Seminar: Multimedia Coding and Transmission

Digital TV

Ifi, UiO
Norsk Regnesentral
Vårsemester 2005
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Digital Television

This part of the course ...

- ... is prepared by
  - Wolfgang Leister
- … with contributions from
  - Tore Solvar Karlsen
  - Anders Kluge
  - Lars Aarhus
  - Thorstein Lunde
- … uses material from MHP (Georg Luettke)
- … and DVB, … and ...

Digital Television

Preview

Digital Television

- Television Technology
- Roles in todays and future TV
- Interactive TV technology
- Standards for digital TV
- DVB, MHP, ...
- Bandwidth and program manyfold
- Digital TV and interaction
- New opportunities with Digital TV

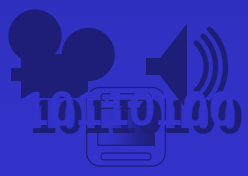
Television

Digital Television

- Paul Nipkow (1884)
- A.A. Campbell Swinton (1911): CRT
- von Ardenne, Zworykin, Schoenberg, Bartholemy
- Broadcast: 1936 Berlin Olympics
- Different standards: lines: 240, 405 (Gr.Br.), 441 (Germany), 455 (France), 340 (New York), …
- 1941: 525-line 60 frames/sec (America)
- 1952: 625-line 50 frames/sec (Europe)

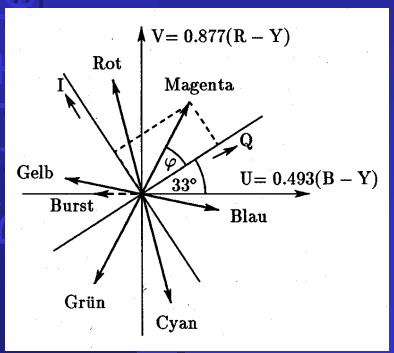
Colour Television

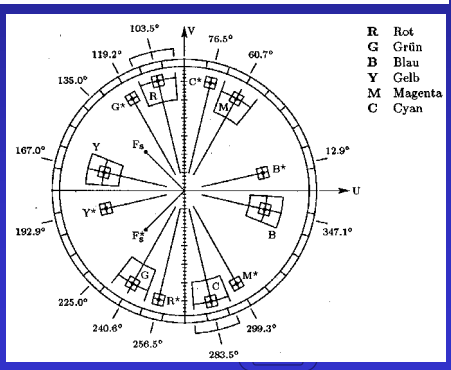
- 1953 RCA and Hazeltine labs ↑ NTSC
- 1961 Henri de France ↑ SECAM
  Sequentiel Couleur à Memoire
- 1961 Dr Walter Bruch ↑ PAL
  Phase Alternation by Line



Colour Television

$$
\begin{array}{lcrcrcr}
Y & = & & & 0.299 \cdot R & +0.587 \cdot G & +0.114 \cdot B \\
U & = & 0.493 \cdot (B-Y) & = & -0.15 \cdot R & -0.29 \cdot G & +0.44 \cdot B \\
V & = & 0.877 \cdot (R-Y) & = & 0.61 \cdot R & -0.52 \cdot G & -0.097 \cdot B
\end{array}
$$

