Self-
Study

Exercise

Block lecture
Multimedia Coding
- Methods and Applications -

Part 7: Service Enablers for Digital TV

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Multimedia Coding
Part 7: Service Enablers for Digital TV

7.1 Overview
7.2 Service Information and Electronic Program Guides
7.3 Enablers for Mobile TV
7.4 Enablers for Interactive TV
7.5 Further information

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What are Service Enablers?

- **Service Enablers**
  - application layer building blocks that enable to build services

- **Main Function Groups**
  - Service Information Signaling (System-specific, ESG, EPG)
  - Service and Content Protection; Purchasing
  - Transmission Protocols and Codecs
  - Interactivity

- **Standardized**
  - DVB Project
  - Open Mobile Alliance (OMA)
  - Java Community Process

- **… or proprietary**

Multimedia Coding
Part 7: Service Enablers for Digital TV

7.1 Overview
7.2 Service Information and Electronic Program Guides
7.3 Enablers for Mobile TV
7.4 Enablers for Interactive TV
7.5 Further information

DVB Metadata for "Classic TV Services"
PSI/SI tables overview (1)

- **Digital age: increase of the amount of content which can be transmitted via same spectrum by factor of 4-8**
  - → we need metadata to inform the user about this large amount of content

- **DVB uses a structure in the MPEG-2 transport stream called PSI/SI tables to carry metadata**

- **Set Top Boxes contain an EPG browser which collects these data and presents them to the user**

DVB Metadata for "Classic TV Services"
PSI/SI tables overview (2)

- **Program Map Table (PMT)**
  - list of all PIDs of a service
  - contains the program ID of that service
  - contains pointer to PID with time basis (PCR)

- **Network Information Table (NIT)**
  - Information about the service providers and their network parameters

- **Service Description Table (SDT)**
  - Information about the services ("TV channels")
  - contains the program ID and channel/provider name etc for each channel

- **Event Information Table (EIT)**
  - Information about the Program → Electronic Program Guide, EPG
  - At least, name, start time, duration of current and next „Broadcast Event" must be supplied
  - Most stations supply more, e.g. data for one week in advance

DVB Metadata for "Classic TV Services"
EPG – example for usage of signaling information

- **Service Selection via EPG (Electronic Program Guide) is based on PSI/SI**
  - user watches a service in a TS which is transmitted on a particular frequency (TS #1)
  - user wants to switch to a service in a TS transmitted on another frequency (TS #2)

- **Service selection steps**
  - User consumes digital TV service from TS #1
  - STB extracts information about services and programs from EIT and displays EPG
  - User decides to switch to other service in TS #2
  - STB looks up reception parameters (frequency, transponder, orbital position) for the newly selected service from NIT_other
  - STB tunes to the new channel (may involve re-adjusting satellite dish) and receives TS #2
  - STB finds out the program ID of the new service in SDT of TS #2
  - STB opens the all PMTs to find the PMT for that service, identified by the program ID
  - From that PMT, STB looks up audio and video PID for new service
  - STB demultiplexes the audio and video stream and displays the new service

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DVB Metadata for "Classic TV Services"
PSI tables in detail (Recall from MPEG-2 TS)

- **PAT:** Program Association Table (once per TS)
  - list of all services in the TS;
  - per service a pointer to PID of Program Map Table (PMT) plus pointer to PID with Network Information Table (NIT)
  - always at PID=0

- **PMT:** Program Map Table (once per service)
  - list of all PIDs of a service
  - pointer to PID with time basis (PCR)
  - mandatory

- **NIT:** Network Information Table (at least once per TS)
  - signals network parameters (e.g. ID, orbital position, transponder number, frequency)
  - mandatory for parameters of the current network (NIT_actual), optional also for parameters of neighboring / related networks (NIT_other)

DVB Metadata for "Classic TV Services"
SI tables in detail (1)

- **SDT:** Service Description Table (at least once per TS)
  - contains information about all services („TV channels") in the TS
  - per service: Service Name, Provider Name, Info Text
  - mandatory for current TS, optional for other TSs

- **EIT:** Event Information Table (at least once per TS)
  - contains data to fill the EPG (Electronic Program Guide)
  - per "Event": Name of program, start time, duration, parental rating
  - mandatory for current TS to contain current and next program, further programs optional
  - optional additional EITs for other TSs

DVB Metadata for "Classic TV Services"
SI tables in detail (2)

- **RST:** Running Status Table (at least once per TS)
  - contains per EIT entry one flag „running/not running" to signal the currently running program
  - information used to control video recorders

- **TDT:** Time and Date Table (once per TS)
  - mandatory table signaling date and time (in UTC)

- **TOT:** Time Offset Table (at most once per TS)
  - optional table signaling the difference between current time zone and UTC

- **INT:** IP/MAC Notification Table (at most once per TS)
  - signals the mapping of IP and MAC addresses for the transmission of IP streams using MPE (multi protocol encapsulation)
  - optional

DVB Metadata for Browser Integration
DVB URL (Uniform Resource Locator)

- **URL-Schema to reference content in MPEG-2 TS**

- **Defined in the MHP specification (ETSI TS 101812), to be able to uniformly reference Broadcast streams**

- **Format (simplified):**
  ```
  dvb://<original_network_id>.[<transport_stream_id>][.<service_id>
  [.<component_tag>{&<component_tag>}][;<event_id>]]
  {/<path_segments>}
  ```
    - original_network_id: ID of the station which created the content (coordinated at DVB) (in the NIT)
    - transport_stream_id: ID of the transport stream (coordinated nationallly) → „Transponder"
    - service_id: ID of the service in the TS (in the PAT)
    - component_tag: List of PIDs in the TS
    - event_id: ID of the events in the EIT
    - path_segments: path of the files in the object carousel
    - Example: dvb://27.66.44.88/directory/file.jpg

DVB Metadata for IPTV
Two Steps

- **DVB has defined a two-step approach to signal Program Guide information**
    - as part of the DVB-IPI (Internet Protocol Infrastructures) standard

- **Service Discovery and Search (SD&S)**
    - discover providers of Service Information
    - list of available channels
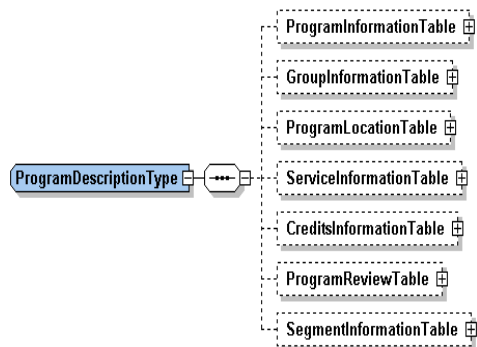   - information how to do Service Selection

Service List	
Austria 1	⚙
BR	⚙

- **Broadband Content Guide (BCG)**
    - detailed information about the content that is carried in the individual services
    - based on TV Anytime

BR - Program
20:00 Tagesschau
20:15 Tatort
22:10 Abendschau

DVB Metadata: TV Anytime
Overview

- **EIT-Data are not sufficient for PDRs (Personal Digital Recorders)**
- **TVA is a Metadata standard for EPGs, specifically tailored to the needs of PDR users**
  - Booking to record future broadcast events by many criteria
  - Concepts to model repetitions and series
  - Search the media archive in the box
- **TVA is based on MPEG-7 descriptors, but it offers a significantly reduced complexity**

DVB Metadata: TV Anytime
Content Reference ID (1)

