A Device Independent XML User Agent for Multimedia Terminals

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Outline

- Introduction/ Problem
- Background
  - SMIL / XForms
  - Digital Television
- Overview of the Paper
- Requirements
  - Language Profile
  - UI Compatibility
- XML User Agent Implementation
- Case Study
  - Screenshots
  - Evaluation
- Conclusion & Future Work

Introduction

- ”Interacting in Chaos” (1999, by Olsen):
  - Device chaos: ”variability of future interactive devices”
- “Past, present, and future of user interface tools” (1999, Myers et. al):
  - “We are at the dawn of an era where user interfaces are about to break out the “desktop” box”
- In conclusion
  - Not so long ago, desktop computer the only multimedia platform
  - Today, the number of interactive devices is growing (e.g., mobile phones, digital television receiver)
  - So, Interactive Multimedia Software running on different devices will be a consumer expectation in the near future

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Problem

- Development of Cross-Platform Interactive Multimedia Applications
  - Multimedia Objects: audio, video, images, fonts
  - User Interaction
  - Temporal Dimension (synchronisation of objects)
- Distribution of multimedia applications using higher abstraction languages: XML based
- XML user Agent: Java most interoperable option available
- Still, Java has different APIs depending on the platform: Component Factory is needed

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Background: SMIL and XForms

- XML based languages: easy to write, like HTML
- Recommendations by World Wide Web Consortium

SMIL

- Language intended for multimedia presentations
- Defines spatial dimension of the document (layout)
- Defines temporal dimensions of the document (synchronisation)
- User input included as links
- Does not define media formats, only integrates them

XForms

- Next generation of web forms
- Not intended as a self-standing document type
- Needs of a host language to provide the document layout (e.g., XHTML, SMIL)
- User input includes: text input, select one, select many, submit
- User input can be validated in the client-side

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Background: Platforms

- In this paper, we consider three different platforms:
  - PC: Java 2 Standard Edition (J2SE)
  - Handheld device: Java 2 Micro Edition (J2ME)
    - High End: Connected Device Configuration (CDC) (personal Java) e.g., Nokia Communicator
    - Low End: Connected, Limited Device Configuration (CLDC), mobile phones
  - Digital Television Receivers: (J2ME, CDC)

	PC	Handheld High End	Handheld Low End	DTV Receiver
UI Library	Swing	AWT	MIDP	HAVi
Input	Keyborad, Mouse	Keypad, stylus	Keypad	Remote control
Ouput	1800x1440	240x320	176x192	640x496

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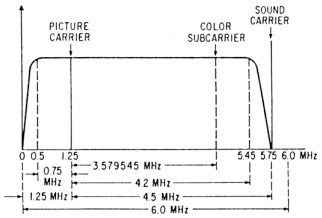
Background: Platforms (DTV)

Analog tv:

1 television program in a 6 or 8 MHz channel

Little choices

Receiver: only Television set



Digital tv:

Audiovisual signal is compressed and transported by digital means (MPEG-2 stream).

Spectrum efficiency. Multiple programs in 6 or 8 MHz.

Interactive Services: VoD, banking, games...

Receiver: TV set + decoder.

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Background: Platforms (DTV)

- Each Broadcaster decides how to use its own bit-rate:
  - Only television programs
  - Only interactive applications
  - Television program(s) plus interactive application(s)
- Flexible quality of video and audio signals
  - 3 Mbps is enough for satisfactory video quality.
- Interactive Applications as value added services
  - Java Xlets and XHTML documents
  - Internet access (e-mail, web, ...)

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Background: Platforms (DTV)

- Standards = Horizontal Market
  - Applications and decoders can be developed by different developers and manufacturers.
- DVB Standards (Digital Video Broadcasting)
  - Specifies the transmission in different mediums: DVB-S (Satellite), DVB-C (Cable), DVB-T (Terrestrial)
- MHP (Multimedia Home Platform)
  - Platform independent middleware between applications and receivers
  - Every DTV receiver include them
  - Defines to languages: DVB-J and DVB-HTML
  - DVB-J includes different packages: Home/Audio Video Interoperability (HAVi) is the GUI library

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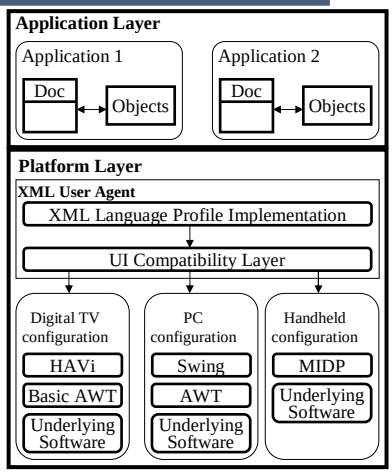
Overview of The Paper

