



Pablo Cesar Doctoral Dissertation Defense, HUT, December 2005
A Graphics Software Architecture for High-End Interactive TV Terminals



A Graphics Software Architecture for High-End Interactive TV Terminals

Pablo Cesar

Helsinki University of Technology

Telecommunications Software and Multimedia Laboratory

pcesar@tml.hut.fi



Outline

- Introduction
- Definitions
- DTV
- Challenges
- Contribution
- Services
- Conclusions

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Introduction (1/2)

- What is this thesis about?
 - About software for digital television receivers
 - About multimedia capabilities in next-generation receivers
 - About visualization of content and interaction
- Why to write it?
 - Bringing multimedia to the mass audience is a challenge
 - As an input to all the standardization efforts
 - New ideas for manufacturers
 - To get a PhD
- How?
 - Work on Otadigi – DTV Broadcast system
 - Development of Ubik – DTV Receiver

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Introduction (2/2)

- Understanding and explaining DTV
 - Understanding DTV and its standards
 - Trying to explain it to the general public
- Extending and filling the gaps of those standards
 - Multimedia capabilities
- Providing a reference implementation
 - How to implement the extensions
 - Showing a number of services that can be provided (more attractive environment)
- Proposing specific graphics architecture
 - To understand current needs of media stations
 - To improve previous proposed architectures

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Definitions (Multimedia)

"Computer mediated applications that integrate and present different media objects, which are arrange spatially and temporally. Moreover, user interaction can control the behavior of the application."

**Multimedia
Objects**

**Visual
Style**

**Temporal
Dimension**

**Spatial
Layout**

**User
Interaction**

Application Logic

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Definitions (Multimedia Objects & Visual Style)

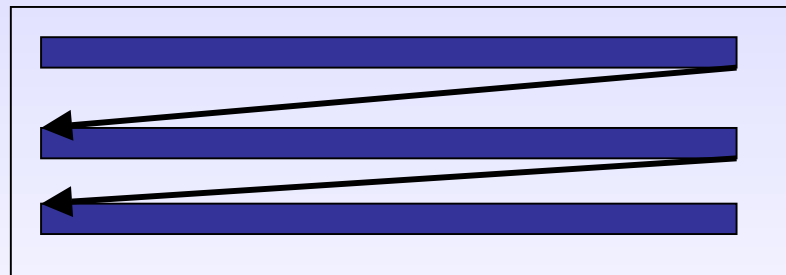
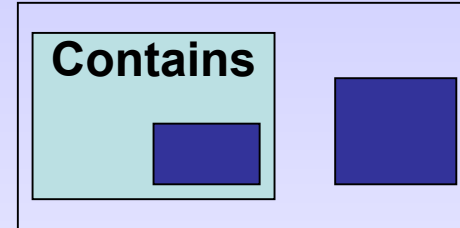
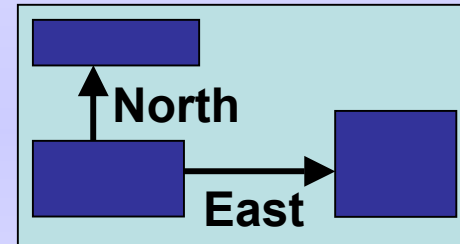
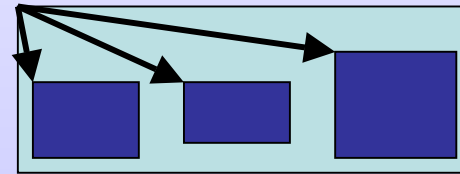
- Discrete Media
 - Icons: Semantic images (e.g., stop symbol). Require the user to have previous knowledge
 - Graphics: Computer generated. Can be 2D or 3D graphics depending on the goal
 - Images: Natural source (e.g., photograph)
 - Text: **Size**, font type, **Color**
- Continuous Media
 - Motion pictures (audio + video)

Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Definitions (Spatial Layout)

- **Absolute**
 - Coordinates relative to origin
- **Directional relations**
 - Define order in space
- **Topological relations**
 - Disjoint, touch, inside of, covered by...
- **Text Flow**
 - One-dimensional flow showed in two-dimensional area