- **Situation**
  - The same content may be transmitted at different times and using different transport systems (e.g. Broadcast, Internet, …)
- **Required**
  - A URI-Schema to identify content independent of transmission time and transport system
  - A method to find the actual broadcast times and addresses of the content
- **Solution: Content Reference ID (CRID)**
  - Identifies a piece of content uniquely
  - Format: `crid://<Authority DNS name>/<Authority-specific data>`
  - Example: `crid://ard.de/tagesschau20070112-1200`

DVB Metadata: TV Anytime
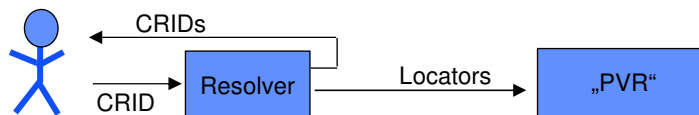## Content Reference ID (2)

CRID-Resolution

- A CRID Resolver converts a CRID into one or more Transport Locators (space and time)
- These locators can be used to find content and to initiate ist recording
- Exapmple of a resolution:

```
crid://ard.de/tagesschau
```

```
dvb://123.5ac.3be;3e45@2001-12-07T19:00:00.00+01P15:10
ftp://example.net/mirror/def123.mov
```

Multimedia Coding
Part 7: Service Enablers for Digital TV

7.1 Overview
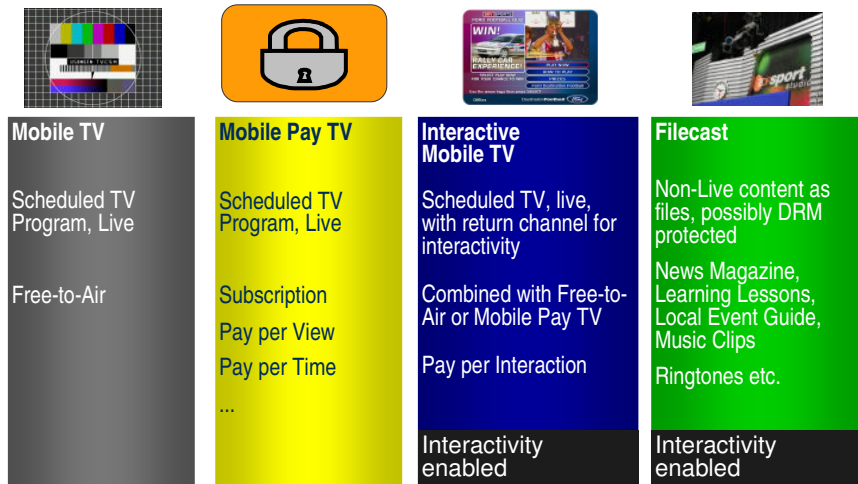7.2 Service Information and Electronic Program Guides
7.3 Enablers for Mobile TV
7.4 Enablers for Interactive TV
7.5 Further information

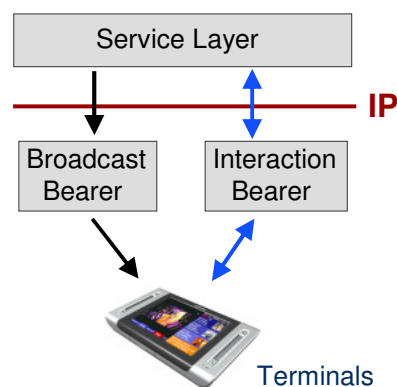## Mobile TV
Basic Scenarios for Mobile TV Use

Mobile TV	Mobile Pay TV	Interactive Mobile TV	Filecast
Scheduled TV Program, Live	Scheduled TV Program, Live	Scheduled TV, live, with return channel for interactivity	Non-Live content as files, possibly DRM protected
Free-to-Air	Subscription Pay per View Pay per Time ...	Combined with Free-to-Air or Mobile Pay TV Pay per Interaction	News Magazine, Learning Lessons, Local Event Guide, Music Clips Ringtones etc.
		Interactivity enabled	Interactivity enabled

Mobile TV
It's about Convergence

- **Mobile TV has a Bearer Layer and a Service Layer, separated by Internet Protocol (IP)**

- **The Service Layer provides services over converging different Bearers**

  - Point-to-Multipoint, unidirectional: *Broadcast bearers*

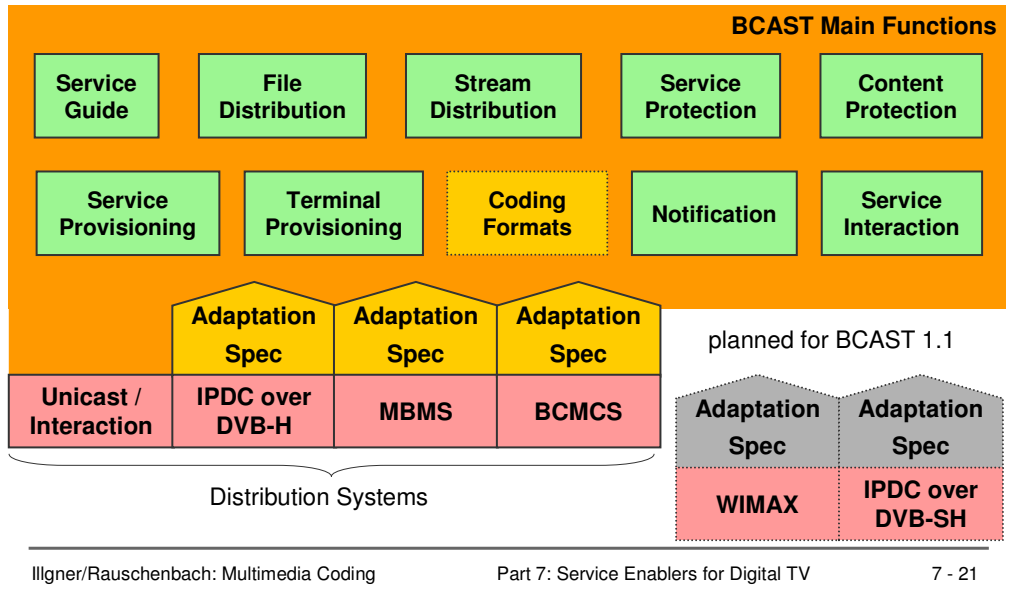 - Point-to-Point, bi-directional: *Interaction bearers*

Service Layer

IP

Broadcast Bearer

Interaction Bearer

Terminals

Mobile TV
Relevant Standards

Interaction Support Java Middleware, Rich Media Browser	**Interaction** **JSR-272** **Rich Media**
Service Layer Functions • Audio/Video Formats • Content Delivery Protocols • Electronic Service Guide • Service and Content Protection • …	**Service Layer** **DVB IPDC** **OMA BCAST**
IP Layer	
Mobile Broadcast Bearer Optimized for mobility, battery efficiency, error resilience	**Bearer Layer** **DVB-H** **3GPP MBMS**

Mobile TV Service Layer
Important Standards

- **Principle of the Service Layer**
  - use the Internet Protocol as Abstraction Layer for the Services
  - create Services, which deliver high data rate multimedia streams over the broadcast bearer to all users and transmit personalized information and billing data over the cellular network

- **DVB-IPDC**
  - Digital Video Broadcasting – IP Datacast (www.dvb-h.org)
  - Service Layer above IP which has been optimized for the DVB-H bearer

- **OMA BCAST**
  - Open Mobile Alliance – Mobile Broadcast (www.openmobilealliance.org)
  - Service Layer above IP, focusing on re-use and multi-bearer capability
  - Re-using parts of existing Service Layer functionalities
    - ○ currently DVB-IPDC and the Service Layer parts of MBMS and BCMCS
    - ○ furthers are planned
  - Supported bearers: DVB-H, MBMS, BCMCS