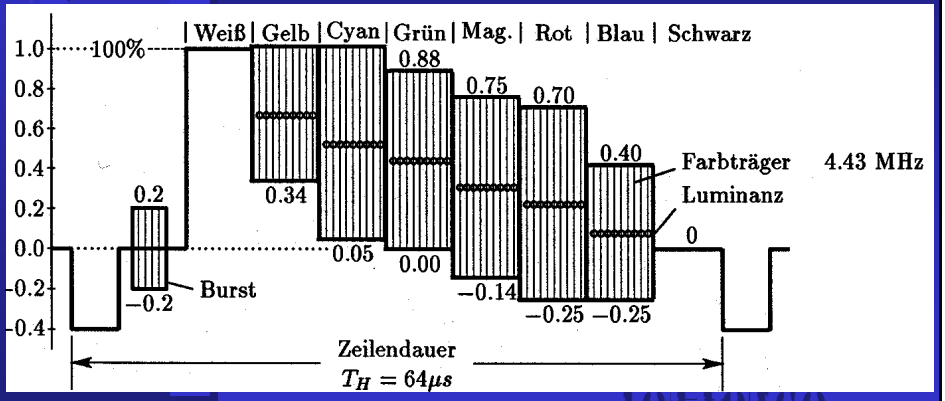




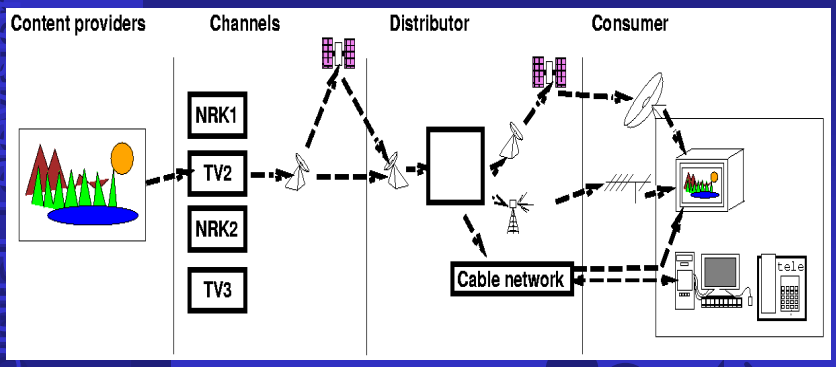
Colour Television

- PAL
- SECAM
- NTSC
- U,V components, (Q,I components NTSC)
- ampl. modulation 90°, 4.43 MHz
- FBAS signal

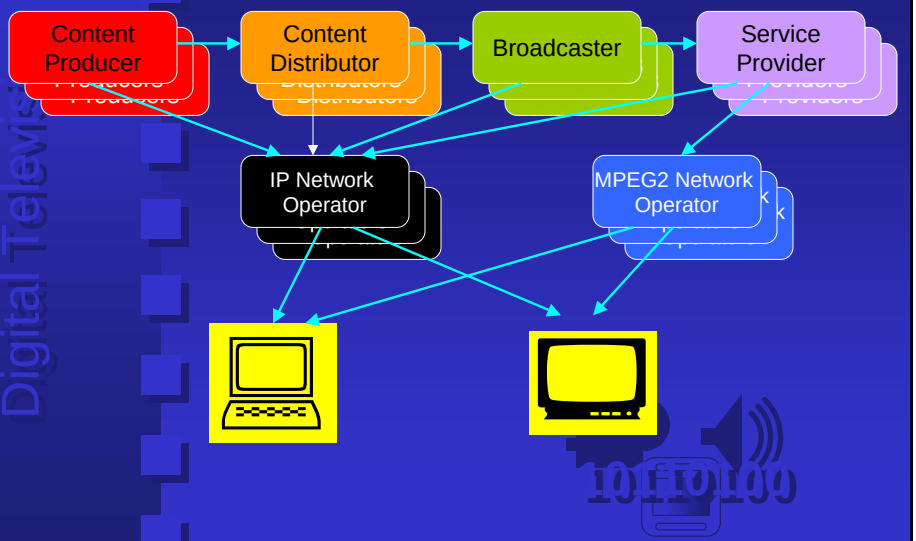
Colour Television



Roles



Multi Channel



Digital Television

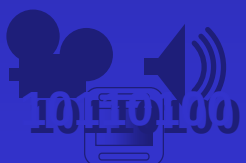
Set-top boxes (STB)

- *Analogue broadcast*: 1st generation, one-to-many, without return channel; e.g., decoder for cable TV or satellite
- *Analogue interactive*: hybride, data services and return channel, e.g., WebTV
- *Digital broadcast*: 2nd generation, digital compression and transfer, e.g., satellite decoder
- *Digital interactive*: 3rd generation, future solution, “everything” is digital, return channel; e.g., DVB MHP

Digital Television

DVB

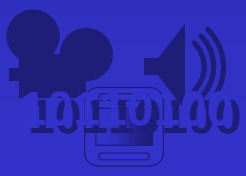
- Digital Video Broadcasting Project
- industry-led consortium of over 300 broadcasters, manufacturers, network operators, software developers, regulatory bodies and others in over 35 countries
- commited to design global standards for the delivery of digital television and data services.
- http://www.dvb.org



DVB Standards

Digital Television

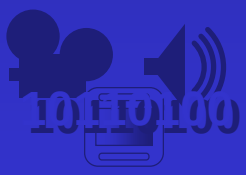
- Audio
- Conditional Access
- Interactivity
- Interfacing
- Measurement
- MHP
- Multiplexing
- Sub-titling
- Transmission
- Cookbook



