20

ID code	1927
Name	Pham Minh Khoa

71

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Sampling Frequency should be 2 times higher than signal bandwidth

$f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) : −4

(b) Signed Truncation : −3

(c) Rounding : −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

2

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48\,kHz}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate = $\cancel{\frac{(48 \times 1000) \times 24}{2}} \cdot 6$

(c) Calculate the size of 60[min].

$= 60 \cdot 60 \cdot \frac{(48 \cdot 1000) \times 24}{2} \cdot 6$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing: 18 KHz~~

16

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) complex
(c) good
(e) ~~Poor~~ Good
(d) Poor
(f) good
(g) Poor
(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3

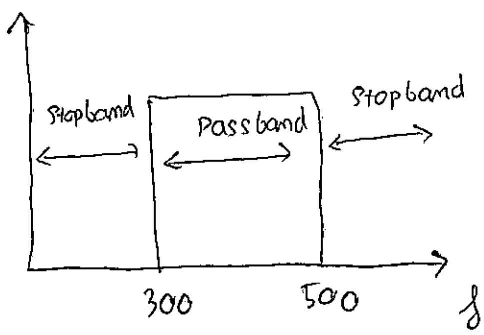
The advantage of FFT compare with DFT is:
- Reduce Multiplication and addition

	DFT	FFT
Multiplication	N^2	$\frac{N(\log_2 N-1)}{2}$
addition	$N(N-1)$	$N\log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

we will use band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

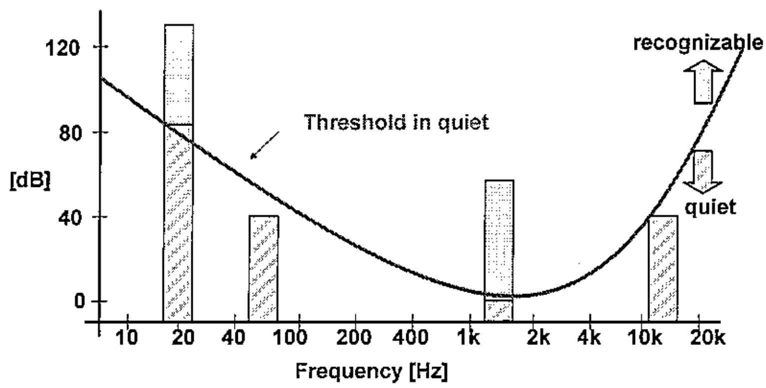
(1) Fourier Transform
Utilize [Time dom , Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Meaning : To realize the effect of dynamic noise in ofi differente frequency

Pourpose: preven recogzizable noise

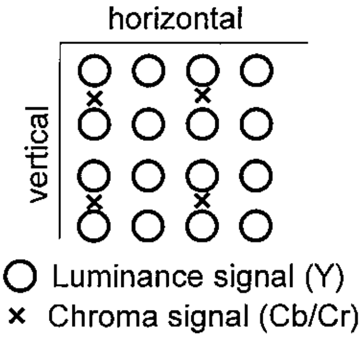
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

3840[pixels/line] × 2160[line/frame] ~~×8~~

2) Calculate chrominance data volume. (Cr and Cb total)

Ans: [$\frac{3840 \times 2160 \cancel{\times 8}}{4}$ · 8 . 3]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times \frac{1}{2} \cdot 3$

unit ?

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 8 \times \frac{1}{2} \times 3 \times 30$ bit/s