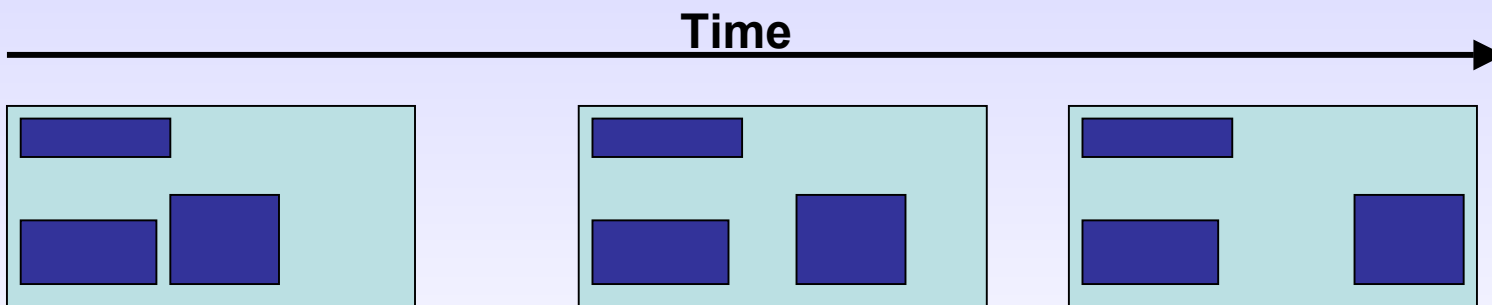


Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Definitions (Temporal Dimension)

- Temporal Models:
 - Definite: For example, 6 seconds
 - Indefinite: For example, when user clicks
 - Parallel and Sequential relations: For example, start these two videos at this moment or start this video after this other one
- Animation:
 - Mixture of temporal dimension and spatial layout (i.e., position of an object changes in time)

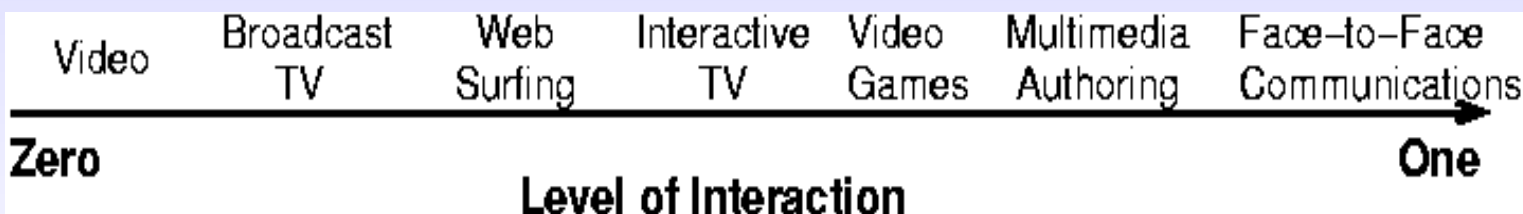


Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Definitions (User Interaction)

- Different Levels of Interaction (Aleem):
 - Passive: Only visualization
 - Reactive: Limited interaction
 - Proactive: Choose a path or make selections
 - Reciprocal: Corresponds to user authoring of information
- Interaction Models (Boll):
 - Navigational: Choice to decide where to go next
 - Design: User can modify the visual style of the presentation (e.g., colors)
 - Movie: User can control the global time (e.g., VCR capabilities)



- Outline
- Introduction
- Definitions
- DTV
- Challenges
- Contribution
- Services
- Conclusions



Definitions (Development Languages 1/2)

- Requirements
 - Supported media types: Audio, video, text, graphics, and animation
 - Arrangement of the signs: Spatial and temporal
 - Interaction: Passive, reactive, proactive, and reciprocal
 - Difficulty to use (threshold)
 - Expressional power (i.e., ceiling)
 - Safety of distribution
 - Interoperability
- Development Languages
 - Compiled languages: Normally, used for system software (e.g., operating system) and resource demanding services
 - VM languages: A Virtual Machine is an abstraction of the computing environment (e.g., Java)
 - XML-based Languages: Only what has to be done, not how

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Definitions (Development Languages 2/2)

- Outline
- Introduction
- Definitions
- DTV
- Challenges
- Contribution
- Services
- Conclusions

	Threshold	Ceiling	Interoperability	Safety of Distribution
Compiled Languages	+++	+++	+	+
VM Languages	++	++	++	++
XML-based Languages	+	+	+++	+++