- Application Layer:
  - XML languages used for implementing interactive multimedia applications
- Platform Layer:
  - User Agent supports the language profile
  - UI Compatibility Layer (Component Factory)
  - Specific Device configuration



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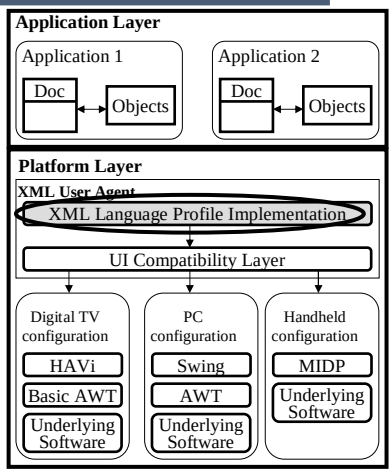
Requirements: Language Profile

- Temporal Dimension
- Spatial Layout
- Multimedia Objects Support
  - Continuous
  - Discrete
- User Interaction
  - Links
  - Validated Entry
  - Submission (server-side)



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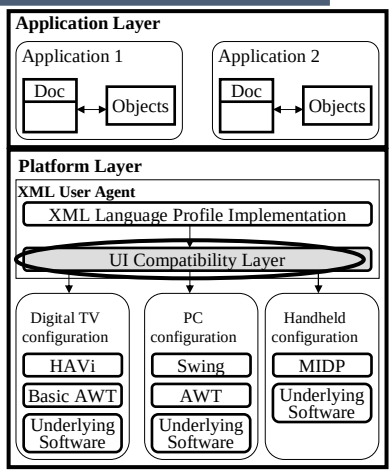
Requirements: UI Compatibility

- Platform uses Java
- Most platform independent option
- The actual APIs for user interface development differ between multimedia terminals:
  - Digital TV: HAVi
  - PC: Swing
  - Handheld: MIDP



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Requirements: Summary (XML Profile)

Temporal Dimension	SMIL
Spatial Layout	SMIL (no flow layout)
Multimedia Object Support	
Continuous Media	SMIL
Discrete Media	SMIL
User Interaction	
Links	SMIL
Validated Entry	XForms
Submission	XFomrs

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Requirements: Summary (Platform)

Different Libraries	Java + UI Compatibility Layer
Different Input Mechanisms	Java + UI Compatibility Layer
Different Output Devices	CSS, XSL transformations, or automated content adaptation
Different Capabilities	CSS, XSL transformations, or automated content adaptation

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Implementation: SMIL

SMIL player divided into three layers:

- Core Logic handles timing, layout, hyperlinks, etc.
  - GUI independent
- Viewer Layer draws the user interface
  - Swing, AWT, HAVi GUI versions
- Media Players play media files
  - text, images have custom players, audio, video by JMF
- SMIL Player also integrated into X-Smiles
  - Download it at: www.xsmiles.org

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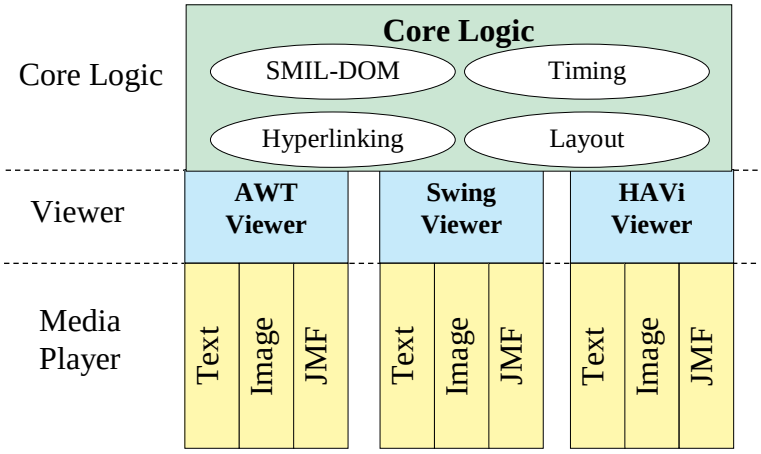
Implementation: SMIL



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Implementation: XForms

XForms engine divided into three layers

- XForms model:
  - XML parsers (Xalan, Xerces), validation and calculation engine
- Meta UI:
  - Implementation of repeating user interface constructs and switching parts dynamically
- User Interface: Implementation of form controls
  - High Level: logic implementation, not aware of the actual details
  - Low Level: actual implementation (using a component factory)
- XForms also integrated into X-Smiles
  - Download it at: www.xsmiles.org

