Digital Television based on the MPEG-2 Standard
Overview

- MPEG-2
- Digital TV
- DVB
- PSI tables structure
- Digital TV Distribution System
- The MHP system
MPEG History

• Moving Picture Experts Group was founded in January 1988 by Leonardo Chiariglione together with around 15 experts in compression technology.
• Creator of numerous standards like MPEG-1, MPEG-2, MPEG-4, MPEG-7, MPEG-21 etc.
• The Group has not limited its scope to only “pictures” – sound wasn’t forgot (e.g. MPEG-1 Layer3).
• Because almost all of their work is a success story, the industry adopted fast the MPEG standard (Philips, Samsung, Intel, Sony etc).
• MPEG has given birth to a number of technologies we take now for granted: DVD and Digital TV (MPEG-2), MP3 (MPEG-1 L3).
MPEG-2

- In 1994, MPEG has published the ISO/IEC-13818, also known as MPEG-2
- MPEG-2 was the standard adopted by DVD (Digital Video Disk or Digital Versatile Disk) and Digital TV
- It is designed for video compression between 1.5 and 15 Mbps
- MPEG-2 streams come in 2 forms: Program Stream and Transport Stream
Digital TV

- Why use Digital TV instead of Analog TV?
  - ease of transcoding (changing the same perceptual content by decreasing quality, but with great gains in bitrate)
  - ease of storing data for future use and reprocessing
  - no quality loss (digitized information does not "change" in time)
  - ability to supply more services (like MHP, EPG etc)
  - better and more flexible protection system in commercial TV (encoded channels)

- It has been discovered that there are more television sets than telephones in the world – huge market

- The video and audio information is digitized and compressed using the MPEG compression standard (source coding)

- There are presently three international standards for digital television
  - Digital Video Broadcasting (DVB)
  - Advanced Television Systems Committee (ATSC)
  - Integrated Services Digital Broadcasting (ISDB)
Digital TV Standards Adoption Map

Digital Standards - Worldwide 2000

- DVB-S
- DVB-S, DVB-C
- DVB-S, DVB-C and DVB-T
- DVB-S, DVB-C, DSS - Hughes standardized digital satellite system, OpenCable - Digital cable standard by US Cablelabs, ATSC DTV
Model for MPEG-2 Systems
MPEG-2 Program Stream

- Similar to MPEG-1 Systems Multiplex
- Combines one or more Packetised Elementary Streams (PES), which have a common time-base, into a single stream
- Designed for use in relatively error-free environments and suitable for applications which may involve software processing
- Program stream packets may be of variable and relatively great length
MPEG-2 Transport Stream

- Combines one or more Packetised Elementary Streams (PES) with one or more independent time bases into a single stream (sometimes called multiplex)
- Elementary streams sharing a common time-base form a program
- Designed for use in environments where errors are likely, such as storage or transmission in lossy or noisy media
- The transport stream is made of packets with fixed length of 188 bytes
Packets are identified by PID’s

PID= Packet IDentifier, for video, audio and other data: Example: satellite transmission parameters

- Number of QPSK symbols/sec
- Error correction rate
- Program identification number
- Video PID
- Audio PID
The Transport Stream Packet
DVB

- DVB Project is an industry-led consortium of over 300 companies
- The DVB Project was launched on 10\textsuperscript{th} September, 1993
- In 1995 it was basically finished and became operational
- There are several sub-standards of the DVB standard
  - DVB-S (Satellite) – using QPSK – 40 Mb/s
  - DVB-T (Terrestrial) – using QAM – 50 Mb/s
  - DVB-C (Cable) – using OFDM – 24 Mb/s
- These three sub-standards basically differ only in the specifications to the physical representation, modulation, transmission and reception of the signal
About DVB Standard

• DVB uses the MPEG-2 Transport Stream to carry it’s data

• DVB has added some features in the MPEG-2 standard (the MPEG standard had a door open for future additions to the standard)

• Can deliver to the home almost anything that can be digitized:
  – High Definition Television (HDTV)
  – Standard Definition Television (PAL / NTSC, SECAM)
  – New broadband multimedia data and interactive services