6

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

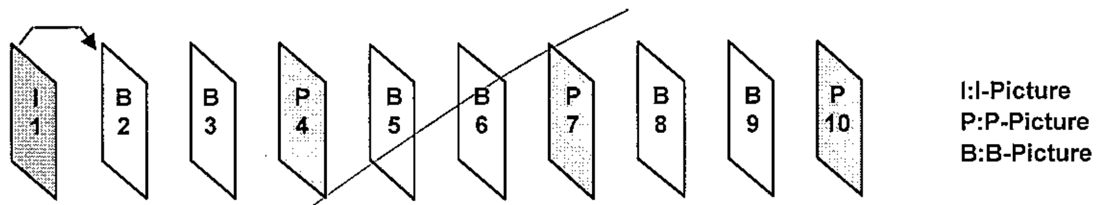
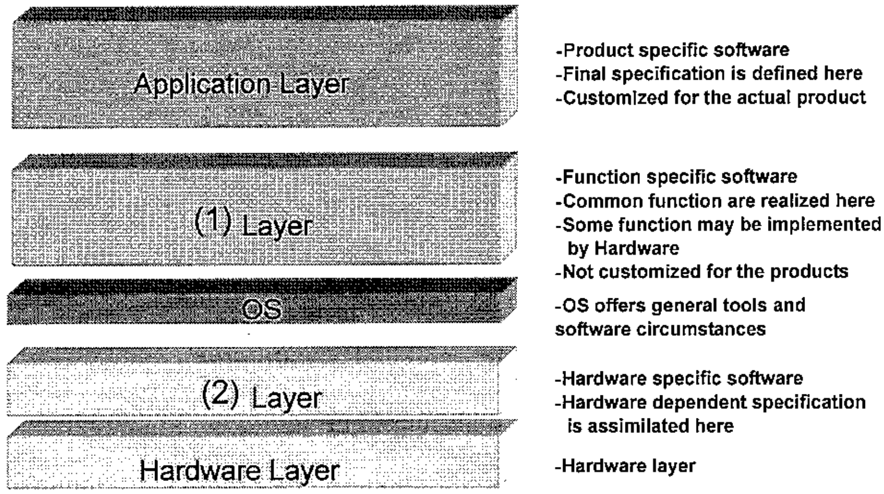


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API ~~b)~~ Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL ~~d)~~ Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAXIL server as a low-level interface for audio video and imaging codec used in embedded device
It gives application and media framworks a ability to ~~work~~ inteface with multi media codecs and supporting component in a unified manner

2

23

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~~75~~ 79

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 - The sampling frequency should be 2-times higher than the signal bandwith (Nyquist frequency)

$f_s > 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 \cdot f_M \Rightarrow f_M \leq \frac{f_s}{2} = \frac{48\,kHz}{2} = 24\,kHz \Rightarrow f_{max\ CD} = 24\,kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

[Bit/sec] = (f_s) (linear PCM) . (6 channels) = 48.1000. 24 . 6 ~~8~~ [?]

(c) Calculate the size of 60[min].

[data] = (Bit/sec).(time) = 48.1000 . 24. 6 . 60. 60 ~~8~~ [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_s = 48\,kHz < 2 \cdot f_M = 2 \cdot 30\,kHz$

=> Aliasing happen ~~and~~ aliasing signal frequency 2.30 - 48.

1.4 Following table shows the merit and demerit of analog & digital processing.

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
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Cost	Reasonable	Expensive
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Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) ~~Poor~~ Good

(d) Poor

(f) Good

(g) Poor

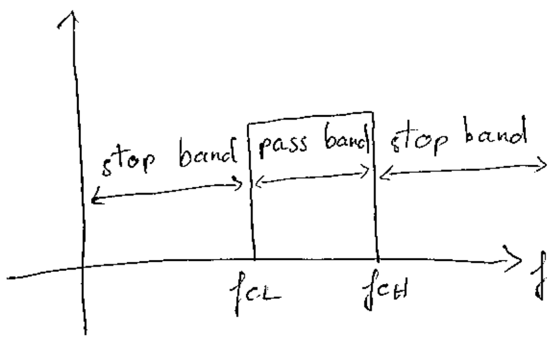
(h) Good

2 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

	DFT	FFT
Multiplication (complex)	N^2	$\frac{N(\log_2 N-1)}{2}$
Addition (complex)	$N(N-1)$	$N\log_2 N$

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We should use filter Band Pass Filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

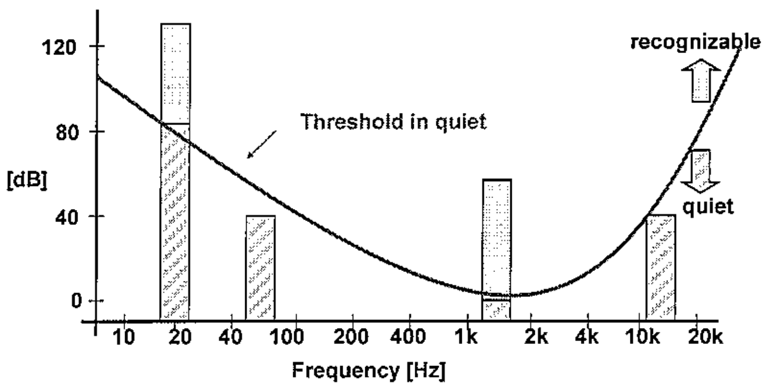
(1) Fourier Transform
Utilize [Time – Frequency Transformation – Fourier] transformation.

(2) Stereo Coding
Utilize the property of [~~correlation concatation~~ correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance – Entropy Coding.