Mobile TV Service Layer
OMA BCAST – Functions and Structure

BCAST Main Functions

| Service Guide | File Distribution | Stream Distribution | Service Protection | Content Protection |

| Service Provisioning | Terminal Provisioning | Coding Formats | Notification | Service Interaction |

| Adaptation Spec | Adaptation Spec | Adaptation Spec |

planned for BCAST 1.1

| Unicast / Interaction | IPDC over DVB-H | MBMS | BCMCS |

| Adaptation Spec | Adaptation Spec |
| WIMAX | IPDC over DVB-SH |

Distribution Systems

Mobile TV Service Layer
Function groups

Function group	Description	DVB-IPDC	OMA BCAST
Audio/Video Codecs	High compression ratio codecs for audio and video	X	
Electronic Service Guide	Service discovery, Service List, Service Metadata	X	X
Stream Distribution	Protocols for Live Streaming	X	X
File Distribution	Protocols for File broadcast point to multipoint	X	X
Service Protection	Encryption methods to control access to content	X	X
Content Protection	Encryption methods to control access to content		X
Notifications	Real-time messages about events	Phase 2	X
Service Provisioning	Methods to buy access to services and content		X
Terminal Provisioning	Methods to provide configuration parameters to terminals		X
Service Interaction	Methods to enrich services with interactivity		X

Mobile TV Service Layer
Audio/Video Codecs

C

e.g. 320x240@30fps
bitrate < 768 kbps

- **Efficient Encoding of Audio and Video**
- **DVB-IPDC defines „Video Capability Classes"**
  - to adapt the service to terminals and networks with different performance
- **OMA BCAST just references codecs – no own recommendations**

B

e.g. 320x240@15fps
bitrate < 384 kbps

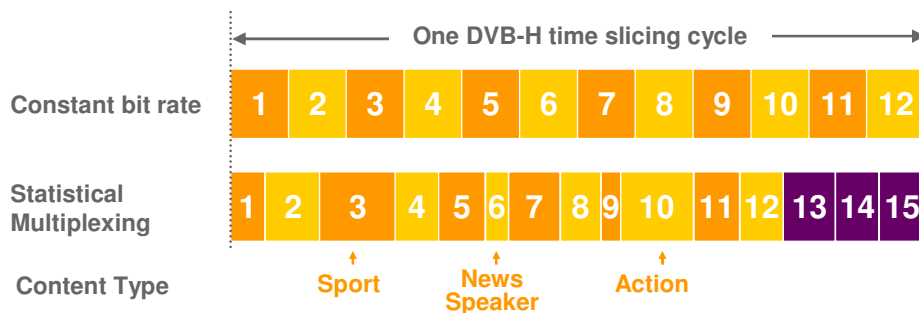| Standard	Video	Audio
DVB IPDC	H.264 (recommended), VC-1 (optional)	HE AAC v2 (mandatory), AMR WB+ (optional)
MBMS	H.264 (mandatory), H.263 (optional)	HE AAC v2 (recommended), AMR WB+ (recommended)
BCMCS	Under consideration, goal: harmonized with MBMS	

A

e.g. 176x144@15fps
bitrate < 128 kbps

Mobile TV Service Layer
Statistical Multiplexing

**Allow a higher number of TV channels in a DVB-H multiplex**

- Exploit the variability of video signals to increase number of channels
- Improve the video quality compared to constant bit rate encoding
- Overall gain approx. 25% - 30% depending on content of channels
- Realized by varying the length of the DVB-H time slices

One DVB-H time slicing cycle

Constant bit rate
1 2 3 4 5 6 7 8 9 10 11 12

Statistical Multiplexing
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Content Type
Sport   News Speaker   Action

Mobile TV Service Layer
Content Delivery Protocols

Different protocols for
- – real-time content (audio/video streaming)
- – non-real-time content (file carousels)
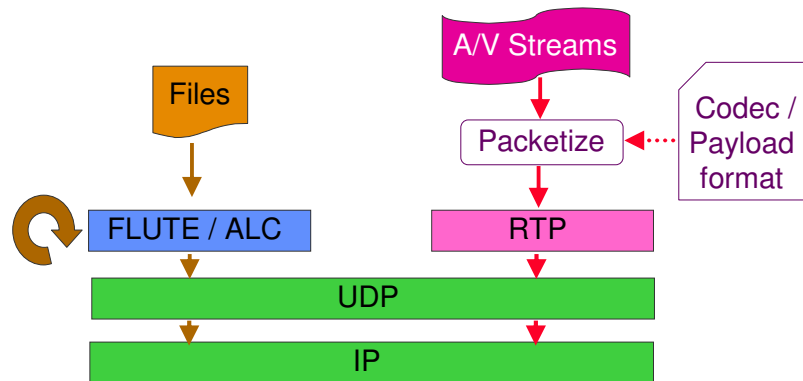
Mobile TV Service Layer
Electronic Service Guide – Overview

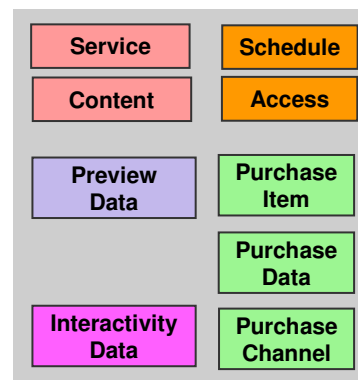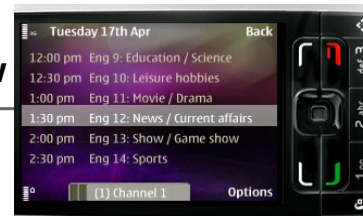- **Describes all aspects of the service offering**
  - – information describing the service, **displayed to the user**
  - – information about how to **purchase** access to the service
  - – **technical information** for the terminal to access the service

- **Datamodel allows different Services**
  - – Broadcast streaming
  - – 3G Unicast streaming
  - – "Cachecast" (broadcasted files)
  - – **Service Previews**
  - – **Simple interactions**

- **Technical realization:**
  - – Representation as XML fragments
  - – Packetized fragments transmitted via FLUTE/ALC

Service	Schedule
Content	Access
Preview Data	Purchase Item
	Purchase Data
Interactivity Data	Purchase Channel

OMA BCAST Service Guide

Mobile TV Service Layer
Electronic Service Guide – Fragments

- **Service**
  - describes a service („TV channel")
  - shown to the user
- **Content**
  - describes actual content, e.g. a News show
  - shown to the user
- **Schedule/ScheduleEvent**
  - describes an actual time interval when a Content is on air
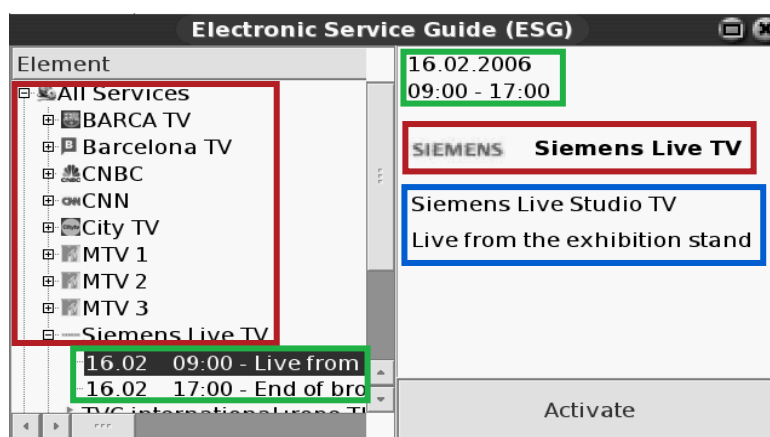 - shown to the user
- **Purchase**
  - different fragments which contain purchase-related information → this is needed to realize the different dynamic pay models
- **Access/Acquisition**
  - technical information for the terminal how to access a particular service
  - not shown to the user

