      </aco:MetaInformation>
      <aco:From component="w12345" />
    </aco:AmaComponentLinkComponent>
  </elementTemplate>
</value>

```

Design Source

Tasks Problems

10 errors, 18 warnings, 7 others

Description

- Errors (10 items)
- Warnings (18 items)
- Infos (7 items)
 - Found XPath containing function(s). Static Analysis is not able to perform test on these ad
 - Possible inhibit effect. Can not be intercepted, because value contains variable: \$value

Resource Path Location

hyperadapt hyperadapt line 0 line 0

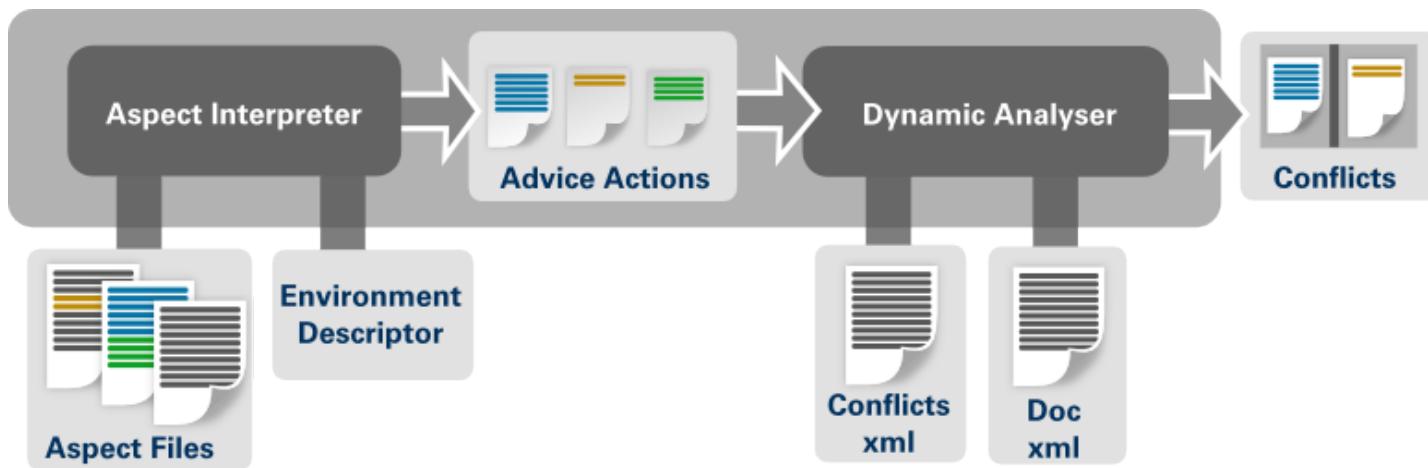
aspect/adviceG.../insertElement Writable Smart Insert 21 : 40 [1018]

04 Weaknesses of the Static Approach

- ❑ Checks are restricted to $XP(/;//;[];*)$
- ❑ Pointcuts may be unsatisfiable w.r.t. to the actual schema (c.f. [Benedikt08])
- ❑ Direct usage of tree patterns / canonical models (c.f. [Miklau+04,Cate+09]) can improve the interaction detection

04 Conflict Detection at Runtime

- ❑ Works on concrete node sets → more precise than static analysis
- ❑ Causes overhead → can be deactivated
- ❑ Feedback via log files



04 Dealing with Conflicts

- ❑ Aspect interaction is nothing bad, but the common case
- ❑ To avoid conflicts you can prioritize adaptation rules
 - PX-Weave allows the specification of an aspect order
- ❑ Use the aspect metaphor to group cross-cutting adaptation rules in a sensible way
- ❑ Avoid redundancies: A replacement (e.g. *collapse element*) makes no sense if the replaced node is deleted afterwards
- ❑ Use *safe* XPath expressions

04 Safe Content-based Pointcuts

- **Location-safe** pointcut expressions match the same element under all possible contexts in a document (e.g., matching nodes by unique IDs)
- **Value-safe** pointcut expressions match the same element under every possible value change (e.g., matching nodes by their location path)

	trgloc	inhloc	trgval	inhval
ChangeOrder	□	□	■	■
Change Value	■	■	□	□
Choose Variant	□	■	□	■
Collapse Element	■	■	■	■
Delete Element	□	■	□	■
Enrich Content	■	■	□	□
Expand Element	■	■	■	■
Insert Element	■	□	■	■
Move Element	□	□	■	■
Reduce Content	■	■	□	□

Example Conflict Matrix

```

<PatternConflicts>
  <ChangeOrder>
    <ChangeOrder>
      <status>warning</status>
      <reason>ChangeOrder -> ChangeOrder</reason>
      <solution>no solution yet</solution>
    </ChangeOrder>
    <ChooseVariant>
      <status>warning</status>
      <reason>ChangeOrder -> ChooseVariant</reason>
      <solution>no solution yet</solution>
    </ChooseVariant>
    <CollapseElement>
      <status>warning</status>
      <reason>ChangeOrder -> CollapseElement</reason>
      <solution>no solution yet</solution>
    </CollapseElement>
    <DeleteElement>
      <status>error</status>
      <reason>ChangeOrder -> DeleteElement</reason>
      <solution>no solution yet</solution>
    </DeleteElement>
  </ChangeOrder>
  ...