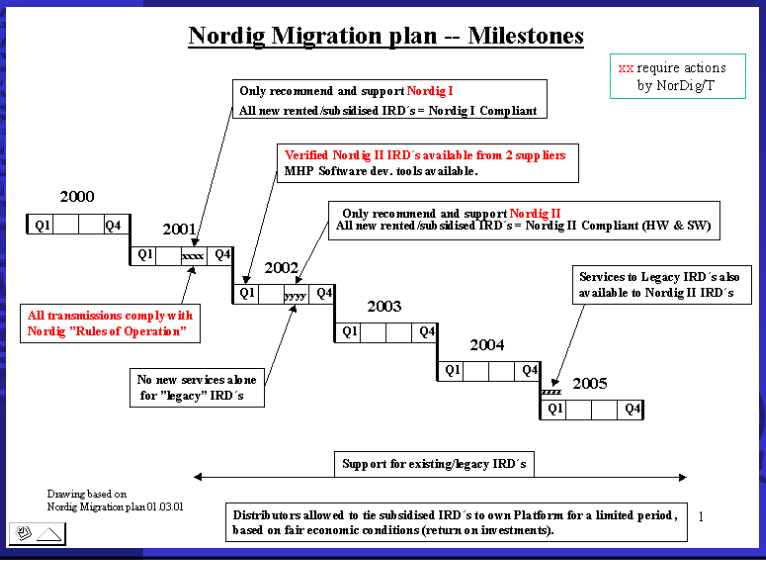
NorDig

Digital Television

- NorDig is specifying a common platform for Digital Television to be used within the Nordic region (Denmark, Finland, Island, Norway and Sweden).
- NorDig follows DVB
- + nordic specifications
- http://www.svt.se/nordig/

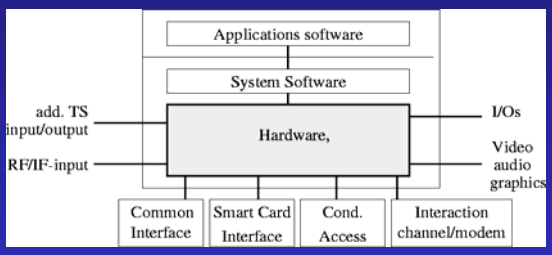


NorDig Migration Plan



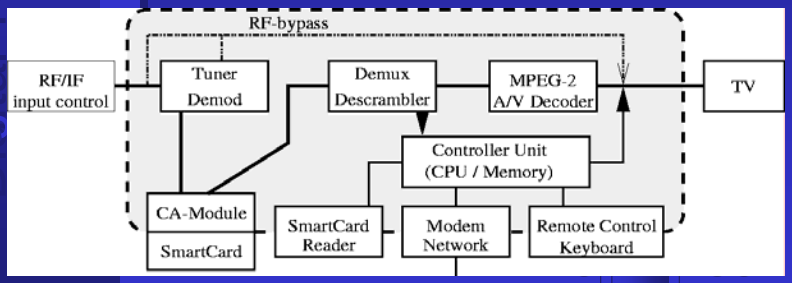
Set Top Box

- Set top box
- API
- CA system
- Operating system
- Networking connection



Digital TV Hardware

- Specified by DVB (Digital Video Board)
- Set top box



Digital Television

Multiplexing

- DVB DATA
- DVB MPEG
- DVB SI
- DVB TXT
- DVB VBI

Digital Television

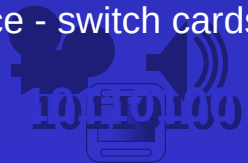
Transmission

• DVB-C	Cable
• DVB-DSNG	Digital Satellite News GAthering
• DVB-MC	MMDS
• DVB-MS	MVDS
• DVB-MT	OFDM (digital terrestrial television)
• DVB-S	Satellite
• DVB-SFN	Single Frequency Network
• DVB-SMATV	Satellite Master Antenna TV
• DVB-T	Terrestrial
• DVB-H	Handheld

Digital Television

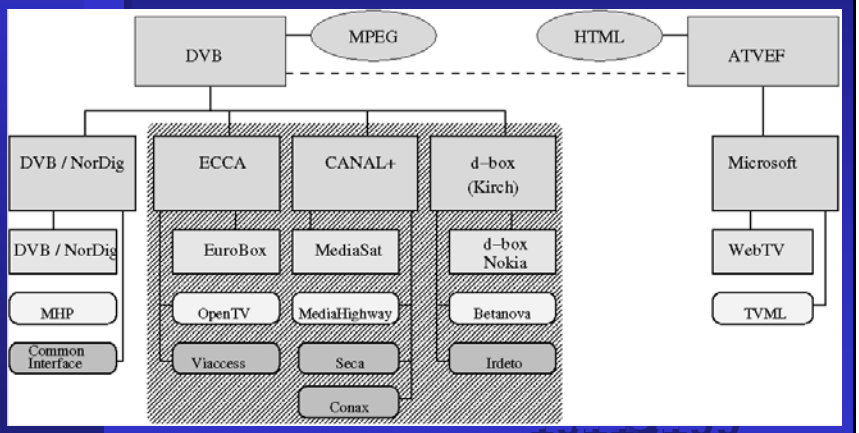
Conditional Access (CA)

- DVB CA package (available from ETSI)
- DVB Common Scrambling Algorithm (CSA)
- only partially defined by DVB
- CA Interoperability Scenarios:
  - SimulCrypt (one stream - several CA systems)
  - MultiCrypt (Common Interface - switch cards)



Digital Television

Standards, API, and CA



Actors

EuroBox (ECCA)

- Example for a set top box
- Remote Control Unit

DTV Platforms

- proprietary APIs
- associated to proprietary CA systems
- operating systems

API Systems	MediaHighway OpenTV MHEG-5 BetaNova .....
Applications	

A / V Coding	
Programmes	MPEG-2

MEDIA HIGHWAY

B-HTML

MHEG-5

JavaTV

opentv

WinCE

ATVEF

BetaNova

DTV Platforms

- Access to system functionality:
  - GUI, graphics, EPG, interaction
  - network access
  - stream objects, MPEG
  - conditional access, security
  - system functions (file, clock, hardware access)
- Examples: Java, JavaTV, OpenTV, MediaHighway, TVML, SMIL, MHEG, ...