Compiled

Not so safe to distribute, only for native applications

VM

In DTV world is called Procedural Environment

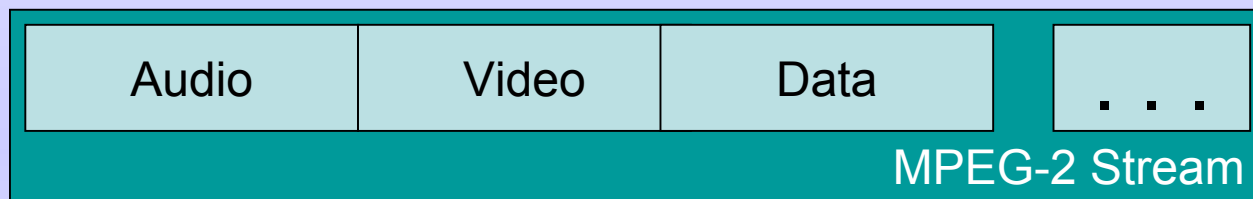
XML-based

In DTV world is called Declarative Environment



DTV (What is it?)

- Audiovisual signal is compressed and transported by digital means



- Spectrum efficiency:
 - That's what we say when we can fit more channels in the same bandwidth
- Each broadcaster decides how to use its own bit-rate:
 - Only television programs
 - Only interactive applications
 - Television program(s) plus interactive application(s)
- Interactive applications as value added services
 - Java applications (procedural)
 - XHTML documents (declarative)

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



DTV (Requirements)

Infrastructure

- Home
 - Receive TV: Antenna
 - Watch TV: TV set
 - Tune to channel: Digital Set-top Box
- Broadcast
 - A/V stream: MPEG-2 encoder
 - Data Stream: Object Carousel
 - Transmission: Multiplexer, Modulator, Transmitter, Antenna

Smooth Transition

- Horizontal-Market: Standards agreed by major player
- Easiness of use: usability considerations
- Price
- Viewer Expectations
 - A/V: Better quality
 - Content: More channels
 - Services: Extra services
- Receiver
 - A/V Support
 - Application Support
 - Return Channel