• Several tables have been added to the MPEG-2 Transport Stream specifications (CAT, EIT etc)
The MPEG-2/DVB Multiplex

- A multiplex is a bouquet of PIDs containing several channels (television, radio, data etc), basically is a collection of programs.
- This bouquet contains several types of information (audio data, video data) and a Program Specific Information (PSI) section made of tables containing the description of the contents.
- Based on the PSI, the decoders can select the correct PIDs of the desired program in order to decode them.
- All the programs present in the multiplex have different PIDs for their data (audio, video, pcr, subtitle, teletext etc).
DVB Service Information

- DVB-SI provides information to enable automatic configuration of the receiver to demultiplex and decode the various streams of programs within the multiplex
- Program Specific Information (PSI)
  - Program Association Table (PAT): for each service in the multiplex, the PAT indicates the location (the PID values of the TS packets) of the corresponding PMT. It also gives the location of the NIT
  - Conditional Access Table (CAT): provides information on the CA systems used in the multiplex; the information is private and dependent on the CA system
  - Program Map Table (PMT): identifies and indicates the locations of the streams that make up each service, and the location of the Program Clock Reference fields for a service
  - Network Information Table (NIT): provides information about the physical network
- Additional Service Information
  - Bouquet Association Table (BAT): provides information regarding bouquets
  - Service Description Table (SDT): describes the services in the system e.g. names of services, the service provider, etc
  - Event Information Table (EIT): contains data concerning events or programs such as event name, start time, duration, etc
  - Running Status Table (RST): gives the status of an event (running / not running)
  - Other tables: TDT, TOT, ST, SIT, DIT
MPEG-2/DVB PID Allocation

- PAT always has PID = 0 (zero)
- CAT always has PID = 1
- EIT always has PID = 18
- The PMTs have the PIDs specified in the PAT
- The audio, video, PCR, subtitle, teletext etc PIDs for all programs are specified in their respective PMT

<table>
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<tr>
<th>Table</th>
<th>PID value</th>
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<td>PAT</td>
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<tr>
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<tr>
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<td>0x0002</td>
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<td>0x0003 to 0x000F</td>
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<td>NIT, ST</td>
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<td>SDT, BAT, ST</td>
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<td>EIT, ST</td>
<td>0x0012</td>
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<tr>
<td>RST, ST</td>
<td>0x0013</td>
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<tr>
<td>TDT, TOT, ST</td>
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<td>0x0015</td>
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<tr>
<td>reserved for future use</td>
<td>0x0016 to 0x001B</td>
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<tr>
<td>DIT</td>
<td>0x001E</td>
</tr>
<tr>
<td>SIT</td>
<td>0x001F</td>
</tr>
</tbody>
</table>
MPEG-2/DVB PSI Structure

Program Map Table For Programme 1

Stream 1  |  PCR  |  31
Stream 2  |  Video 1 |  54
Stream 3  |  Audio 1 |  48
Stream 4  |  Audio 2 |  49
Stream k  |  Data k  |  66

Table section id always set to 0x02

Program Association Table (always PID 0)

Program 0  |  PID = 16
Program 1  |  PID = 22
Program 2  |  PID = 33
Program K  |  PID = 55

Program Map Table For Programme 2

Stream 1  |  PCR  |  41
Stream 2  |  Video 1 |  19
Stream 3  |  Audio 1 |  81
Stream 4  |  Audio 2 |  82
Stream k  |  Data k  |  88

Table section id always set to 0x00

Multi-Program MPEG-2 Transport Stream

CA Section 1 (programme 1)  |  EMM PID (99)
CA Section 2 (programme 2)  |  EMM PID (100)
CA Section 3 (programme 3)  |  EMM PID (119)
CA Section k (programme k)  |  EMM PID k

Table section id always set to 0x01

Conditional Access Table (always PID 1)

Private Section 1  |  NIT info
Private Section 2  |  NIT info
Private Section 3  |  NIT info
Private Section k  |  NIT info