</PatternConflicts>

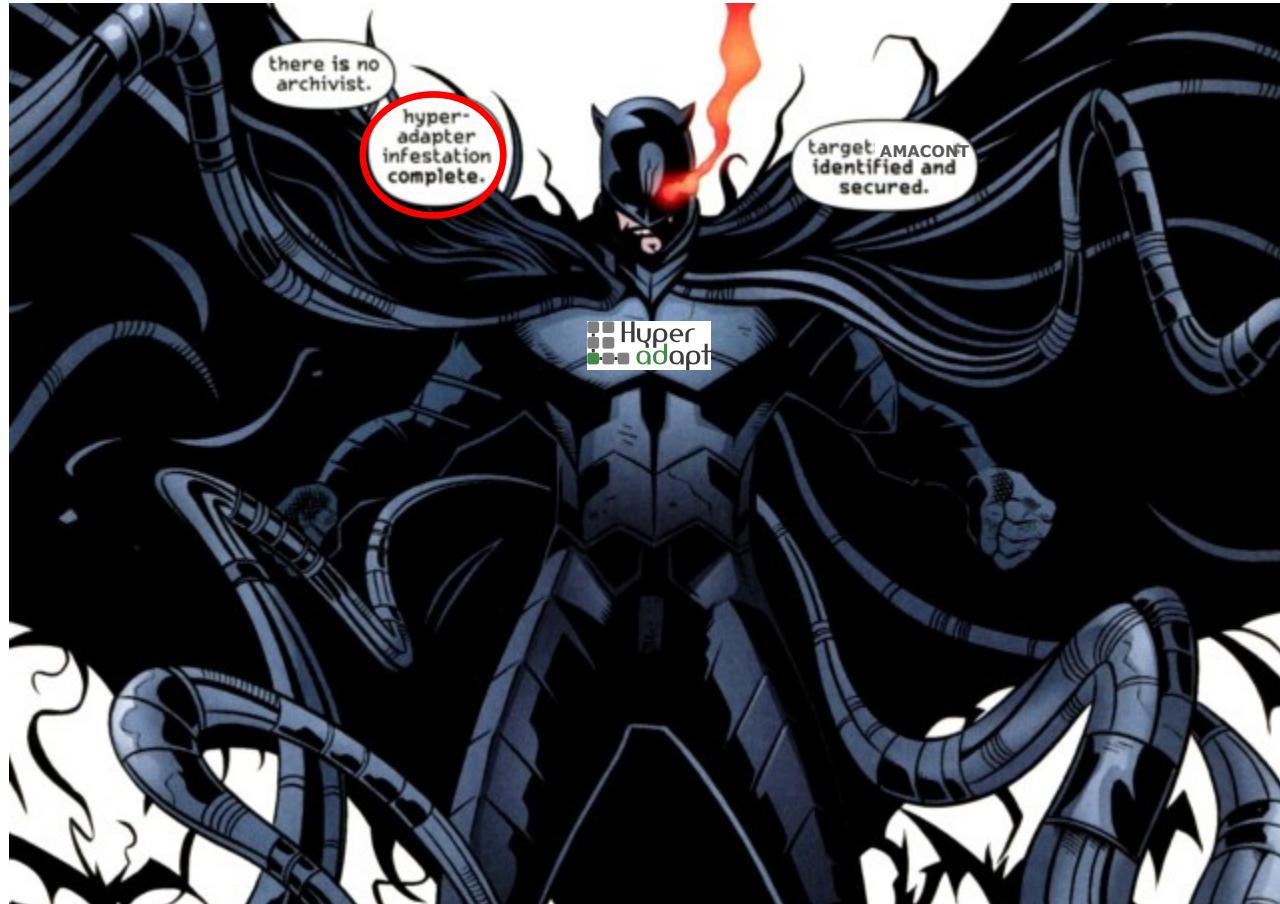
```

Kind of Interaction/Conflict
Implications
Proposed Solution (not implemented yet)

Conclusion and Outlook

- ❑ We presented a simple, understandable language/terminology for adaptation aspects
- ❑ We transferred the notion of aspect interactions to the hypermedia domain (at least to some extend)
- ❑ We implemented a proof of concept tooling (PX-Weave, DALEA)
- ❑ We currently work on a bigger case study and an application to the JSF format
 - Easier to explain
 - Relevance in industry
- ❑ Static conflict detection will be improved by employing better algorithms
 - Use layout/adaptivity metrics for automatic conflict solution for semantic conflicts

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- [Niederhausen+07]** M. Niederhausen, Z. Fiala, N. Kopcsek, und K. Meissner, „Web Software Evolution by Aspect-oriented Adaptation Engineering“, *Web Site Evolution, 2007. WSE 2007. 9th IEEE International Workshop on*, S. 3-7, Okt. 2007.
- [Karol+10]** S. Karol, M. Heinzerling, F. Heidenreich, und U. Aßmann, „Using feature models for creating families of documents“, in *Proceedings of the 10th ACM symposium on Document engineering*, New York, NY, USA, 2010, S. 259-262.
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- [Casteleyn+06]** S. Casteleyn, Z. Fiala, G.-J. Houben, und K. van der Sluijs, „From adaptation engineering to aspect-oriented context-dependency“, in *Proceedings of the 15th international conference on World Wide Web*, New York, NY, USA, 2006, S. 897-898.
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- [Schauerhuber+07]** A. Schauerhuber, M. Wimmer, W. Schwinger, E. Kapsammer, und W. Retschitzegger, „Aspect-oriented modeling of ubiquitous web applications: The aspectwebml approach“, in *Engineering of Computer-Based Systems, 2007. ECBS’07. 14th Annual IEEE International Conference and Workshops on the*, S. 569-576.
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- [Hinz+07]** M. Hinz, S. Pietschmann, M. Umbach, und K. Meißner, „Adaptation and Distribution of Pipeline-Based Context-Aware Web Architectures“, *Software Architecture, Working IEEE/IFIP Conference on*, Bd. 0, S. 15, 2007.
- [Fiala+03]** Z. Fiala, M. Hinz, K. Meissner, und F. Wehner, „A component-based approach for adaptive, dynamic web documents“, *Journal of Web Engineering*, Bd. 2, S. 58-73, 2003.