DVB Standardisation

- Infrastructure / Transport
  - Broadcast Transmission (satellite, cable, terrestrial, ...)
  - Service Information SI
  - Return channels for interactive services
- Middleware
  - Multimedia Home Platform, including ***API***

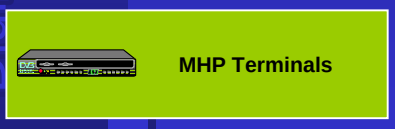
MHP

- MHP = API for digital TV, defined by DVB
- MHP1.0 formally accepted by ETSI
  - Enhanced Broadcasting
  - Interactive Broadcasting
- MHP1.1 (spring 2001)
  - Internet Access
- Based on DVB-Java
- HTML / XML
  - Enhanced & Interactive Broadcasting (optional)
  - part of Internet Access profile
- Existing (legacy) APIs to be handled as plug-ins

The Scope of MHP

- **Independent developers**
- **Different service providers**
- **Various application areas**

Generic SW Interface (API)

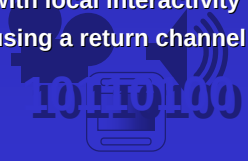


- **Independent implementations**
- **Different hardware**
- **Different software**
- **All kind of terminals (low-end STB / high-end PC)**

Digital Television

MHP System Definition

- **Equipment (hardware, software)**
  - **home terminal / receiver**
    set top box, integrated TV set, multimedia PC, PDA
  - **local cluster**
    peripherals, in-home digital network (smart house)
- **Services / applications (content)**
  - **enhanced broadcasting** **with local interactivity**
  - **interactive services** **using a return channel**
  - **internet access**

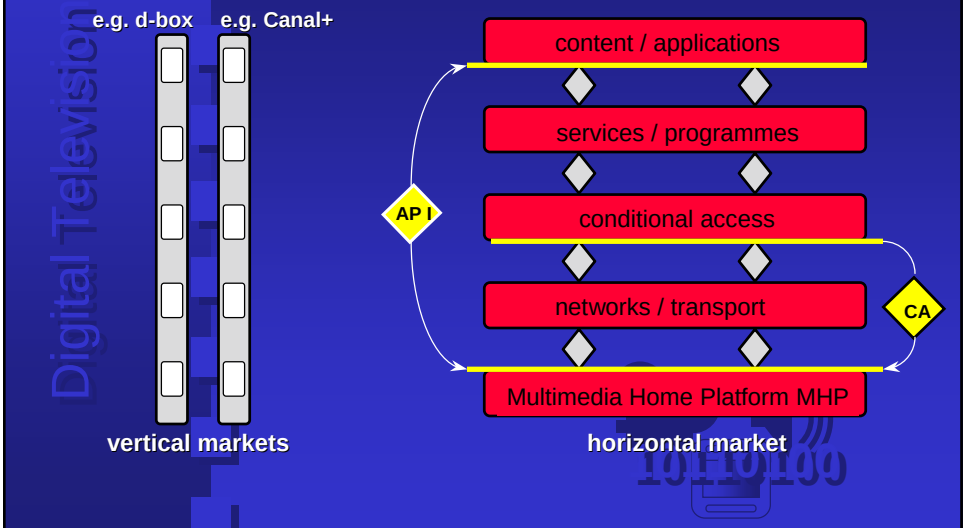


Digital Television

MHP System Definition

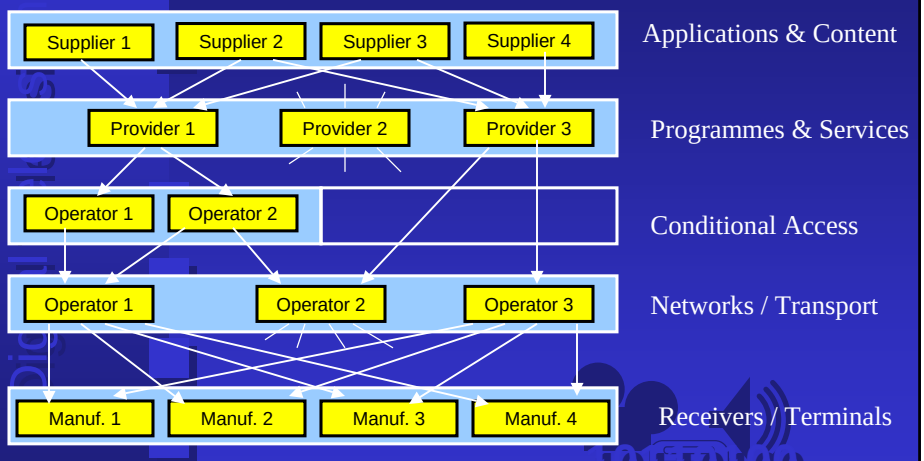
- **Security**
  - **operation (… the TV should not crash …)**
  - **content**
  - **user data, transactions etc.**
- **Local Cluster**
- **Copyright Management & Protection**
  - **levels, signalling**
  - **operational model**
- **Conformance & Interoperability Testing**
- **Migration**

