RESHAPING DIGITAL MEDIA BUSINESS MODELS BY RECONFIGURABLE VIDEO CODING

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Main theme of this paper

- Can the design of media codec influence future licensing and business models of digital media applications?
Story 1:
Digital Media Contents and IPRs
Digital Media

- Media
  - Medium: what can stimulate one of our five senses.

- Digital media
  - Digitally represented media
  - Require dedicated digital media processing

- Digital media processing
  - Acquisition: Analog to digital conversion
  - Transmission/storage: coding and decoding (with/without compression)
  - Reconstruction: digital to analog conversion
Digital Media Format

- Digital media format (DMF)
  - For transmission and storage.
  - DMF is a language to describe digital media contents.

- Yes, Contents!
Digital Media Contents and Formats

- Audio and sound
  - MP3, OGG, WMA...

- Image and video
  - MPEG-1, MPEG-2, MPEG-4 SP, MPEG-4 AVC, VC-1 ...

- Graphics
  - VRML, MPEG AFX ...
For an example...

- I have this content in my PC.
If I open the file with a text viewer...
This time I do it right. 😊

- This content
  - JPEG image
  - Copyright owner: Euee S. Jang
  - And
  - It needs a proper DECODER!!!
A simple and silly conclusion:

- For a digital content, we need:
  - NOT ONLY:
    - (encoded) data
  - BUT ALSO:
    - Decoder (and reconstructor)
After all, digital media

- Is all about content business.
- A content is protected by IPRs.
- IPR (intellectual property rights)
  - Copyrights
  - Patents
Copyright? Yes. What Patents?

- Content = encoded data + decoder

- Common confusion
  - Encoded data: protected by copyrights
  - Decoder: protected by patents
What happens if we apply IPRs only on encoded data?

☐ Not on the decoders…

☐ Why? Will be explained shortly after…
Story 2: MPEG Reconfigurable Video Coding
MPEG Video Coding Standards

- 1992 MPEG-1
- 1995 MPEG-2
- 1999 MPEG-4 Part 2 (MPEG-4 SP)
- 2003 MPEG-4 Part 10 (MPEG-4 AVC)
- Should we keep the same quantization step size to remain ‘competitive’ in the market?
Problem Posed...

- Paradigm shift in media coding
  - One tool-one functionality
    - Many tools-many codecs
  - One standard for each dedicated application
    - Many codecs housed in a single platform
    - (i.e. Samsung’s Multi-format decoder (MPEG2, DivX, VC1, H.264))
  - MPEG dominancy
    - Competitions of MPEG and nonMPEG codecs everywhere
Pending Issues for the Future

- **Complexity**
  - Was a big issue when we developed early video coding standards (i.e., MPEG-1, MPEG-2)
  - No more a critical issue (many codecs in a single platform)
  - One-tool-one-functionality was a means to keep complexity down.

- **Enhancement of existing codecs**
  - A new design of DCT module
  - Shape coding is only available in MPEG-4 Pt. 2
  - Color space issue
  - Can we enhance our existing codecs to meet the future needs of video coding standards?
MPEG’s Possible Choice

- So far:
  - “Let’s maximize the use of MPEG standards!”

- From now on:
  - “Let’s maximize the use of MPEG tools!”
MPEG Reconfigurable Video Coding

- Is a framework that flexibly enables
  - Supporting existing standard codecs
  - Defining new codecs

- With
  - Decoder description (bitstream syntax + decoding rules)
  - Functional units (decoding modules)
## Concept of RVC

- **Toolbox and Decoder configurations**

### Repository Toolbox

<table>
<thead>
<tr>
<th>Functional units (e.g. IDCT)</th>
<th>Conformance testing tools (for functional units)</th>
</tr>
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<tbody>
<tr>
<td>Processing</td>
<td></td>
</tr>
<tr>
<td>Context-Control</td>
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</table>

### Decoder Configurations

<table>
<thead>
<tr>
<th>Global Control Unit</th>
<th>Connections</th>
<th>Conformance testing tools (for decoders)</th>
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A codec is a collection of functional units.

Basic Building Block: Functional Unit

- **Processing Unit**
  - **INPUT**
  - **OUTPUT**

- **Context-Control Unit**
  - Context & control [in]
    - e.g. coding parameters
    - mode selection signals
  - Context & control [out]
    - e.g. derived parameters
    - result of this unit
What’s new in RVC?

Decoder description

1. Reconfigurable bit-stream syntax
2. Reconfigurable connection
Decoder Description Types

- Case 1: Existing codec
- Case 2: Update on one existing codec
- Case 3: Update on multiple codecs
- Case 4: New codec description
Decoder Description Decoder:

**Concept**

- Extended Bit-stream
- MUX
- Decoder Description Decoder
- RVC codec
- Decoder Description
Use of Decoder Description

Decoder Description Decoder:

RVC framework

Tool-box

Bit-stream

Video

SYNP

FU#1 → FU#2 → ... → FU#n

GCU

Connection

Decoder Description

SET

S-RT

DVT

CSCIT

FL

F-RT

FU-CSCIT
FU Examples

All possible Functional Units from MPEG-2/4/AVC
Bitstream-level reconfigurable video coding

- Reuse of existing bitstream without reencoding.
A decoding platform example

Functional unit A

Processing unit_A

CC unit_A

Functional unit B

Processing unit_B

CC unit_B

Functional unit C

Processing unit_C

CC unit_C

Global Control unit
Evolution of Standards

Functional unit A

Processing unit \( A \)

CC unit \( A \)

GC unit ‘MPEG-α’

(no change)

Functional unit A

Processing unit \( A \)

CC unit \( A \)

GC unit ‘MPEG-β’

replacement

Functional unit B2

Processing unit \( B_2 \)

CC unit \( B_2 \)

Functional unit X

Processing unit \( X \)

CC unit \( X \)

insertion

Functional unit C

Processing unit \( C \)

CC unit \( C \)

(no change)
Why RVC?
Story 3: A possible licensing scenario with MPEG RVC
In MPEG-RVC

- Various types of encoded data will be decoded by a single RVC decoding platform.

- How do you charge royalties on the decoder? MPEG-2? MPEG-4? AVC?

- Let’s make the decoding platform ‘royalty free’.
How many patent pools?

- Even with RVC, there could be many patent pools.

- Dual-track approach in MPEG
  - RAND and/or Royalty free codecs possible.
MPEG Patents

- Bitstream (encoded data) and decoding process (decoder)
RAND and RF support in RVC

Decoding Process

RAND Bitstream
A  B  J

RF Bitstream
C  D  J

RAND Component

RF Component

Decoding Process
A  B  C  D  J
Submarine patent OR
Any patent outside patent pool?

Bitstream A

A  B  D  J

Bitstream B

C  B  D  J

Decoding Process

A  B  C  D  J

Submarine Patented Component

Patent Pool Components
Can we charge on encoded data?

☐ Yes. In the same way as copyrights are protected.

☐ In Korea, mobile music market is greater than analog music market.
  ■ 9% of any music content purchase → copyright owners
What is better?

- Pay once. (per decoder unit)
  - Patents

- Pay whenever there is a new purchased content. (per digital media content)
  - Copyrights

- If everyone has his/her MP3 player, they only pay for copyrights from that time on.
Summary

☐ We revisited the issue of IPR protection in digital media contents.

☐ It will be possible to reconfigure multiple standard codecs in MPEG RVC platform.

☐ A new way of defining licensing and business models may be possible with the advent of MPEG RVC.