Table section id assigned by system

Network Information Table
always programme 0
NIT is considered private
data by ISO
DVB Subtitles

- Are carried in PES (themselves being carried in TS)
- Timing of presentation is the PTS of the PES (present in the PES header)
- Information is transmitted in graphical format
- Pixel depths of 2, 4 and 8 bits are supported
- Color information is organized in Color Look-Up Tables (CLUT)
- Subtitles are present in a sequence of pages that are going to be overlayed on the associated video image
- A subtitle page contains one or more regions (rectangular areas with specified sets of attributes: position, width, height, depth etc)
- Several regions can be used at the same time (i.e. one region in the bottom of the screen displaying the subtitle, another in one somewhere else on the screen displaying some logo)
- There are different events
  - page update (when only the changed regions from previous page are present)
  - page refresh (when all the data needed to display the page is present)
The Packetised Elementary Stream Packet
PAT Structure

table_id (= 0x00)
section_syntax_indicator
marker_bit
reserved (2 bits)
section_length
transport_stream_id
reserved (2 bits)
version_number
current_next_indicator
section_number
last_section_number

program_number
reserved (3 bits)

network_PID

program_number = 0 ?

no

yes

TS_program_map_table_PID

finished?

no

yes

CRC_32

stuffing_bytes_to_end_of_TS_packet
CAT Structure

table_id (= 0x01)
section_syntax_indicator
marker_bit
reserved (2 bits)
section_length
reserved (18 bits)
version_number
current_next_indicator
section_number
last_section_number

descriptor_tag (=9)
descriptor_length
CA_system_ID
reserved (3 bits)
CA_PID
private_data_bytes

crc_32

finished?
no

CRC_32

yes

stuffing_bytes_to_end_of_TS_packet
PMT Structure

table_id (= 0x02)
section_syntax_indicator
marker_bit '0'
reserved_bits (2 bits)
section_length
program_number
reserved_bits (2 bits)
version_number
current_next_indicator
section_number (=0)
last_section_number (=0)
reserved_bits (3 bits)
PCR_PID
reserved_bits (4 bits)
program_info_length
program_descriptors()

stream_type
reserved (3 bits)
elementary_PID
reserved (3 bits)
ES_info_length
ES_descriptors()

finished? yes

CRC_32

stuffing_bytes_to_end_of_TS_packet
What is MHP
• FOR MULTIMEDIA ORIGINATING FROM DIGITAL TELEVISION
APPLICATION DEVELOPMENT PLATFORM IS MHP – MULTIMEDIA HOME PLATFORM DEVELOPED BY EUROPEAN DVB ORGANISATION
IT WAS ACCEPTED FOR NORDIC COUNTRIES IN MARCH 2001
DVB in the home

DVB – Digital Video Broadcasting, covers digital TV delivery by S - satellite, C- cable and T- terrestrial plus networking

DVB-S

DVB-MS

DVB-MC

DVB-C

DVB-T

Integrated Receiver-Decoder (IRD)

SDTV / EDTV / HDTV

B-ISDN, ASDL, PSTN, GSM

DVD

DVC

PC

INTERACTIVE
The Uses of DVB - a Scenario

- Satellite
- Cable / (S)MATV
- Terrestrial Reception

Integrated Receiver Decoder (IRD)

Multichannel Microwave Distribution System (MMDS)

TV Receiver

 Multimedia PC

B-ISDN, ADSL etc.

Interactivity

Broadcast

DVD etc.

DVC etc.
Convergence of Application Domains

- **TV**
  - EPG
  - PPV
  - Home Shopping
  - e-mail

- **WWW**
  - (limited graphics)
  - (enhanced features)

- **Interactive Multimedia Home Services**
  - Video Conferencing
  - Internet Telephony

- **PC**
  - with DVB Decoder
  - Full Internet Access (ftp, WWW, e-mail, ..)
  - Audio on Demand
  - Internet Telephony