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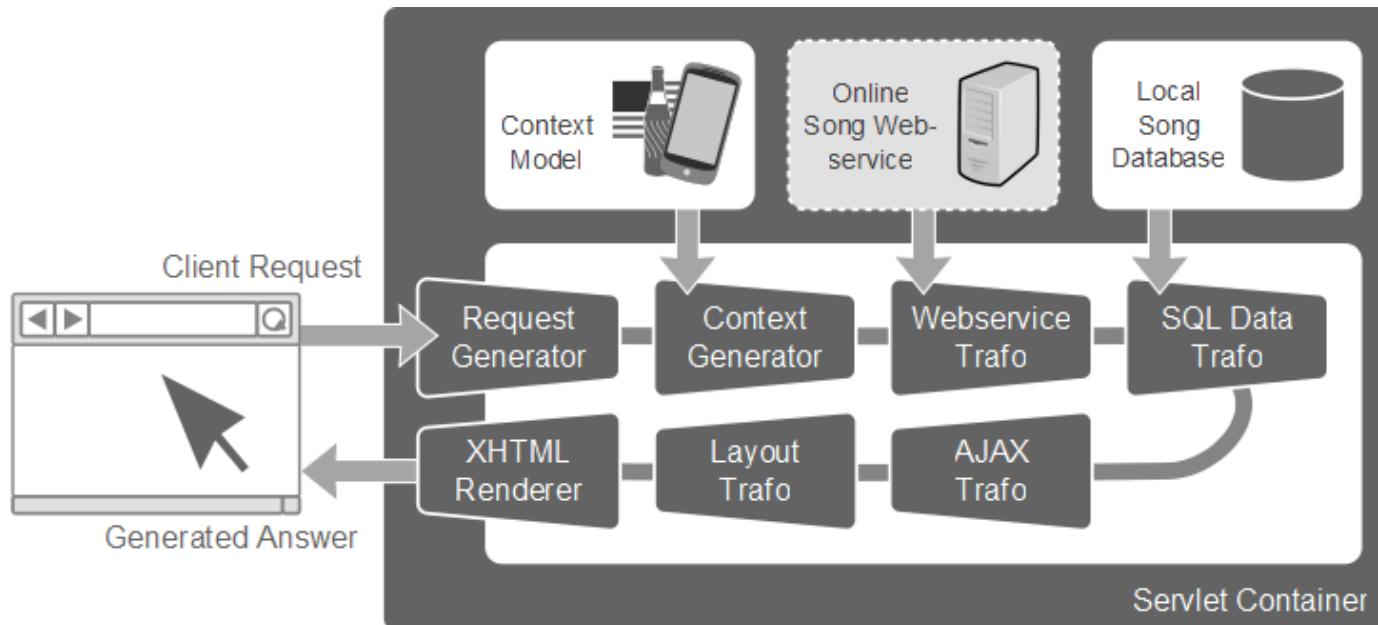


(c) DC Comics

Source: http://dc.wikia.com/wiki/File:Batman_Hyper-Adapter_002.jpg

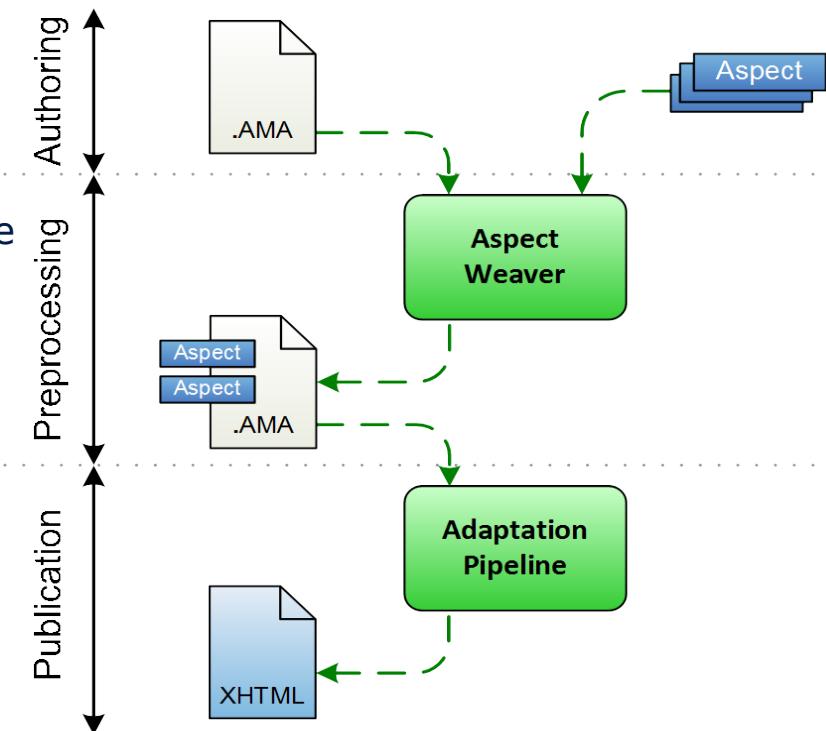
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SoundNexus Pipeline

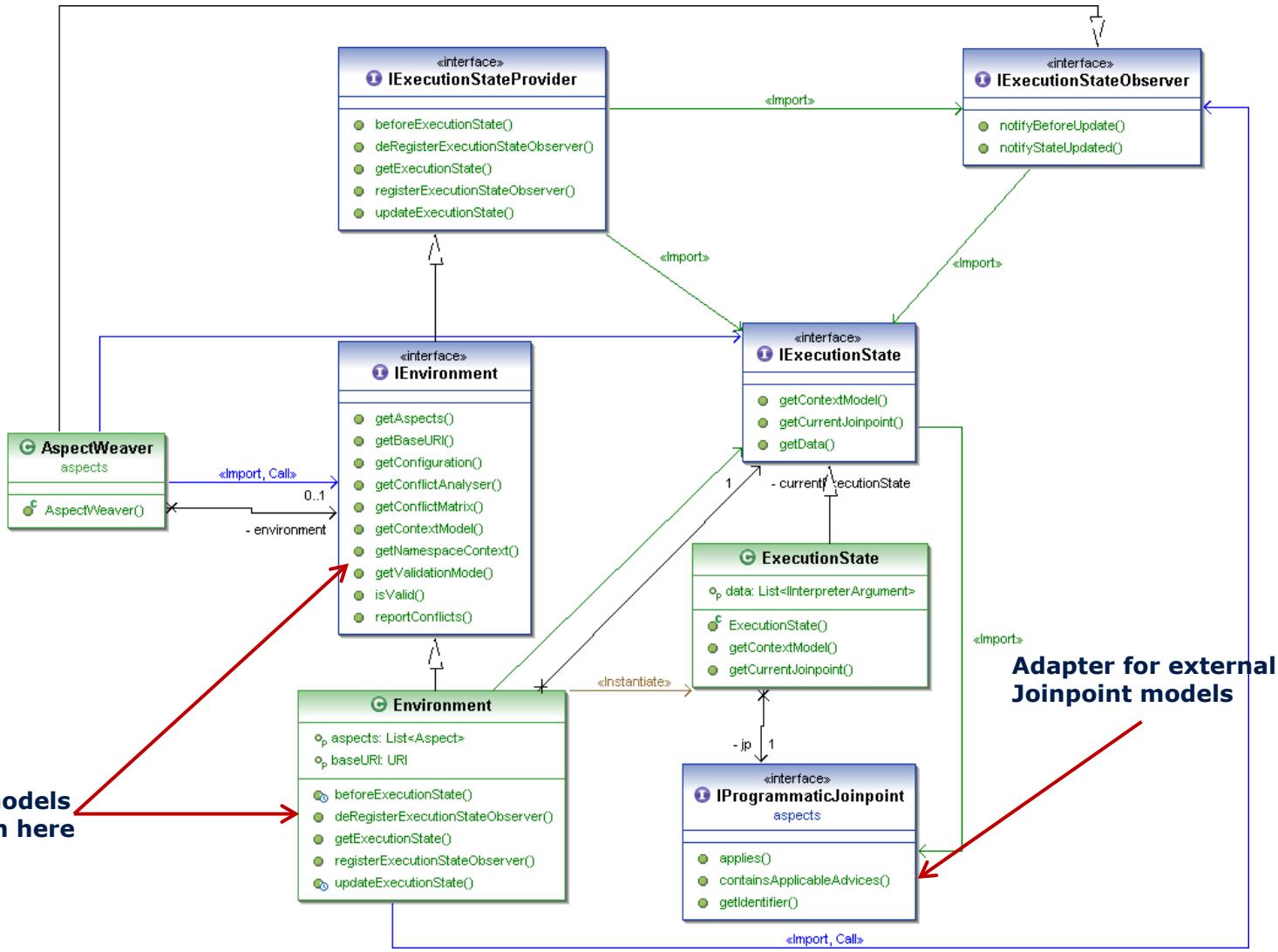


Weaving of Aspects

- ❑ Integration of adaptation aspects into the document
- ❑ Weaving before deployment
 - Single execution
 - Includes variants in the document
 - Interpretation by the AMACONT Pipeline
- ❑ Weaving at runtime
 - Independent of the document lang.
 - Eases conflict detection
 - Additional aspects do not require a re-compilation



Execution Model



05 Related Work

- AspectWebML
- Doxpects
- GAG
- Spring AOP