Mobile TV Service Layer
Electronic Service Guide – Fragments illustrated
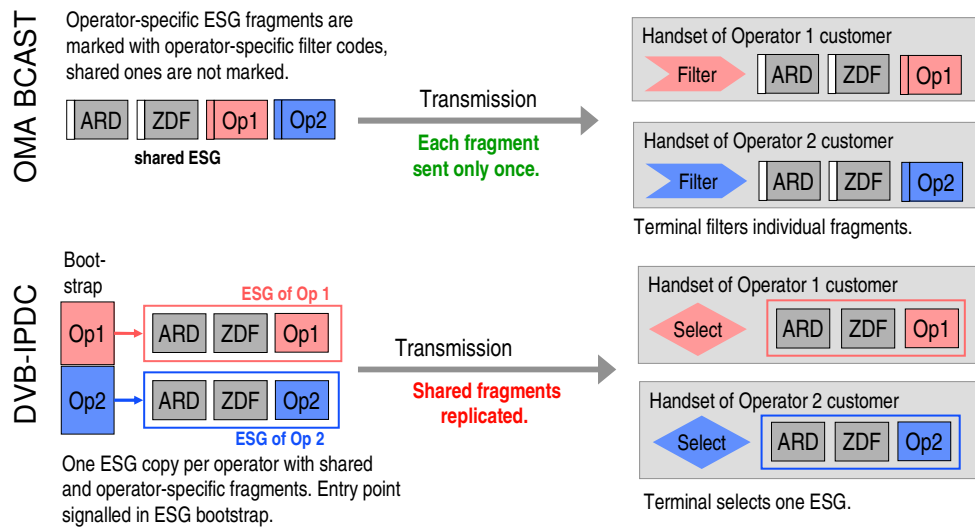

ESG browser of early Siemens DVB-H prototype, 2005

Service   **Schedule**   **Content**

Mobile TV Service Layer
Electronic Service Guide – Multi Operator Capability

OMA BCAST

Operator-specific ESG fragments are marked with operator-specific filter codes, shared ones are not marked.

| ARD | ZDF | Op1 | Op2 |

shared ESG

Transmission

Each fragment sent only once.

Handset of Operator 1 customer

Filter | ARD | ZDF | Op1

Handset of Operator 2 customer

Filter | ARD | ZDF | Op2

Terminal filters individual fragments.

DVB-IPDC

Boot-strap

Op1 → | ARD | ZDF | Op1 |
ESG of Op 1

Op2 → | ARD | ZDF | Op2 |
ESG of Op 2

One ESG copy per operator with shared and operator-specific fragments. Entry point signalled in ESG bootstrap.

Transmission

Shared fragments replicated.

Handset of Operator 1 customer

Select | ARD | ZDF | Op1

Handset of Operator 2 customer

Select | ARD | ZDF | Op2

Terminal selects one ESG.

Mobile TV Service Layer
Service and Content Protection

A broadcast service can be received by all terminals within the area of coverage („one-to-all")

→ control and restrict access by

❍ Encrypting the content or service

❍ Delivering the keys to authorized (i.e. usually paying) users only

Service Protection
- access to the data streams of the service is protected, i.e. the content is unprotected in the terminal after transmission
- aka „Conditional Access"

Content Protection
- the content is protected during its whole lifecycle (e.g. also after recording in the terminal)
- aka „Digital Rights Management"

Transport pipe

15
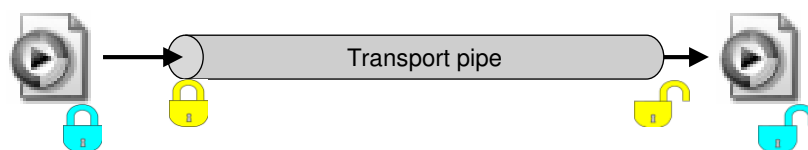
Mobile TV Service Layer
Key Hierarchy for Service Protection (simplified)
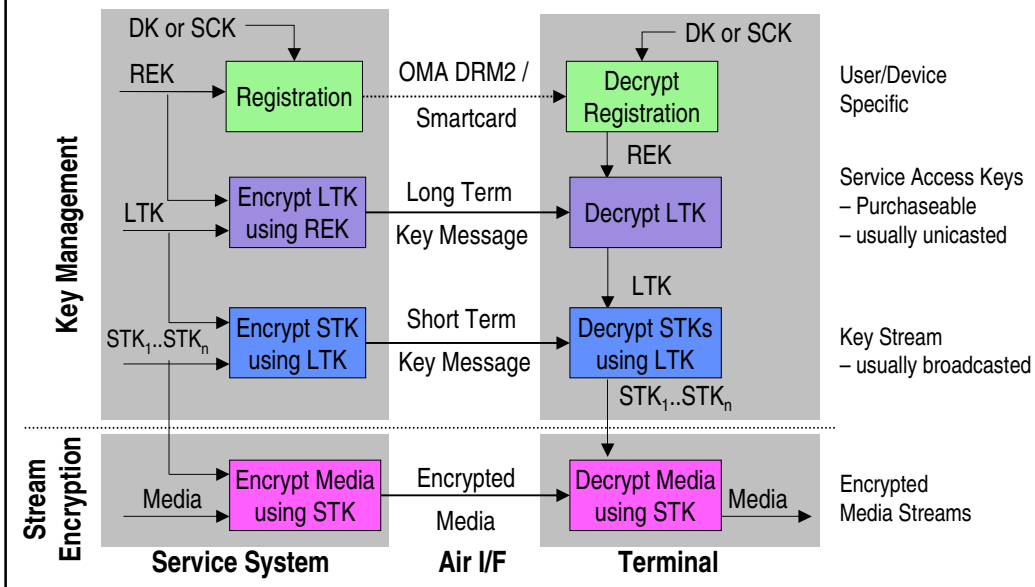
Mobile TV Service Layer
Key Hierarchy Abbreviations Explained (1)

- **TEK: Traffic Encryption Key**
  - Key to encrypt the media stream.
  - Lifetime: few minutes – frequent change hinders attacks

- **STKM: Short term key message**
  - Contains the TEKs that are encrypted with SEK/PEK. Delivered at the same time to all terminals via broadcast.
  - The STKM is formatted in a specific format defined in OMA BCAST, DVB-IPDC, or as MIKEY message, and is transmitted via UDP.

Mobile TV Service Layer
Key Hierarchy Abbreviations Explained (2)

- **SEK/PEK: Service Encryption Key / Program Encryption Key**
  - SEK: protects a service, valid for a time interval (i.d.R. quarters of hours up to a month)
  - PEK: protects a program (e.g. Movie, Show), valid only for this
  - This is used to realize Subscription / Pay Per Time (SEK) and Pay Per View (PEK)
  - These keys are needed to access the service. Normally, the delivery of these keys to the terminal is billed (depending on the business model).