- **Interactivity**
  - TV with increasing processing

- **Broadcast**
  - Internet Telephony
  - PPV
  - Home Shopping

- **1998**
- **1999**
- **2000**
- **2001**
• The Multimedia Home Platform consists of a user terminal including all possible low- to high-functionality implementations, its associated peripherals, and the in-home digital network.
• The MHP solution encompasses the whole set of technologies necessary to implement the MHP including protocols, common languages (API), interfaces, and recommendations.
• The MHP supports several levels of interactive services / applications. These are defined as:
  – Enhanced broadcasting (including local interactivity)
  – Interactive broadcasting (using a return channel)
  – Internet access
The Scope of MHP

- Independent developers
- Different service providers
- Various application areas

Applications

Generic SW Interface (API)

- Independent implementations
- Different hardware
- Different software
- All kind of terminals (low-end STB / high-end PC)

MHP Terminals
Objectives for Standardization

- To deliver bridging between
  - hardware and software worlds
  - consumer and computer worlds
  - existing and future business environment
- thus providing an evolution
  - from today’s fragmented vertical markets
  - to future unfragmented horizontal markets
Some of the key MHP requirements

- User friendly
  Affordability, appropriate lifetime, interoperability
  Designed for all, improving the user experience, customisation
  Protecting privacy e.g. no unauthorized access to personal data or parental control signaling

- Market friendly
  Open standards, Stable, reliable, evolutionary, compatible with CA-systems, Compatible with copy management and content protection
  Performing at least as well as proprietary solutions and supporting migration

- Innovation friendly
  Interactivity, secure transactional services
  Internet links and / or full access

- Regulation friendly
  National or international
  e.g. Respect of power consumption strategies
Application Oriented Requirements

• Enhanced Broadcasting with local interactivity benchmark applications
  • built-in navigator
  • EPG
• Interactive Services using a return channel
• Internet Access
MHP System Definition

- **Equipment** (hardware, software)
  - home terminal / receiver
    - set top box, integrated TV set, multimedia PC
  - local cluster
    - peripherals, in-home digital network

- **Services / applications** (content)
  - enhanced broadcasting with local interactivity
  - interactive services using a return channel
  - internet access
• An Application Programming Interface (API) is used in a terminal device to implement certain functionalities that allow hardware-independent development of content and applications. It allows differentiation in terms of the capabilities of the end user platform.

• The Navigator is the basic user-interface of a terminal device used in the enhanced broadcasting mode. It is defined by the manufacturer of the terminal device. Each MHP provides a Navigator.

• The Electronic Program Guide (EPG) is the higher-level consumer navigation device in the enhanced broadcasting mode. It is an application which can be provided by different parties and may be delivered via the broadcast channel.
MHP is more than APIs

*Important other elements:*

- **Security**
  - operation
  - content,
  - user data, transactions etc.
- **Local Cluster**
- **Copy Management & Protection**
  - levels, signalling
  - operational model
- **Conformance & Interoperability Testing**
- **Migration**
Multimedia Infrastructure & Value Chain

vertical markets

e.g. d-box
e.g. Canal+

horizontal market

content / applications

services / programmes

conditional access

networks / transport

Multimedia Home Platform MHP

API

CA
Today’s “Horizontal” Markets

Service Provider 1
Appl. 1  Appl. 2  Appl. 3  ...
API 1
Platform 1

Service Provider 2
Appl. 4  Appl. 5  Appl. 6  ...
API 2
Platform 2

Service Provider 3
Appl. 7  Appl. 8  Appl. 9  ...
API 3
Platform 3

API: Application Program Interface
Future “Horizontal” Markets

Service Provider 1
Appl. 1  Appl. 2  Appl. 3  ...  

Service Provider 2
Appl. 4  Appl. 5  Appl. 6  ...  