Multimedia Infrastructure & Value Chain



MHP Market Model

Vertical businesses in a horizontal market

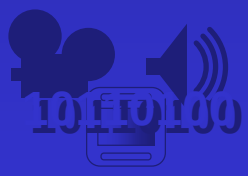


A horizontal Market for Free und Pay TV

Competition in all layers of value chain

Typical MHP Applications

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



MIT: Nyheter

MIT: Vær

ZDF.vision EPG

Digital Television

Digital Television

Application Synchronised to TV Content
Golf Game

Digital Television

E-Commerce

Digital Television

Top of the Pops

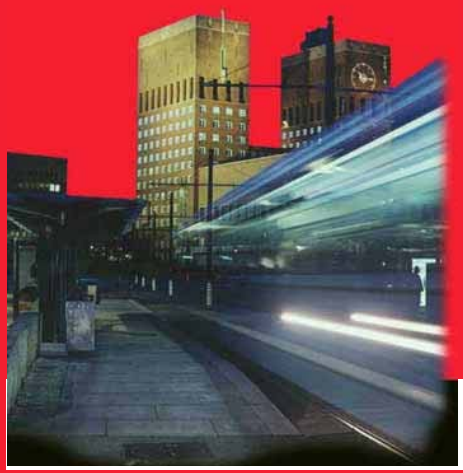