- **Sub-hierarchy at LTKM-level – 2 modes**
  - 1) SEK-only
    - ○ TEK is encrypted with SEK. SEK is transmitted in LTKM.
  - 2) SEK+PEK
    - ○ TEK is encrypted with PEK
    - ○ PEK is encrypted with SEK and is transmitted (as additional key) in STKM.
    - ○ PEK or SEK (depending on what the user wants to access) are transmitted in LTKM
      - PEK in LTKM: Terminal directly decrypts TEK: PEK(TEK)
      - SEK in LTKM: Terminal first decrypts PEK, then TEK: SEK(PEK(TEK))

Mobile TV Service Layer
Key Hierarchy Abbreviations Explained (3)

- **LTKM: Long term key message**
  - contains the encrypted SEKs or PEKs
  - is deliverd to each terminal individually
  - Methods of key delivery:: ROAP (OMA DRM 2.0) or MIKEY (SmartCard)
    - ○ ROAP: Rights Object Access Protocol (part of OMA DRM 2.0) – transmission protocol for OMA DRM rights objects
      - Transmitted via HTTP
    - ○ MIKEY: Multimedia Internet Keying – Protocol for the key delivery in the Internet (defined by IETF)
      - Transmitted via UDP, SMS or HTTP

- **REK/SMK: Rights Encryption Key (OMA DRM 2.0) / Subscriber Management Key ((U)SIM card)**
  - Key used to encrypt the LTKM
  - terminal- or user-specific, may be re-established online from time to time
  - Protocols: ROAP Registration (OMA DRM 2.0) or GBA (Generic Bootstrapping Architecture, (U)SIM)

Mobile TV Service Layer
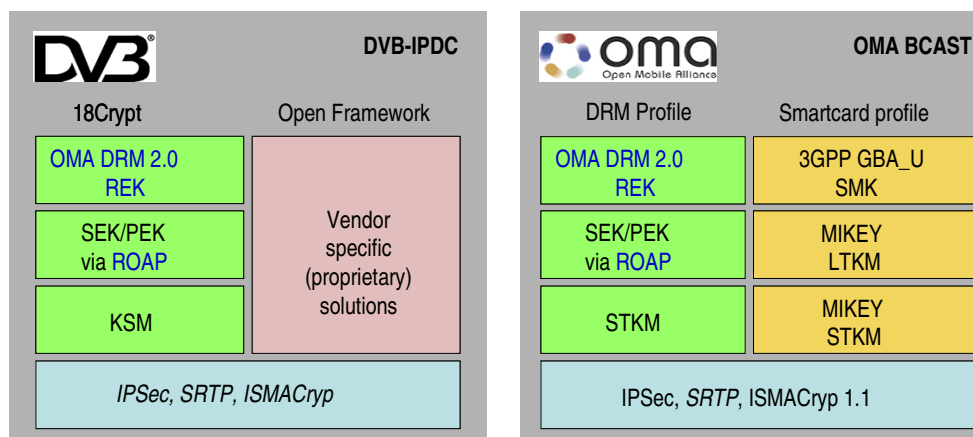## Key Hierarchy Abbreviations Explained (4)

- **DK/SCK: Device Key (OMA DRM 2.0) / Smart Card Key ((U)SIM card)**
  - Key which is stored in the terminal (DK) or Smart Card (SCK)in a secure place and which is also kept in the Service System
  - Enables the encrypted communication between Service System and terminal / smartcard
  - Usually fixed for the duration of the contractual relationship between customer and provider

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Mobile TV Service Layer
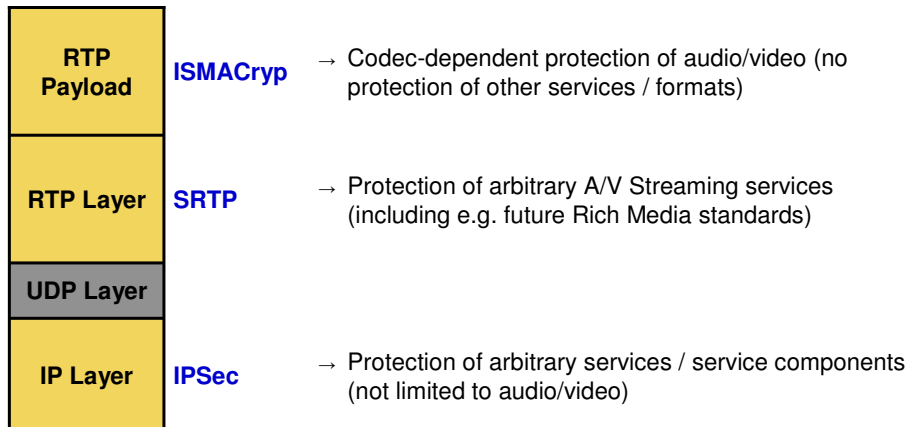## Profiles for Service Protection in the Standards

Three different Profiles in the Service Layer Standards

➔ **The danger of market fragmentation is real!**

DVB-IPDC		OMA BCAST	
18Crypt	**Open Framework**	**DRM Profile**	**Smartcard profile**
OMA DRM 2.0 REK		OMA DRM 2.0 REK	3GPP GBA_U SMK
SEK/PEK via ROAP	Vendor specific (proprietary) solutions	SEK/PEK via ROAP	MIKEY LTKM
KSM		STKM	MIKEY STKM
IPSec, SRTP, ISMACryp		IPSec, SRTP, ISMACryp 1.1	

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Mobile TV Service Layer
Stream Encryption Methods for Service Protection

Three different stream encryption methods for Service Protection, working at different protocol layers

RTP Payload	**ISMACryp**	→ Codec-dependent protection of audio/video (no protection of other services / formats)
RTP Layer	**SRTP**	→ Protection of arbitrary A/V Streaming services (including e.g. future Rich Media standards)
UDP Layer		
IP Layer	**IPSec**	→ Protection of arbitrary services / service components (not limited to audio/video)

Mobile TV Service Layer
Billing and Tariff Concepts

- **Subscription**
  - Run time contract for access to one channel or a bundle of channels („Service Bundle")
- **Prepaid, Metering**
  - Tokens are purchased in advance which can be traded in for consumption time
  - The user determines the start of service use
  - The use period can be interruptible or non-interruptible
- **Pay per View**
  - Access rights are purchased for a specific Program/Show (in advance or spontaneous)
- **Pay per Time**
  - Access rights are purchased for a specific time interval (day, month etc)

- **Clear-to-Air**
  - unencrypted, free of charge
  - public broadcasters
- **Free-to-Air**
  - service is free of charge
  - possibly: basic encryption; network access fee (cf cable TV)
- **Additional Interactions**
  - On top of a free or pay TV program, interactions are offered which must be paid for
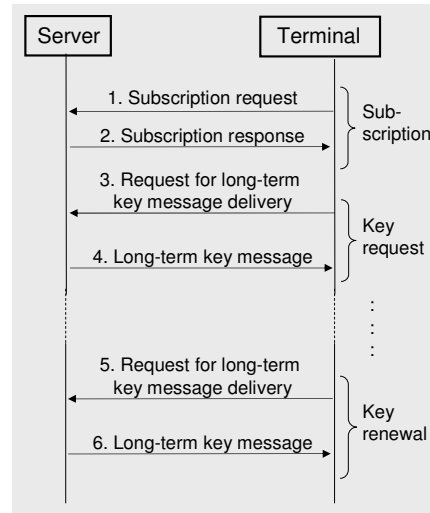
Mobile TV Service Layer
Provisioning/Purchase – Buying access rights

● **Web Shop Purchase**

- Subscription using the Portal of the Mobile Operator
- Portal-based charging
- As result, terminal is authorized to retrieve LTKM

● **Service Guide Based Purchase**

- ESG contains Purchase Fragments
  - *What* can be purchased? → PurchaseItem
  - *How much* is it? → Purchase Data
  - *Which* parameters? → PurchaseChannel
- The ESG browser supports the interactive selection of the items to purchase and triggers the calls needed
- The subscription calls are charged