Internet
Appl. a  ...  Appl. z

Implementations on different HW Platforms (Low-Cost STB to High-End PC) "Horizontal Markets"
A horizontal Market for Free und Pay TV

Competition in all layers of value chain

Applications & Content

Programmes & Services

Conditional Access

Networks / Transport

Receivers / Terminals

MHP Market Model

Vertical businesses in a horizontal market
Typical MHP Applications

- Electronic program guides
- “Super Teletext”
- Applications synchronised to TV content
- Games
- E-commerce
- Interactive advertising
- Internet access
Examples for MHP applications

- Electronic Program Guides
- Information Services
- E-Commerce
  Secure Transactions
- Synchronised to TV Content
Example of a MHP-based Electronic Program Guide
Young at Heart
Kirsty to join Trevor in dream team

2. Girl band in sexy drama!
3. EastEnders Robbie gets back at Barry
5. Friend's star gets a new haircut
6. X-files pets are stranger than fiction
ZDF.vision EPG
Application Synchronised to TV Content
Golf Game
Interactive Advertising

- Upon entering enhanced content, video scales.

- While viewing, audio/video continue to be available.
- Select a product. Learn more about it.

Easy navigation using scroll bar to select product from range

- Make a purchase decision
And complete the transaction!
Top of the Pops
Airport Information System

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Airport Information System
Commercial Requirements
Commercial Requirements Overview

Generic Requirements

Application Based Requirements

- Enhanced Broadcasting
- Interactive Broadcasting
- Internet Access
- Conformance & Interoperability Testing
- Security Model
- Local Cluster
- Copy Management & Protection

Other
Key Generic Requirements

- interoperability
- evolution, scalability, backwards compatibility
- modularity, stability
- migration path
- based on open standards
- upgradability / downloadability
- controlled development path
- simplified and cost controlled operation
  bandwidth efficient format: separation of data from applications
- generic API separated from CA
Technical Specification

IMPORTANT!
MHP Specification Overview

• MHP1.0 formally accepted by ETSI
  – Enhanced Broadcasting
  – Interactive Broadcasting

• MHP1.1
  – Internet Access

• Based on DVB-Java

• HTML / XML
  – optional for Enhanced & Interactive Broadcasting
  – part of Internet Access profile

• Existing (legacy) APIs to be handled as plug-ins
Specification Elements (1)

- MHP architecture
- Detailed profile definition
- Enhanced and interactive broadcasting
- Content formats
  - Including PNG, JPEG, MPEG-2 Video/Audio, subtitles and resident and downloadable fonts
- Mandatory transport protocols
  - Including DSM-CC object carousel (broadcast)
  - And IP (return channel),
MHP Architecture (1)
MHP Architecture (2)

Middleware

Operating System

Drivers

Applications

CA

Cond. Access separated from API

Appl. 1 e.g. EPG

Appl. 2 e.g. Game

Appl. 3 e.g. Home-shopping

Appl. n
Reference Model of the MHP

The architecture of the MHP is described by 3 layers:

- **Hardware and Software Resources**
- **System Software**
- **API**

Interoperable Application 1
Interoperable Application 2
Interoperable Application 3
Interop. Application Library
Possible Control Application
MHP Profiles

Enhanced Broadcast
- "HTML" subset
- Plug-in
- Broadcast Transport Protocols: DVB OC
- APIs
- Java VM

Interactive Broadcast
- "HTML" subset
- Option
- Interactive Transport Protocols: IP
- API extensions for interactivity

Internet Access
- HTML, ECMA script, DOM, CSS, ...
- Broadcast Transport Protocols: IP
- Java APIs for Internet access

*) optional element, MHP 1.1
Specification Elements (2)

• Application model and signalling
• Hooks for HTML content formats
• DVB-J platform
DVB defined APIs and selected parts from existing Java APIs, JavaTV, HAVi and DAVIC
• Security framework
broadcast application or data authentication return channel encryption (TLS)
• Graphics reference model
• Annexes
DSM-CC OC profile, text presentation, minimum platform capabilities, various APIs
MHP based on a DVB Java Platform

- Control Application (Navigator)
- Interoperable Java Applications
  - MHP API
    - "Core" Java APIs
    - "Digital TV" Java APIs
    - Others?
- Java Virtual Machine
- System Software (Operating System, Drivers, Firmware etc.)
- Hardware-Ressources
DVB-J Platform

Interoperable Application (and libraries)

Interoperable Application

Data

Application Manager (Navigator)
Transport Protocol(s)

Sun Java APIs
HAVi APIs
DAVIC APIs
DVB specific APIs

Java Virtual Machine

System Software

OS, drivers, firmware, ..
DVB-J Platform with Plug-ins

Interoperable Java Applications (and libraries)

Legacy Appl. A

Plug-in A

Legacy Appl. B

MHP API

Platform specific plug-in

"Interoperable" plug-in

Plug-in interface

Application Manager (Navigator)

Transport Protocol(s)

Sun Java APIs

DVB specific APIs

...