Digital Television

Airport Information System

Digital Television

Airport Information System

T-banehjelper på TV

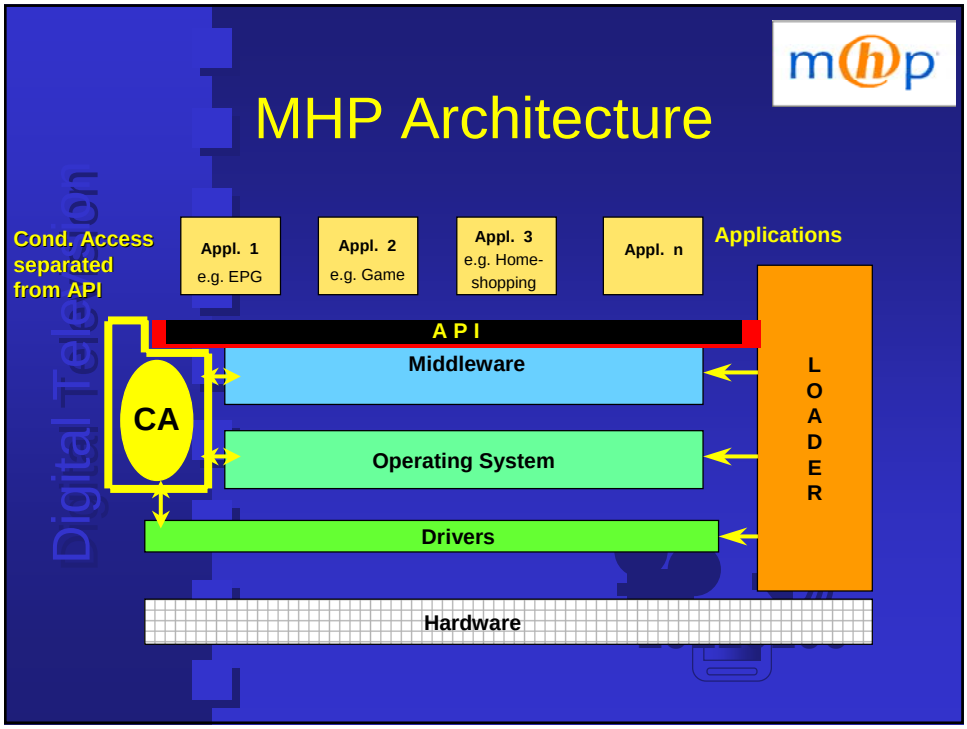


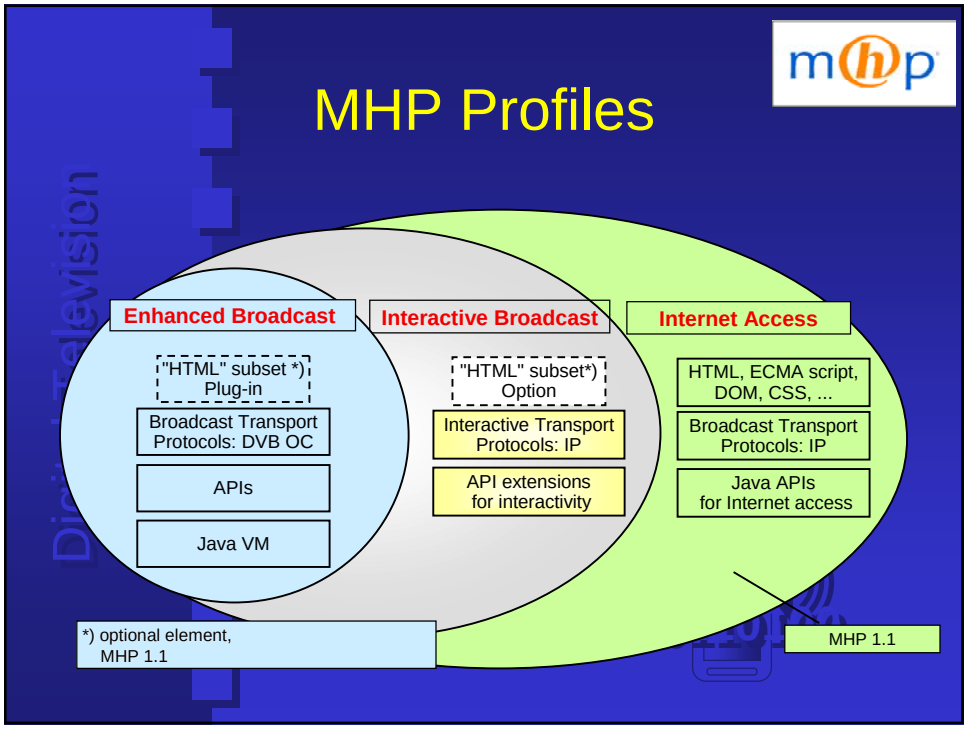
Specification Elements (1)

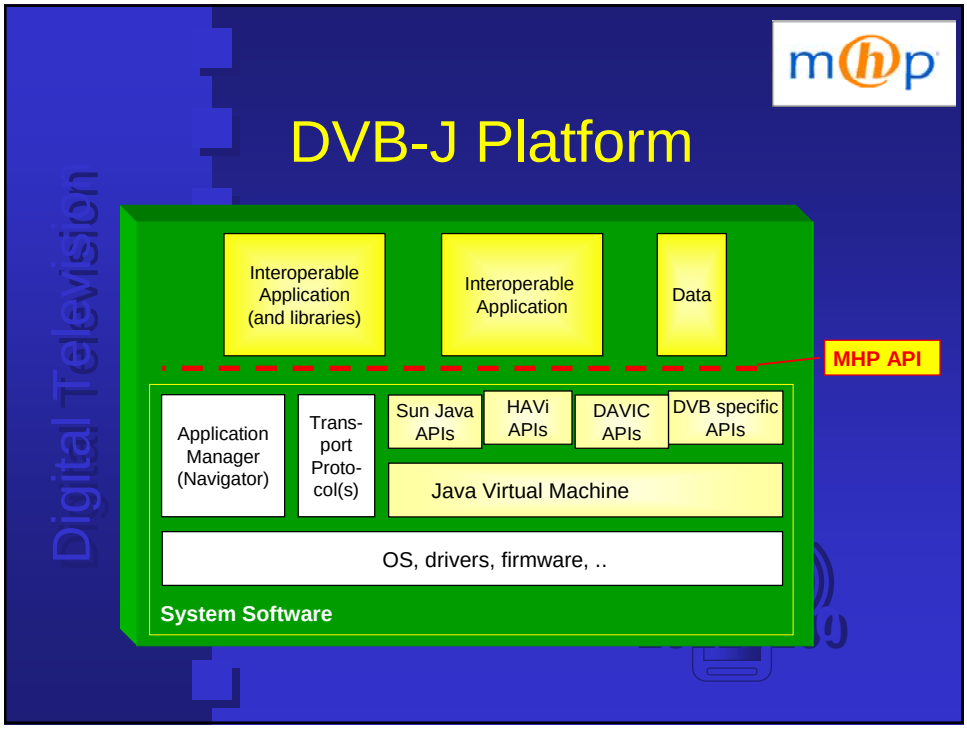
- MHP architecture
- Detailed profile definition
  enhanced and interactive broadcasting
- Content formats
  including PNG, JPEG, MPEG-2 Video/Audio, subtitles and resident and downloadable fonts
- Mandatory transport protocols
  including DSM-CC object carousel (broadcast) and IP (return channel),