Server	Terminal
1. Subscription request	Sub-scription
2. Subscription response	
3. Request for long-term key message delivery	Key request
4. Long-term key message	
⋮	
5. Request for long-term key message delivery	Key renewal
6. Long-term key message	

Mobile TV is arriving
DVB-H Handsets: Prototypes and commercial devices

BenQ-Siemens ✞
Concept Device

Nokia N92

Nokia N77

Nokia 7710

Nokia N96

Motorola
Prototype

Sagem
MyMobileTV

LG U900

Samsung
SGH-P960

Samsung
SGH-P910

Status: April 2008

Multimedia Coding
Part 7: Service Enablers for Digital TV

Types of Interactivity in TV Services

- **Local Interactivity**
  - → Interact with content delivered by Broadcast in the Object carousel and stored on the STB (e.g. MHP Xlets, HTML pages)
  - → The interactive content is usually related to the program
  - → No return channel required; Interaction takes place entirely on the STB, enabled by MHP

- **Internet-based Interactivity**
  - → Interact with Content on the Internet, triggered by link in the broadcasted content
  - → The interactive content may or may not be related to the program
  - → Internet required as return channel and as channel to deliver additional content

- **Deep (or Remote) Interactivity**
  - → Interact with "the Studio"; Interactions influence the program (Call-in, Voting, SMS, MMS, ...)
  - → The interactive content is usually simple but always related to the program
  - → Return channel required (voice, SMS, MMS, Internet)

Interactivity in stationary TV
Multimedia Home Platform as Middleware

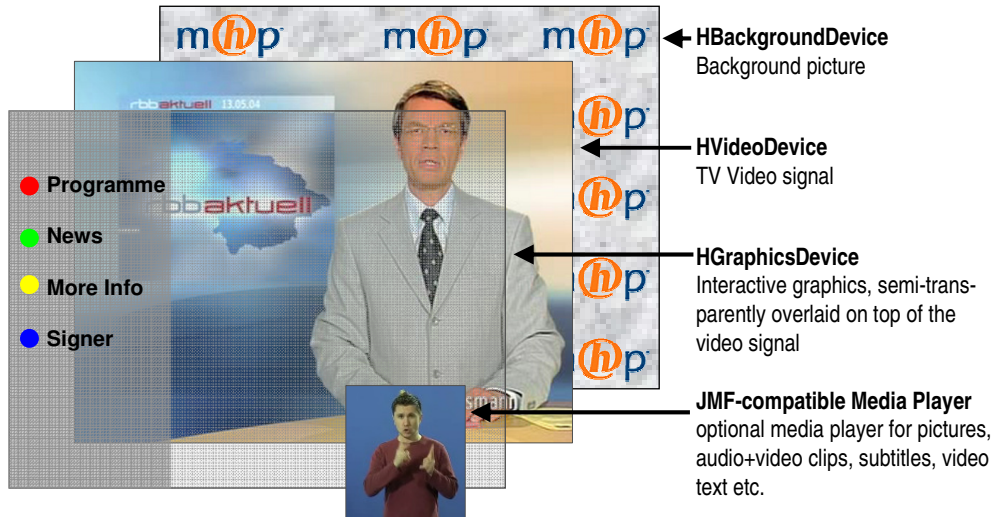**MHP: Middleware for interactive TV applications**

Software layer between operating system and application

which enables the execution of applications independent of the operating system

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Interactivity in stationary TV
MHP – Properties

● **The *Multimedia Home Platform* is a complete JAVA based middleware for interactive TV applications.**

● **MHP application**
  – is named Xlet
  – is transmitted by the broadcaster in the Object carousel
  – the MHP middleware in the STB runs the Xlet either automatically or on user request

● **Versions of MHP**
  – MHP 1.0.x (1.0.0 – 1.0.3): Original MHP spec with updates, broadly used today
  – MHP 1.1.x: Extends MHP 1.0x
      ○ DVB-HTML, stored applications, Internet client APIs, applications via Internet, plugins, smart card APIs)
  – Globally Executable MHP (GEM)
      ○ Based on MHP 1.0.2, Basis for cable TV middleware standards (OCAP, ACAP and ARIB B23)

● **No return channel by default → local interactivity!**

Interactivity in stationary TV
MHP – Multi-Layer graphics model (1)

HBackgroundDevice
Background picture

HVideoDevice
TV Video signal

HGraphicsDevice
Interactive graphics, semi-trans-
parently overlaid on top of the
video signal

JMF-compatible Media Player
optional media player for pictures,
audio+video clips, subtitles, video
text etc.

Interactivity in stationary TV
MHP – Multi-Layer graphics model (2)

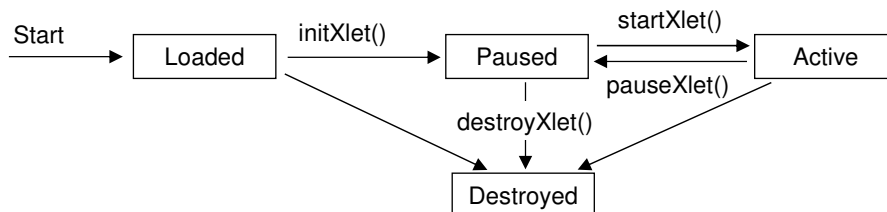

Resulting presentation

Interactivity in stationary TV
MHP – XLet life cycle

Service binding of Xlets

– **Service bound Xlets** → belong to a TV service (e.g. Newsticker)

– **Service unbound Xlets** → are service-independent (e.g. EPG)

– **Stored Xlets** (from MHP 1.1) → can be provided by the broadcaster, are service-independent (e.g. games)

Xlet activation types

– **Autostart:** Xlet starts as part of service selection

– **Present:** Xlet is downloaded but not started

Start → Loaded —initXlet()→ Paused ⇄ Active

startXlet() / pauseXlet()

destroyXlet()

Loaded → Destroyed

Paused → Destroyed

Active → Destroyed

Interactivity in stationary TV
UI Design for TVs is different! (1)

Not every viewer owns a HD screen to view interactive applications!

– when designing for TV, take into account the configuration STB + „classic" CRT TV set

Differences compared to UI Design for PC and Web

– Overscan: not the full resolution can be used

→ subtract 5% „safety zone" at each screen border!

– Two different aspect ratios (4:3 und 16:9)

→ make sure the application looks good at both aspect ratios

– The remote control only has a few keys (digits 0-9, cursor cross, OK, 4 color keys)

→ take this into account when designing the interaction

– Analogue TV sets use interlacing (presentation of two „half pictures" (fields) (first odd, then even rows each @25Hz)) → horizontal details of width 1 pixel lead to flickering

→ avoid horizontal lines of width 1 Pixel as well as horizontal edges with high contrast

→ smooth out photographs with horizontal details using a low pass filter in column direction

→ check the UI design on a TV CRT monitor, not just the PC!

Interactivity in stationary TV
UI Design for TVs is different! (2)

Differences compared to UI Design for PC and Web (cont'd.)

- Colour space issues: PAL-TV uses the YUV system which covers a different gamut than RGB. For NTSC, this problem is even more prominent (YIQ colour space, reduced colour resolution).
  - → check the colours of the UI design on a TV monitor, not just the PC!
- Text legibility: Influence of viewing distance (ca. 3m) und interlacing
  - → use big fonts (test on TV set!)
  - → avoid Fonts with serifs and fine details (MHP font *Tiresias* has been designed according to these rules)
  - → to improve legibility, use (if possible)
    - an inverse contour
    - or a semi-transparent background box

Way forward?

- **Market "success" of MHP**
  - only limited commercial success in some countries where MHP was politically pushed (e.g. Italy)
  - no return channel, too high computing resource demands
  - European Broadcasting Union recommendation for MHP recently withdrawn due to patent licensing issues
  - → questionable future ☹

?

