Combining Future Internet Media with Broadcast TV Content

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Exploit broadcast/broadband network complementarity

- Broadcast is good for live events and mass distribution
- Broadband is good for on-demand, catch-up & personalized services

Develop combined broadcast/broadband networking techniques

- Services composed of components from broadcast, broadband and storage sources

Use cases

- Personalized content for broadcast TV
  - More languages for a film
  - Alternative views for sport/music
- Extension of service delivery capacity
  - 2D to 3D
Technical challenges

TV service components sourced from servers located anywhere
- Broadcast and broadband servers not collocated

Component delivery over heterogeneous networks
- Having different reference clocks
- Using different transport protocols
- With different transmission delays
- Broadcast with Internet multicast or on-demand delivery

Involving TV and second screen terminals
- Clock drift and rendering synchronization
Background

Adopt “usual” broadcast MPEG PTS/PCR for both networks

- Mark broadband content with a PTS that refers to the PCR
- Buffer the first stream received and re-align timing

Such an approach presents some limitations

- Implies reference clock sharing for broadcast and broadband sources
  - Either collocated sources or clock recovery at a remote source
- Is not suitable for on-demand services
  - No reference to temporal position in current event
- PCR continuity can be difficult to maintain
  - Service re-multiplexing regenerates PCR

Our event timeline solution

- A common timing reference attached to the content item itself
  - Independent of transport and timing protocols
The event timeline approach

Event timeline

- Indicates progress in an event since its beginning
  - Event is a grouping of elementary streams with a defined start and end time

Timeline carried as an auxiliary service component

- Conveys multiple event timelines

- Generally carried over both broadcast and broadband networks
  - On-demand content synchronization possible without broadband timeline

- Encapsulated in DVB specified\(^1\) descriptors
  - “broadcast timeline” and “content labelling”

- Synchronized with the other service components
  - Using existing network delivery protocol mechanisms

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(1) ETSI TS 102 823 “Specification for the carriage of synchronized auxiliary data in DVB transport streams”
Timeline insertion

Timeline carried as an elementary stream

- Added to a service in a similar way to subtitles
- Timeline data supplier generates the timeline
  - May exploit existing playout content timecodes
- Timeline encoder encapsulates the timeline in transport format
  - Assures synchronization with A/V components
    - Computes timestamps using system clock

Timeline component insertion in MPEG2-TS
Synchronizing MPEG2-TS and RTP components

Event Timeline

Broadcast Components (MPEG2-TS)

Timeline PTS

Right view Video packet

Timeline packet

Timeline packet

Left View Video Packet

Audio PTS

Inter-delay network

RTP synchro

TS synchro

Event Timeline synchro

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Synchronizing on-demand components

No need for broadband timeline

- Receiver initiates the process
- Broadcast timeline indicates temporal position in event
- Measure RTT to on-demand server
- Content request includes margin
  - Ensures broadband content received before broadcast presentation
- Broadband content aligned to broadcast “master”

- Timeline includes “countdown” announcing event start in advance
- Account for communication time between receiver and companion device
- Receiver periodically reports timeline position
Evaluation platform: 3D Enabler

DVB-T Broadcast network

Left View
Audio

Timeline

Right View
Timeline

Internet

Content Provider

Top
Bottom
Side
by
Side
Frame
Packing
Full HD

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Conclusions

Synchronization solution for combining Internet and broadcast content
- Event based timeline component
- Aligns the presentation of components delivered over different networks
- Compatible with any existing or future transport protocols
- Readily deployed on existing broadcast or broadband infrastructure
- End to end architecture

Experimental implementation
- Stereo 3D TV using combined Internet/broadcast delivery
- High performance synchronization capability demonstrated

Future work
- Standardization
- Alternative solutions

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Thank you for your attention