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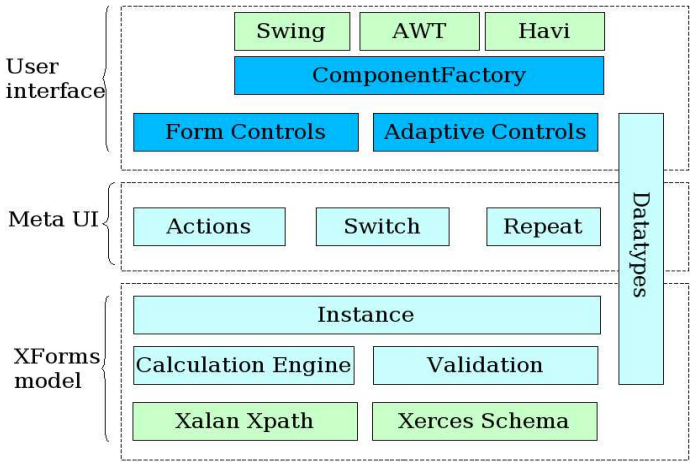
Implementation: XForms



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Implementation: Component Factory

- Generic user interface API
  - Defines abstract widgets (e.g., XInput)
  - Maps those widgets with its actual implementation depending on the device at hand
- Currently three back-ends: AWT (Personal Java), Swing (PC), and HAVi (Digital TV Receiver)
- Benefits:
  - Application is not aware of the specific user interface library in used
  - Developing new back-ends is easy

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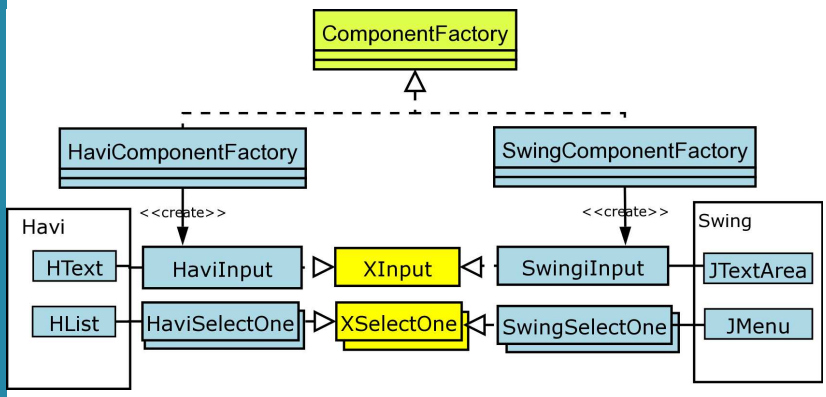
Implementation: Component Factory



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Implementation: Component Factory

XForms Control	AWT Widget	Swing Widget	HAVi Widget
select1 & select	List	JList	HListGroup
trigger	Button	JButton	HTextButton
submit	Button	JButton	HTextButton
label	TextField	JTextField	HStaticText
textarea	TextArea	JTextArea	HText
input + xsd:string	TextField	JTextField	HSingleLineEntry
input + xsd:date	TextField	JCalendar	HSingleLineEntry
input + xsd:boolean	CheckBox	JCheckBox	HToggleButton

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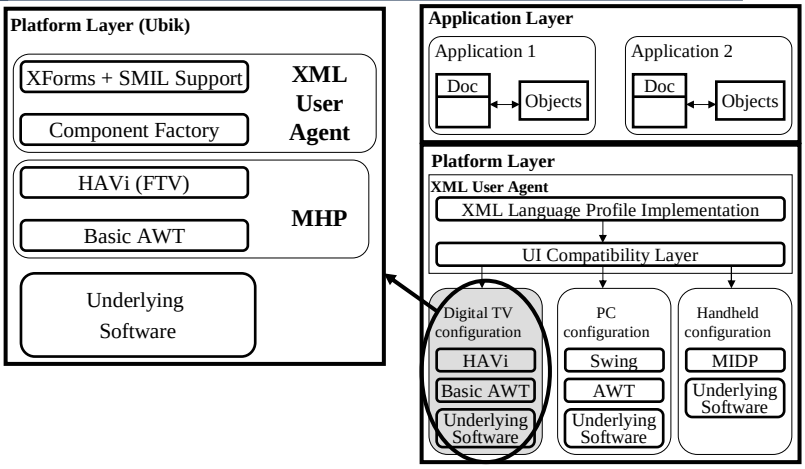
Implementation: Platform - Ubik