Outline

Introduction

Definitions

DTV

Challenges

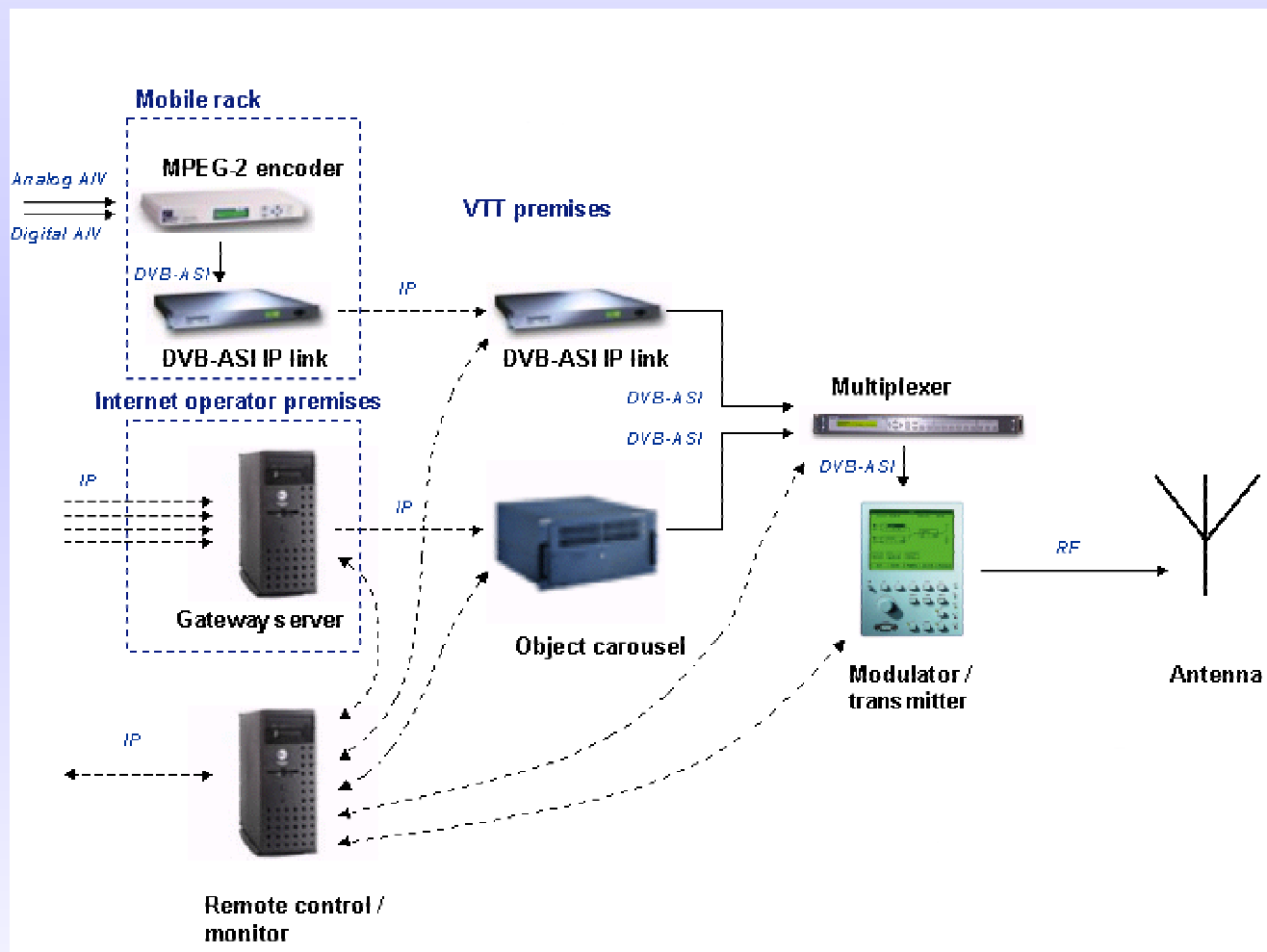
Contribution

Services

Conclusions



DTV (Broadcast Chain)



- Outline
- Introduction
- Definitions
- DTV
- Challenges
- Contribution
- Services
- Conclusions



DTV (Standards)

- Standards = Horizontal-Market
 - Applications and decoders can be developed by different developers and manufacturers
 - Freedom to choose and interoperability assurance
- DVB Standards (Digital Video Broadcasting)
 - DVB is the European initiative in Digital Television field
 - Specifies the transmission in different mediums: DVB-S (Satellite), DVB-C (Cable), DVB-T (Terrestrial)
- MHP (Multimedia Home Platform)
 - Procedural environment (DVB-J) is a set of Java APIs
 - Declarative environment (DVB-HTML) is an XML-based solution

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Challenges

- Low market penetration
 - Viewer expectations:
 - More channels
 - Entertainment services
 - Price
- Smooth Transition
 - Interoperable Standards
 - Profiling
 - Different profiles depending on user needs
 - Evolution profiles, so the providers and consumers go step by step
- Worldwide Solutions (GEM)
 - Development of applications by any country
 - That is one of the reasons of Internet success

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Contribution (Profiles 1/3)

Broadcast: Basic

- Requirements:
 - Television usage: sit on the sofa and watch the favorite show at a given time
 - Catch majority of the population
- Proposed profile:
 - Audio Visual Content Digitized
 - Examples: DVB-T/C/S (Europe), ISDB (Japan), ATSC (USA)

Broadcast: Enhanced

- Requirements:
 - Interactive applications with internal logic
 - Procedural environment: Java
- Proposed profile:
 - DVB-J (as part of GEM, worldwide accepted version of MHP 1.0)

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Contribution (Profiles 2/3)

Interactive: Basic

- Requirements:
 - Browse simple XML documents
 - Limited navigation
 - Images, text
- Proposed profile:
 - XHTML Basic + CSS

Interactive: Internet Access

- Requirements
 - Browse XML Compound Documents (complex)
 - Interactive
 - Temporal Synchronization
 - Video and audio
- Proposed profile:
 - XML Compound Documents (SMIL + XForms)

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Contribution (Profiles 3/3)



Interactive: High-End

- Requirements
 - Integration of all kinds of multimedia objects
 - Temporal Dimension
- Proposed profile:
 - DVB-J + OpenGL
Java Wrappers
 - JMF media player
(all kind of formats)