Java Virtual Machine

OS, drivers, firmware, ...
Lifecycle DVB-J
Application Signalling

- Application Signalling
  - Extension to DVB-SI
  - Dedicated tables (AIT, VST)
Security Framework

Broadcast

Certification Authority

Publish Root Certificate

Manufacturer

Store Root Certificate

Authenticated Applications

MHP

Interactive

Certificates

Broadcaster

Encrypted Communication

Server

MHP

?
MHP EVOLUTION
Next Steps in DVB
Technical Extensions

Building on MHP 1.1, add the following ...
The Internet is leveling the playing field

Content Producer

Content Distributor

Broadcaster

Service Provider

IP Network Operator

MPEG2 Network Operator

“More Content is more King?”
Content Flow in a Broadband World

- Content Producers
- Content Distributors
- Broadcasters
- Service Providers
- IP Network Operators
- MPEG2 Network Operators
- Consumer
- Consumer
- Consumer
- Consumer
MHP Market Model Evolution
Vertical businesses in a horizontal market

All competing for consumers
Multimedia Home Platform

- DVB pioneering phase resulted in several proprietary APIs associated to proprietary CA systems
- DVB-MHP is building the IRD of the future
  - a platform for convergence
  - overcoming market fragmentation
MHP
From Infrastructure to Infostructure

Content & Services
Enhanced Broadc. Interactive Serv. Internet Access

Home Terminal
Set Top Box, TV, PC

Local Cluster

In-home Network

Peripherals

CA

Network A

Network B

API

Consumer

Infostructure

Infrastructure
DVB-J Platform with Plug-ins

- Application Manager (Navigator)
- System Software (OS, drivers, firmware, ...)
- Java Virtual Machine
- Transform Protocol(s)
- "Core" Java APIs
- "Digital TV" Java APIs
- Interoperable Java Applications (and libraries)
- Legacy Appl. A
- Legacy Appl. B
- Plug-in A
- Plug-in B
- "MHP API"
- Platform specific plug-in
- "Interoperable" plug-in
- Plug-in Interface
DVB MHP’s Application Areas & Profiles

Enhanced Broadcast 1

- Java VM
- DVB-J APIs
- Broadcast Transport Protocols: DVB OC
- "HTML" subset *)
- Plug-in

Interactive Broadcast 1

- DVB-J extensions for interactivity
- Interactive Transport Protocols: IP
- "HTML" subset *) Option

Internet Access 1

- DVB-J APIs for Internet access
- Broadcast Transport Protocols: IP
- DVB MHP HTML: XHTML, ECMA script, DOM, CSS, ...

*) optional element

EB: local interactivity
IB: return channel
User Interface Development (1)

- MHP uses the standard 'java.awt' package
  - Based on lightweight components & JDK 1.1.x event model.
  - No "classical" UI widgets - too text based for TV

- Extensions :-
  - org.dvb.ui.DVBColor provides transparency (e.g. seeing through graphics to video)
  - org.dvb.ui.DVBTextLayoutManager allows simple display of formatted text
User Interface Development (2)

• Your application can get its first & top level UI container in 2 ways.
  – javax.tv.graphics.TVContainer.getRootContainer()
    • Returns an invisible {0,0} size container
    • Applications have to size & position the container by hand and test the results to see what happens.
  – Methods on org.havi.ui.HSceneFactory
    • Allow applications to be more expressive about what they really want than getRootContainer().