- **Interactivity in IPTV**
  - IPTV comes with a *return channel integrated*
  - Currently, *HTML-based approaches* are favoured in standardization
  - But also Rich Media (see upcoming in Mobile TV) may play a role in the future

- **Interactivity in Mobile TV**
  - Mobile TV comes with a *return channel integrated*
  - *Rich Media Interactivity* is seen as an *important part of the business model*
  - Currently, there is much debate about the way forward
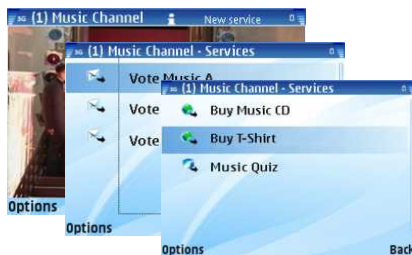
Interactivity in Mobile TV
Standards and Technologies

The great thing about standards is...

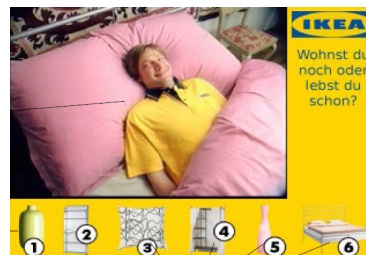**...that there are so many to choose from.**

Interactivity in Mobile TV
Approaches

Metadata-based Interactivity	Rich Interactivity

- Send SMS
- Enable basic voting (SMS or Web page)
- Display web pages
- Slow updates: 10s of seconds up to several minutes
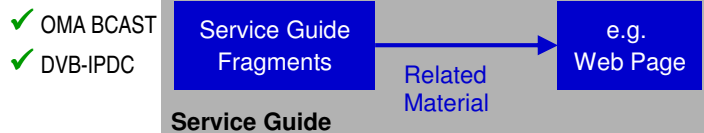- **based on metadata**

- Streaming service with integrated interactive multimedia objects
- Appealing screen layout
- Tightly synchronized with video
- Server-driven fast updates
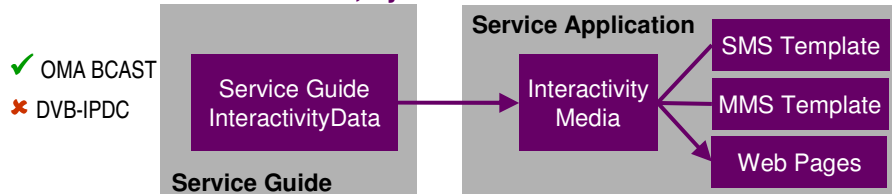- **based on Java Application (JSR 272) or Rich Media browser**

Metadata based Interactivity
Standardized in OMA BCAST and DVB-IPDC

Service Guide Metadata in OMA BCAST and DVB-IPDC support basic interactivity (like following a link or selecting a voting option in a template)

Service Guide related, mostly static

✓ OMA BCAST
✓ DVB-IPDC

Service Guide
Service Guide Fragments → *Related Material* → e.g. Web Page

Service related, dynamic with lose time relation

✓ OMA BCAST
✗ DVB-IPDC

Service Guide
Service Guide InteractivityData →

Service Application
Interactivity Media → SMS Template
Interactivity Media → MMS Template
Interactivity Media → Web Pages

Rich Media based Interactivity
Landscape of Technologies and Standards

Provide appealing applications with limited programming effort, running in a browser as well-defined runtime environment.

Technology		Standard	Comments
	Adobe Flash (Lite)	No	Established comfortable authoring tools and big developer base
	Microsoft Silverlight	No	The challenger of Flash, integrated with.NET tools, developer base assumed to grow, mobile version announced
W3C	SVG Tiny 1.2	Yes	Support in graphics packages increasing; Re-used for scene description in LASeR, DIMS, RME
	MPEG LASeR	Yes	Comfortable authoring tools but few implementations, unclear IPR situation
	3GPP DIMS / OMA RME	Yes	Authoring tools and developer base to be developed, focus on mobile environments
WEB 2.0	HTML/AJAX	Parts	Programming needed

Rich Media based Interactivity
3GPP DIMS and OMA RME

3GPP DIMS (Dynamic and Interactive Media Scenes)

and

OMA RME (Rich Media Environment)

- harmonized effort of 3GPP and OMA to generate an open environment for (Mobile) Rich Media Services; developed by the Mobile Community for the Mobile Community
- DIMS as basis, add-ons defined in RME

Features:

- based on SVG Tiny 1.2
- remote and local interactivity
- server controlled scene updates
- streamable via RTP
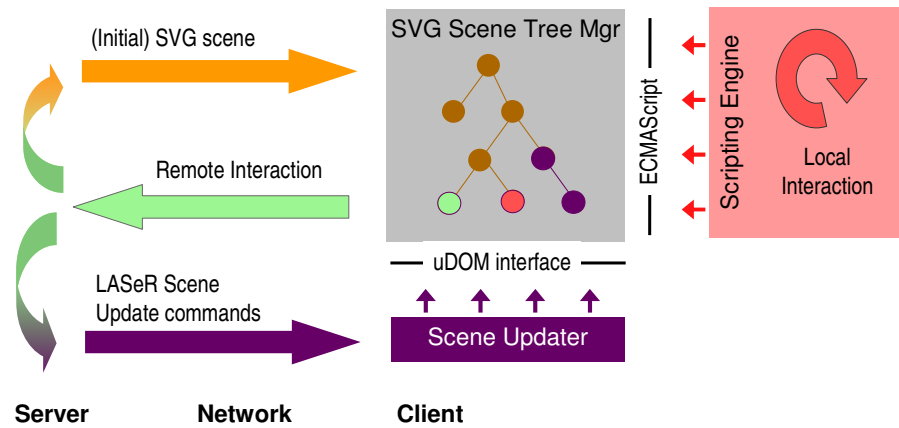- random access and tune-in sopport

RME / DIMS Functions
Architectural Integration
Scene Description – SVG T 1.2
Local User Interaction
Remote Interaction
Client Side Scripting
Scene Updates
High Level Timing Model
Low Level Timing Model
Random Access & Tune in
Compression
Error Resilience
Client Server Efficiency
Aggregation
Payload
Synchronization