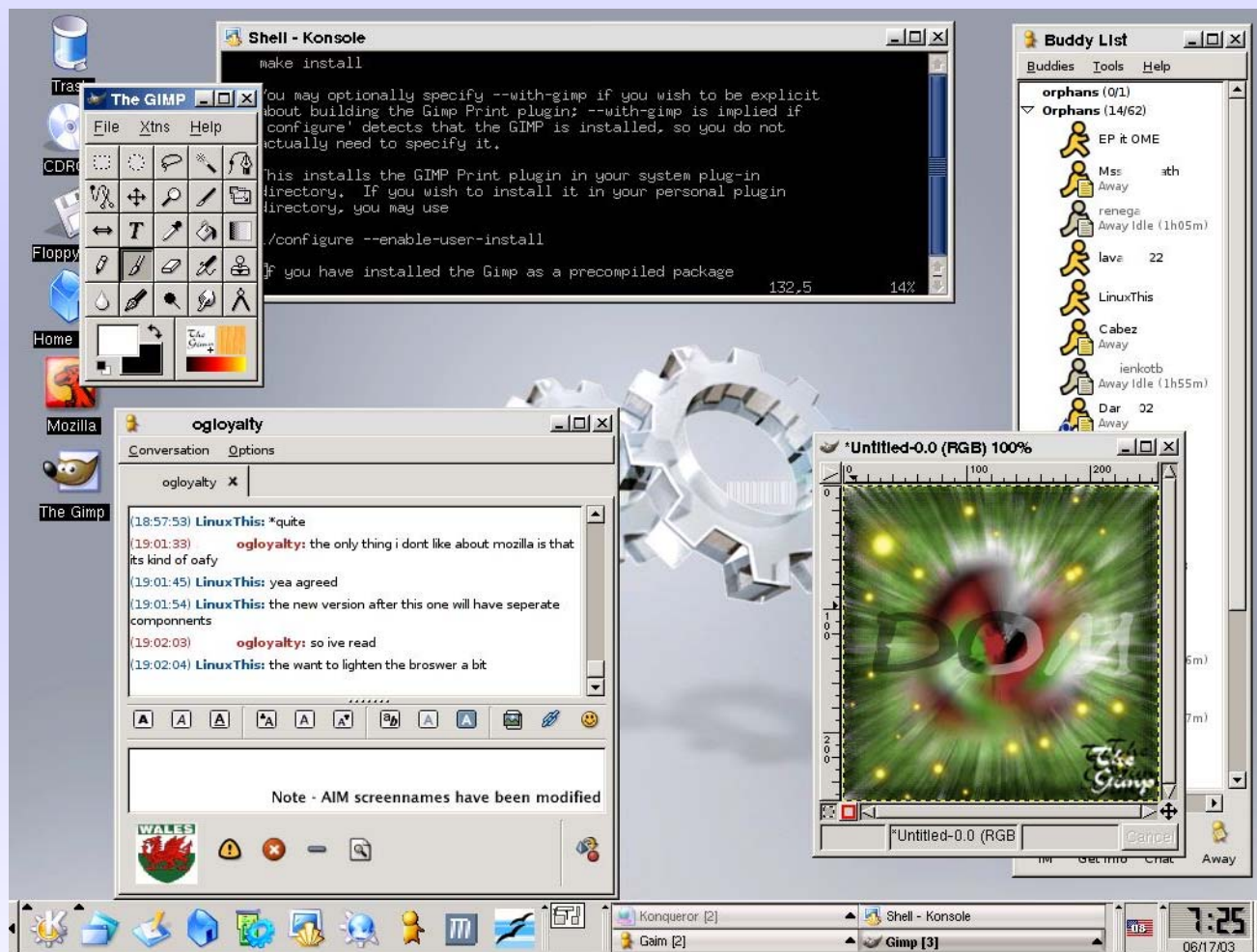
Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Pablo Cesar Doctoral Dissertation Defense, HUT, December 2005
A Graphics Software Architecture for High-End Interactive TV Terminals