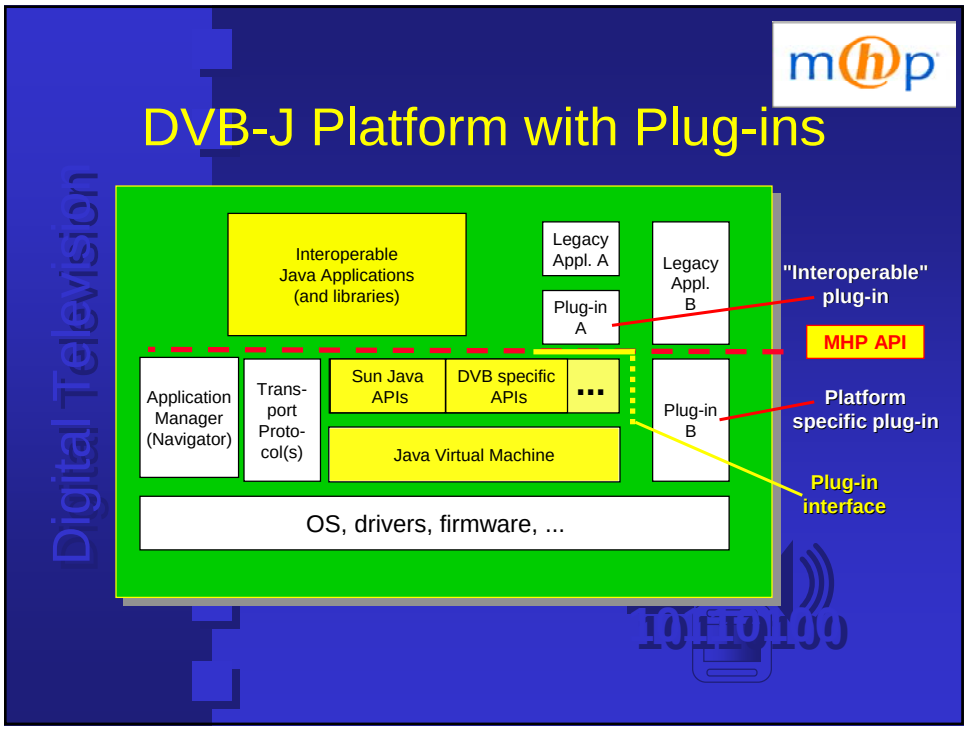
Specification Elements (2)

- 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

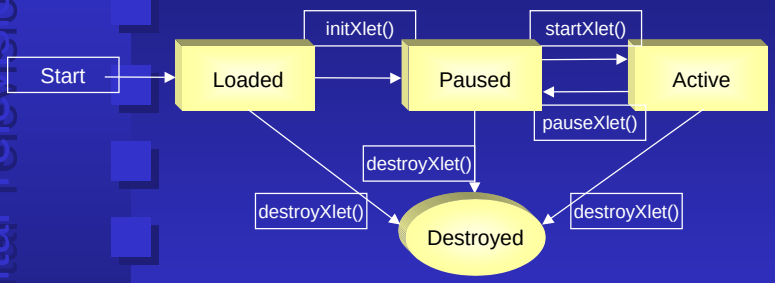

MHP Architecture
Cond. Access separated from API
Appl. 1
e.g. EPG
Appl. 2
e.g. Game
Appl. 3
e.g. Home-shopping
Appl. n
Applications
API
CA
Middleware
Operating System
Drivers
Hardware
LOADER


MHP Profiles
Enhanced Broadcast
Interactive Broadcast
Internet Access
"HTML" subset *) Plug-in
Broadcast Transport Protocols: DVB OC
APIs
Java VM
"HTML" subset*) Option
Interactive Transport Protocols: IP
API extensions for interactivity
HTML, ECMA script, DOM, CSS, ...
Broadcast Transport Protocols: IP
Java APIs for Internet access
*) optional element, MHP 1.1
MHP 1.1


DVB-J Platform
Digital Television
Interoperable Application (and libraries)
Interoperable Application
Data
MHP API
Application Manager (Navigator)
Trans-port Proto-col(s)
Sun Java APIs
HAVi APIs
DAVIC APIs
DVB specific APIs
Java Virtual Machine
OS, drivers, firmware, ..
System Software


DVB-J Platform with Plug-ins
Digital Television
Interoperable Java Applications (and libraries)
Legacy Appl. A
Legacy Appl. B
Plug-in A
"Interoperable" plug-in
MHP API
Application Manager (Navigator)
Trans-port Proto-col(s)
Sun Java APIs
DVB specific APIs
...
Plug-in B
Platform specific plug-in
Java Virtual Machine
Plug-in interface
OS, drivers, firmware, ...