• No requirement for a windowing system
User Interface Development (3)

• The org.havi.ui package
  – Widget sets.
    • Graphic based not text based like the ones in java.awt
    • HNavigable.setFocusTraversal() allows applications to describe a focus navigation map (up/down/left/right)
  – Device framework
    • HScreenDevice & sub-classes allow applications to access a model of the graphics, video & background devices in a system
  – Extra key codes for remote controls
    • org.havi.ui.event.HRcEvent extends awt.event.KeyEvent
User Interface Development (3)

- Several different ways of approaching this in your applications.
  - Draw everything using awt.Graphics primitives
  - Define your own lightweight components extending java.awt.Component.
    - Can implement org.havi.ui.HNavigable for extended navigation
  - Use the HAVi widget set
    - Can define your own appearance if you need.

- Start this early in your process
  - Test it on TVs & with TV remote controls very early
Controlling Video & Audio (1)

• Applications can do basic control of video and audio with the Java Media Framework.
  – Based on JMF 1.0
  – Uses 'dvb:' URLs to select what to show

• Applications can obtain running JMF players.
  – Needed for applications running as part of a TV service to get access to already running a/v.
  – See javax.tv.service.selection.ServiceMediaHandler
Controlling Video and Audio (2)

- MHP provides a number of extra JMF controls
  - For video scaling...
    - javax.tv.media.AWTVideoSizeControl (simple)
    - Org.dvb.media.BackgroundVideoPresentationControl (flexible)
    - Platforms aren't required to support unlimited video scaling
  - Control and monitoring of subtitles, service components
  - Fine control over audio playback from memory
    - org.davic.media.MediaTimePositionControl
  - Notification of changes in incoming TV signals
    - video size, aspect ratio, ...
Synchronising Apps. To Video

• DSMCC stream events
  – These need to be injected by the broadcaster.
  – Can fire immediately or at a specific time
  – Applications can listen for them with these APIs
    • org.dvb.dsmcc.DSMCCStreamEvent.subscribe()
    • org.davic.media.StreamEventControl.subscribeStreamEvent()

• Other possible solutions
  – org.davic.media.MediaTimeEventControl
  – Using org.davic.mpeg.sections as described above
Electronic Programme Guides

(1)

- Access to broadcast service information
  - DVB-SI API - org.dvb.si
    - Gives access to all the low level detail of DVB-SI for those who know how to use that.
  - JavaTV SI API - javax.tv.service, javax.tv.service.guide
    - A high level abstract view

- Many broadcast networks don't follow the DVB-SI specification very well or very completely.
  - You really need to know what you're doing here.
Electronic Programme Guides (2)

- Previewing a TV service
  - Using JMF, an EPG can preview a TV service without starting any associated applications.

- Really selecting a TV service (incl. applications)
  - Use
    - javax.tv.service.selection.ServiceContext.select()
  - Can obtain service contexts from ServiceContextFactory
  - Calling select() on your ServiceContext may kill you!

- If your EPG needs to run on a group of services
Security & Signed Applications

• Does your application need to be signed & authenticated?
  – Many MHP features need applications to be signed & for the signature to be authenticated.
  – Use of the return channel (i.e. modem)
    • Make connection, specify phone number to dial, read current phone number settings, ...
  – Tuning & service selection

• MHP uses Java 2 fine grained security model.
Non-Broadcast Networks

- Uses 'java.net' for access to "normal" IP based networks (e.g. internet or private network)
  - Called 'return channel' or 'interaction channel' in DVB
- For a secure channel over to a server ...
  - use JSSE as an API to SSL (equiv to an 'https' URL).
- For control of the return channel, use org.dvb.net.rc
  - Allows monitoring of connection state (e.g. phone call interrupted)
  - Allows specifying your own phone number
Application Environment

- MHP services can include multiple applications
  - Your application may need to execute at the same time as other applications in that service (e.g. an EPG).
- Many MHP APIs support resource negotiation
  - Apps implement org.davic.resources.resourceClient
- Apps can use org.dvb.event to request access to specific user input events
  - Also notification when you have it and when you don't.
- Your application needs to think about this
  - Otherwise you may have problems selling your app!