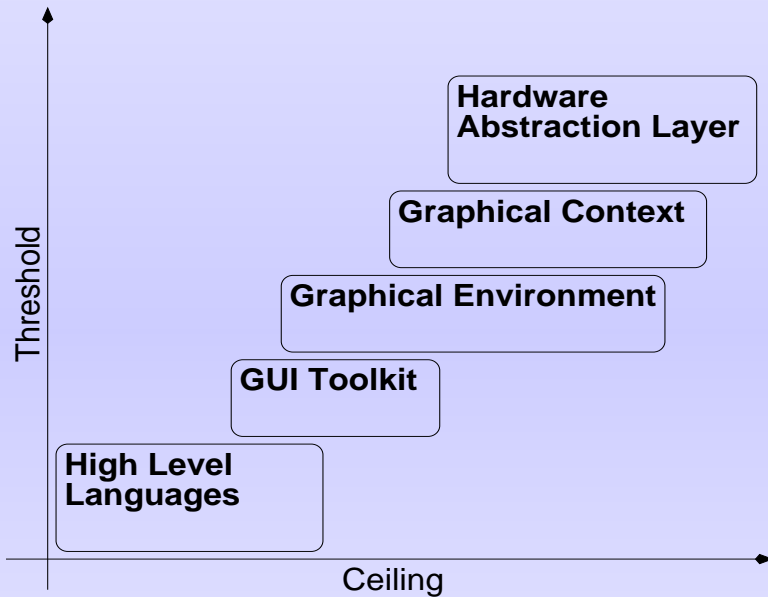
Contribution (Graphics Architecture 1/2)



Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Contribution (Graphics Architecture 2/2)



- Lack of pointing device
- One task at the time
- Screen composed of multimedia objects
- Seamless integration of video, 2D and 3D objects
- A layered architecture, so developers can implement at any level

- HAL: renders the final graphics output
- Graphical Context: cross-platform abstraction of the rendering region
- Graphical Environment: means to control different contexts
- GUI Toolkit: "ready-made" user interface widgets
- HLL: to develop simple services

Outline

Introduction

Definitions

DTV

Challenges

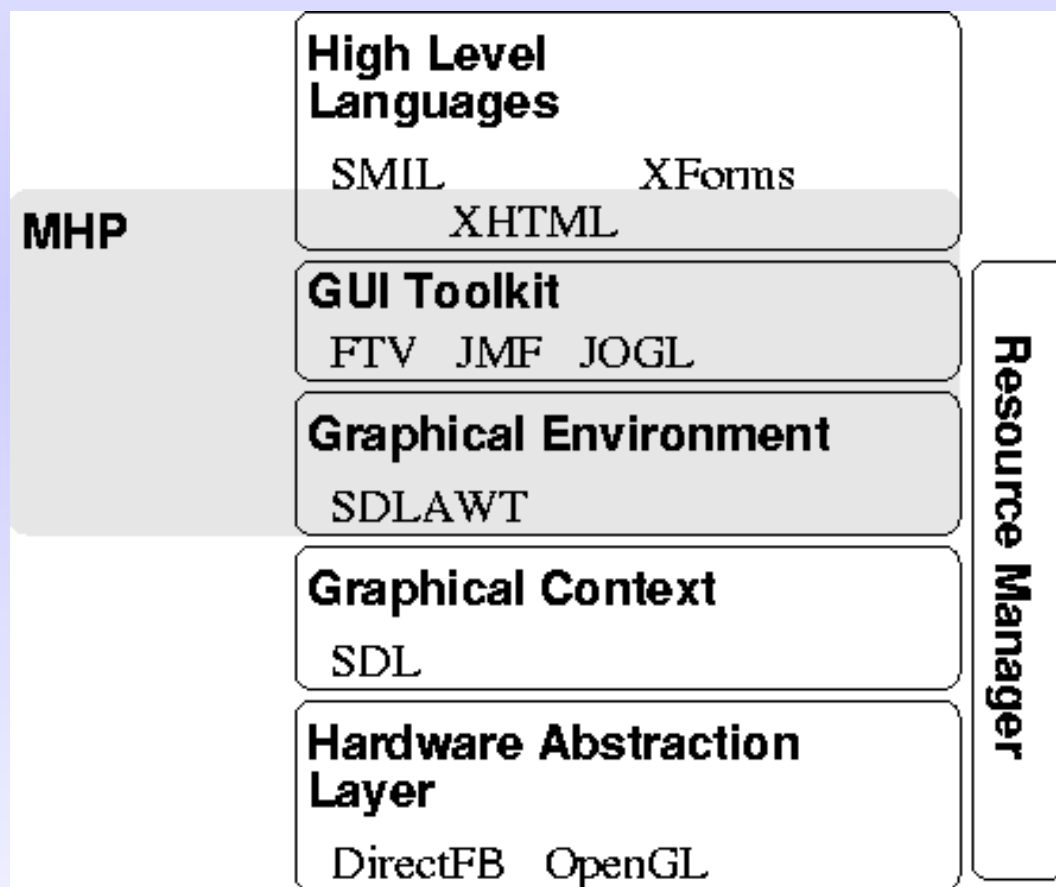
Contribution

Services

Conclusions



Contribution (Implementation)



Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions

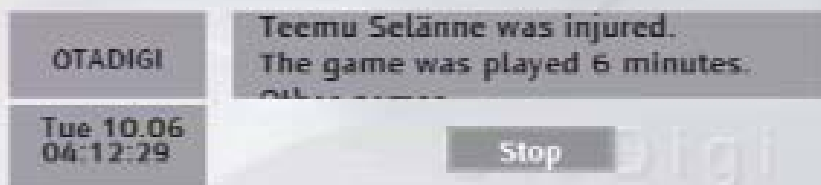
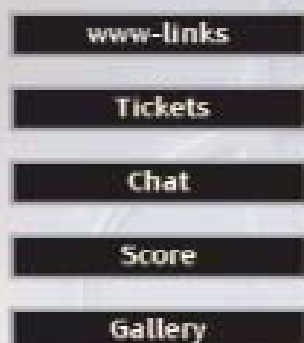


Services (Otadigi 1/3)

Simple Application



Navigator



- Outline
- Introduction
- Definitions
- DTV
- Challenges
- Contribution
- Services
- Conclusions



Services (Otadigi 2/3)

Red Cross Service



Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Services (Otadigi 3/3)

SMIL Player

Enhanced TV



Super Teletext



Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Services (Ubik 1/3)

Example native 3D Graphics

- Some games downloaded from a portal

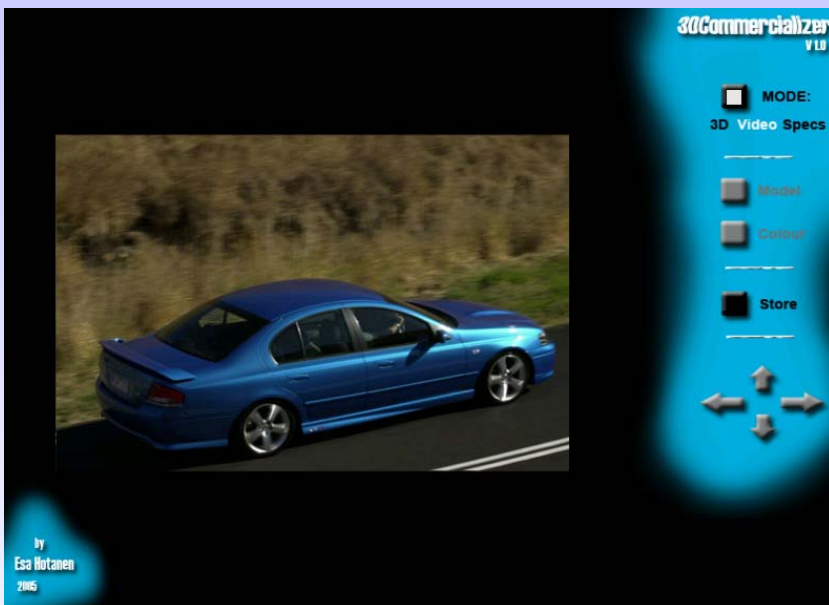


Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions



Services (Ubik 2/3)

- Example Java 3D Commercial
 - Car
 - Interactive



Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Pablo Cesar Doctoral Dissertation Defense, HUT, December 2005

A Graphics Software Architecture for High-End Interactive TV Terminals



Services (Ubik 3/3)

Example of Super Teletext

Super Teletext

MAIN INDEX

- News
- Weather
- TV Guide
- Finance
- Shopping
- Documentaries
- Travel
- Film

YLE: 18:00 - 21:30
European Cities, Helsinki

● GOTO ● BACK ● HOME ● HELP

file:/home/pcesar/src/xsmiles/demo/smil/demo_lecture/w

Frequency allocation

1. Frequency Allocation
2. WLAN Standards
3. Exam...
4. WLAN Layers

Example of E-Learning application

Outline

Introduction

Definitions

DTV

Challenges

Contribution

Services

Conclusions



Conclusions

- This thesis tries to understand the situation in Digital Television environment and to explain it
- This thesis tries to improve current standardization activities and provides a reference implementation (services, how-to tutorial)
- This thesis proposes a graphics architecture for media stations

Thanks!

Questions, Comments? Discussion

Outline
Introduction
Definitions
DTV
Challenges
Contribution
Services
Conclusions