Lifecycle DVB-J Application Signalling



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

MHP Technical Implementation Group Members

- ARD
- Bertelsmann
- Beta Research
- Canal+ Technologies
- Deutsche Telekom
- DVB
- EBU
- Fantastic
- F.U.N.
- GMD
- Grundig
- I-D Media
- IfN TU Braunschweig
- IRT
- LfR
- Loewe
- Mediagate
- Nine Network Australia
- Nokia
- NTL
- OpenTV
- ORF
- Panasonic
- Philips
- Pioneer
- PowerTV
- QuBiz
- RAI
- RTL New Media
- Samsung
- S & T
- Scientific Atlanta
- Scip
- Singapore Broadc. Authority
- SES/ASTRA
- Sony
- Sun
- Telenor
- Televisó de Catalunya
- Television Corp. Singapore
- Teracom
- WDR
- YLE
- ZDF

Nokia Media Terminal

- > Intel 566 MHz CPU
- 40 GB Disk
- 64 MB RAM
- MPEG2/DVB compliant
- Modem/DSL
- Accelerated 3D graphics
- Content protection

- Linux Operating System
- Mozilla, NaviBars, Plug-Ins, …
- IP over MPEG
- …

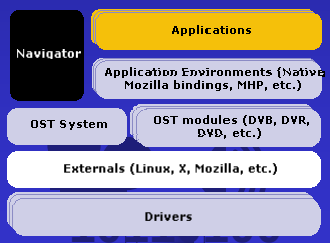
- DirectFB
- OstDev
- LinuxTV

OstDev

- Framework: integrates MHP, Linux, Web
- Native linux applications, e.g. games
- Full IP access
- Support all web standards
- Support legacy iTV standards
- Extend to new application

  and content standards

http://www.ostdev.net/



LinuxTV

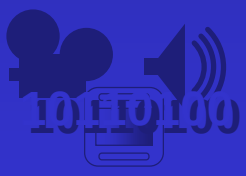
- development platform
- DVB API
- DVD API
- clib (for embedded devices)
- directFB
- ...

http://www.linuxtv.org/

platform for the development of open source software for digital television (DVB, DTV) receivers, Linux DVD players and tools to stream audio and video to the net.

LinDVR

- Debian-based linux distribution
- For PC with DVB card
  - watch digital television
  - record digital television
- lindvr.org



Bandwidth needs and program manifold

- **Why DTV?**
  - bigger distribution capacity
  - access to several channels
  - cheaper distribution
  - available channels: 20-200
- **Electronic Program Guide (EPG)**
  - tool to navigate in the programme jungle
  - program that runs locally in the set top box
  - possible to integrate functionality as:
    - personal profiles
    - order programmes
    - interaction
    - integration towards other services (Web, irc, news)

Digital TV and interactivity

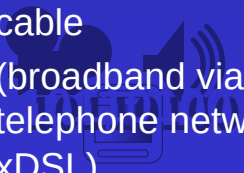
Digital Television

What is a return channel?

- telephone line
  - POTS (trad. telefony)
  - ISDN
  - ADSL (xDSL)
- cable TV with modem
- (satellite...)

”Down stream” (broadcasting):

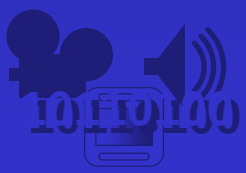
- satellite
- ground based net (air born)
- cable
- (broadband via telephone network xDSL)



Categories for interactivity

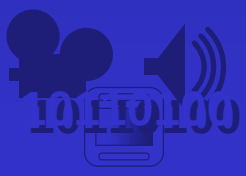
Digital Television

- **interaction with TV / set top box locally**
  - video text (text-TV)
  - electronic programme guide (EPG)
  - use of downloadable applets
  - broad band material: sent together with the program, and downloaded to the set top box.



Categories for interactivity

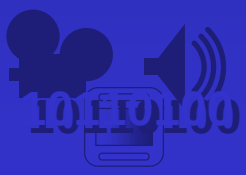
- **interaction with information available on web**
  - additional information provided by the channel
  - electronic commerce, attached to programs or commercials
  - use of web
  - email



Digital Television

Categories for interactivity

- **real time add-ons to programmes**
  - vote
  - answer in quiz-show
  - smart house applications
  - auctions

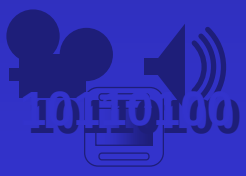


Digital Television

Categories for interactivity

Digital Television

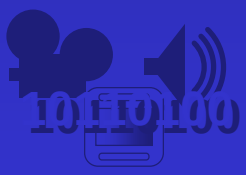
- **adaptation of programmes to individuals**
  - personal profile and choice of material
  - be your own producer / director
    (chose between cameras, see parts once again, …)
  - advanced applications by Image Based Rendering



New opportunities with DigitalTV

Digital Television

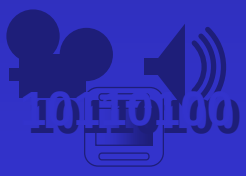
- What will be futures channel: EPG?
- order programmes
- store programmes locally
- new types of services
- create communities
  - based on subject
  - based on place/area



Digital Television

Literature and Links

- DVB:
  http://www.dvb.org



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The End of Part