Rich Media based Interactivity
RME Architecture

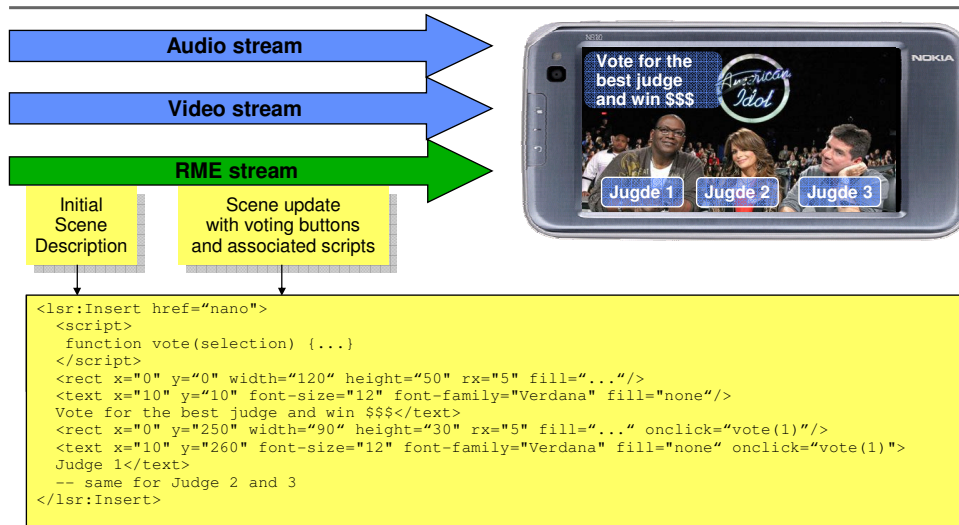**DOM level3, ECMAScript**

SVG Tiny 1.2 scene LASeR scene updates
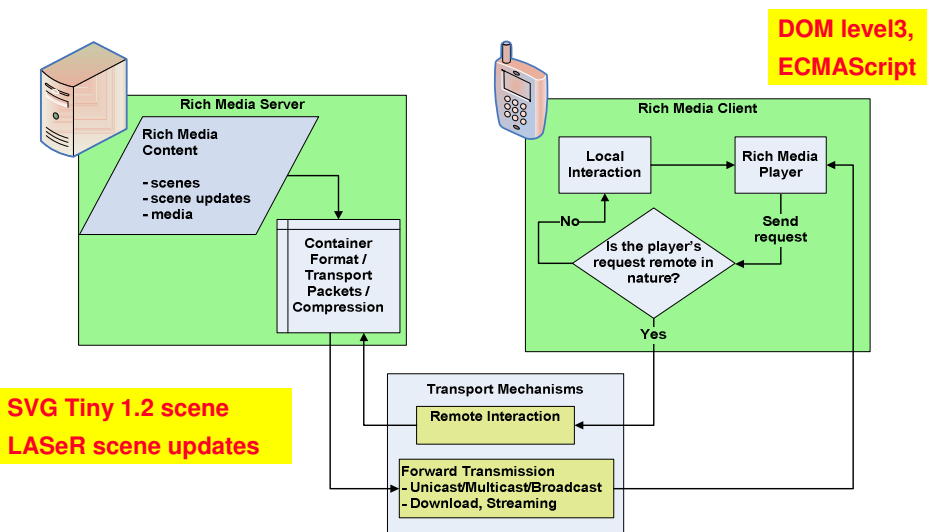
Rich Media based Interactivity
RME Mechanics

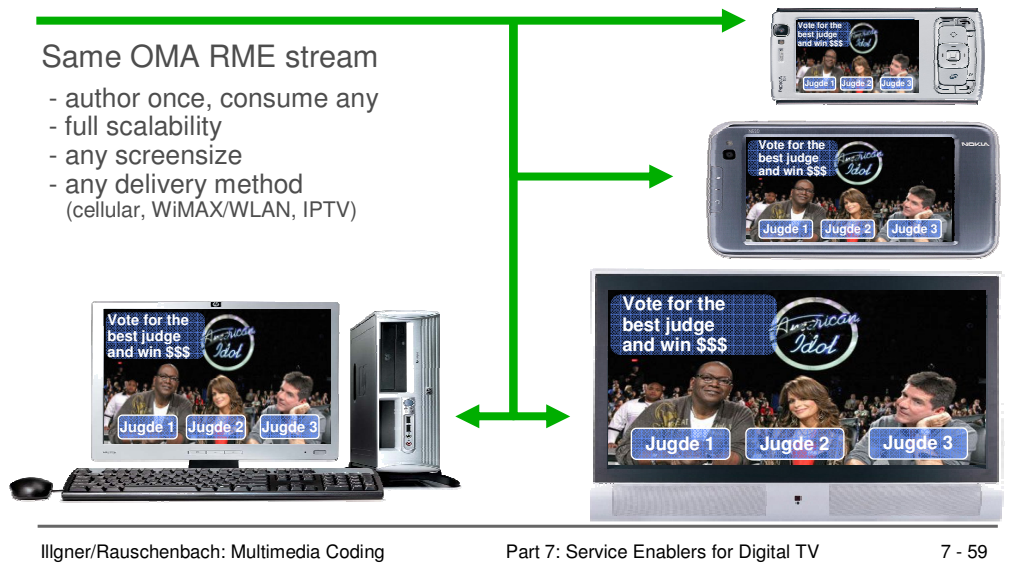Ingredients: **SVG Scene Tree + LASeR Update Commands + ECMAScript + Remote Interactivity**

Server   **Network**   **Client**

RME Example –
Rendering of service specific, interactive menu

Audio stream

Video stream

RME stream

Initial Scene Description

Scene update with voting buttons and associated scripts

```
<lsr:Insert href="nano">
  <script>
   function vote(selection) {...}
  </script>
  <rect x="0" y="0" width="120" height="50" rx="5" fill="..."/>
  <text x="10" y="10" font-size="12" font-family="Verdana" fill="none"/>
  Vote for the best judge and win $$$</text>
  <rect x="0" y="250" width="90" height="30" rx="5" fill="..." onclick="vote(1)"/>
  <text x="10" y="260" font-size="12" font-family="Verdana" fill="none" onclick="vote(1)">
  Judge 1</text>
  -- same for Judge 2 and 3
</lsr:Insert>
```

RME – Scalability across consumption environments (idealized)

Same OMA RME stream

- author once, consume any
- full scalability
- any screensize
- any delivery method
  (cellular, WiMAX/WLAN, IPTV)

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API based Interactivity
JSR-272 Java Middleware

JSR 272 defines a Java API to support interactivity in Mobile TV.

ESG Query	Service Selection	Presentation	Recording
Purchasing	Broadcast Objects		Security

CLDC 1.1	MIDP 2.0	Other JSRs

Java Community Process

Optional package in J2ME for interactive broadcast services for mobile terminals
- provide applications full control of a broadcast service implementation
- query the electronic service guide
- select a particular program or service
- present and record the media content
- download content and applications
- references other JSRs (e.g. JSR-135) to create appealing interactive graphics

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Interactivity in Mobile TV
Which Standard/Technology will win?

We are living in interesting times:

- – A number of **different standards** and technologies compete in the market to be used for creating **interactivity** in mobile TV services.

  → These different technologies support different **degrees of interactivity** and differ in the **degree of flexibility** and **ease of content creation**.

- – **Metadata based interactivity** offers very basic interactions at low implementation cost.

- – **Rich Media Approaches** offer the potential to provide a **harmonized** and **versatile environment** for feature-rich interactive services at reasonable content creation costs.

  → Whether **DIMS / RME** has a chance against **Flash Lite / MS Silverlight** depends largely on how well DIMS/RME can address the content creation community.

  → In the future, **WEB 2.0** technologies may play an increasing role when mobile terminals become more powerful and open

- – **API based approaches** are suitable for **specific, highly used applications** but MHP has shown that market acceptance is not easy to achieve.

Multimedia Coding
Part 7: Service Enablers for Digital TV

7.1 Overview

7.2 Service Information and Electronic Program Guides

7.3 Enablers for Mobile TV

7.4 Enablers for Interactive TV

7.5 Further information

Further information

- **Tutorials covering digital TV topics: www.interactivetvweb.org**

- **DVB IP Datacast standards**
  – available from http://www.dvb-h.org/technology.htm

- **OMA BCAST standard**
  – available from http://www.openmobilealliance.org/release_program/bcast_v1_0.html

- **JSR-272: Mobile Broadcast API:** http://www.jcp.org/en/jsr/detail?id=272

- **Rich Media standards**
  – 3GPP DIMS: http://www.3gpp.org/ftp/Specs/latest/Rel-7/26_series/26142-720.zip
  – OMA RME: http://www.openmobilealliance.org/ftp/Public_documents/MCE/MAE/Permanent_documents/OMA-ERP-RME-V1_0-20080423-D.zip