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Implementation: Platform - Ubik

- A Linux based prototype system for configurable digital television receivers
- Based on MHP standard, hence it allows us the study of new ideas for interactive television
- Study how different programming languages should be used for different purposes:
  - Native: 3D graphics demanding applications
  - Java: complex services
  - XML: information services + simple multimedia applications

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Implementation: Platform – Ubik (HAVi)

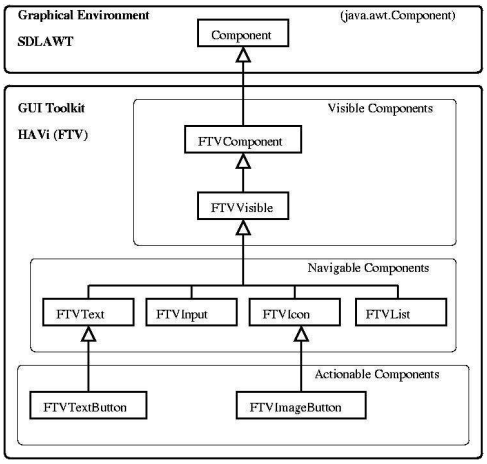
• All widgets are visible, in addition they could be:

  • Navigable: navigated using the remote control

  • Actionable: launch functionality (buttons)

  • Selectionable: selection of an item or set of items (Lists)

•Each widget has associated a Look class (i.e., view)



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Case Study: Distance Education Portal

- Author
  - Non-programmer
  - Very easy to produce the content
- User
  - Student accessing from a remote terminal
- Content
  - Attractive multimedia content
- Synchronisation:
  - Internal: video content of the lectures
  - External: slides changing as the lecturer talks
- User Interaction:
  - Navigation: Normal links
  - Exam: submission and validation controls

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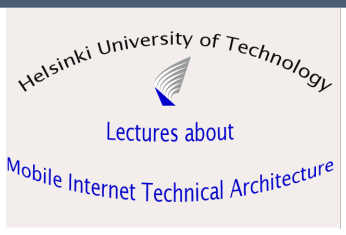
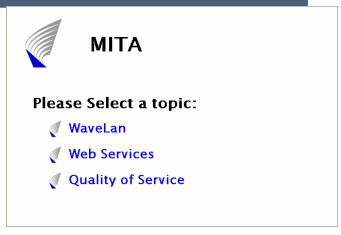
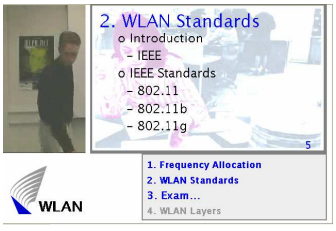
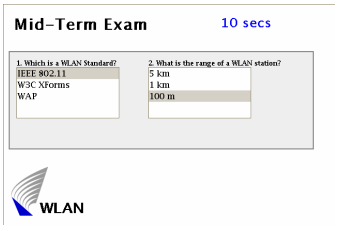
Case Study: Screenshots









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Case Study: Evaluation

- Includes synchronisation mechanism
  - Cannot be achieved using only HTML
- Includes validation and calculation mechanisms of user input
  - Cannot be achieved using only SMIL
- Application completely developed using declarative languages (SMIL+XForms)
  - Easy to author: no scripting is used
  - Quick to author: number of lines for the whole application is around 256

Conclusions

- Device Independent XML based user interface model
  - Presentation (SMIL): separates the synchronisation logic from user interface
  - User Interaction (XForms): separates the widgets from their look and feel
  - Component Factory: cross-platform user interface support
- Case Study shows the benefit of the approach
  - easy and fast to develop interactive multimedia applications
- Ubik Environment: prototype of configurable digital television receivers
  - DTV stream: audio, video, composite graphics (transparencies)
  - 3D Graphics support (OpenGL, Java OpenGL): games, basic 3D applications
  - MHP support: services such as Teletext or Navigator
  - X-smiles: support for XML based languages such as XHTML 2.0, SMIL, XForms
- X-smiles have been ported to commercial device:
  - Nokia communicator as a high end handheld device

Future Work

- SMIL: temporal dimension can be included using Timesheets
  - Similar to CSS, but time
  - Easier to implement
  - Less troublesome
  - Separated time from layout (could use flow layout)
  - Embedded into XHTML
- Some XForms functionality could not be implemented (e.g., switch and repeat)
- In depth study of how the system should react against:
  - Different capabilities (J. V. Ossenbruggen et al.)
  - Different output (J. Smith et al.)
- Study of MIDP (too different from AWT!!)

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Questions

Thank you very much!

Questions ?

Comments ?

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