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



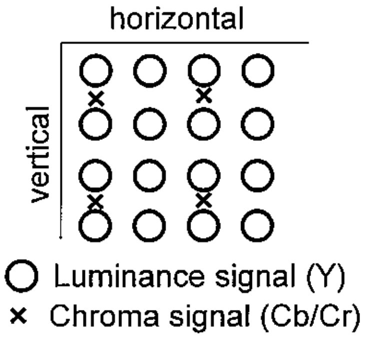
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \cdot 2160 \cdot 8 \cdot 3 \cdot 1/2$ [bits/frame]

[pixel/line] · [line/frame] · [bits/pixel]]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \cdot 2160 \cdot 12 \cdot 30$ [bps]

[pixel/line] [line/frame]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[3840 [pixel/line] · 2160 [line/frame] · $12 \cdot 30 \cdot \frac{1}{100 \cdot 10^6 \text{ [bps]}}$]

9

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

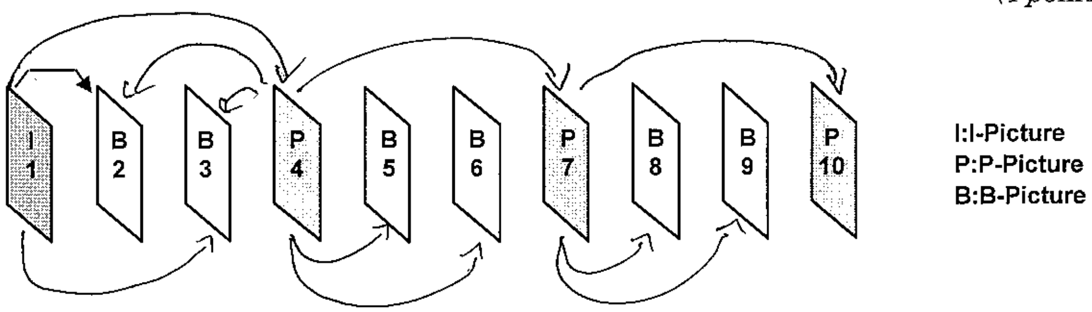


Figure 2.1. Prediction of MPEG1/2 Video coding

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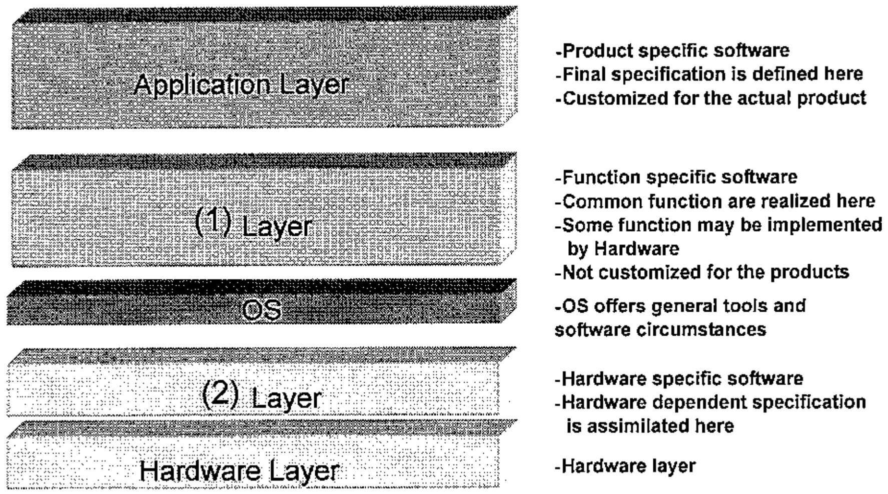
Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Media components can be intergrated into flexible media graphis for advanced streaming media processing
- OpenMAX IL Server as a low-level ~~intergrate~~ interface for audio, video, and imaging codecs used im embedded device.

2

It gives application and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner

ßM 19

ID code 1942	1942
Name	SIEU HOANG

52

RVC "System Solution" **Examination** November 24, 2017

54

1. Digital Signal Processing

0) 1.1 How to prevent "Aliasing"? *(3 points)*

→ use analog signal which has frequency lower than sampled frequency.

→ increase sampled frequency bigger than analog frequency which you use.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) -3

(b) Signed Truncation -4

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

4
6

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48}{2} = 24\ kHz$ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = $f_s \cdot 24 \cdot 6$ = ~~$48 \cdot 10^3 \cdot 6$~~ 9 [X]

(c) Calculate the size of 60[min].

size = bit rate . 60 . 60 = ~~48 . 10 . 6 . 60 . 60~~ [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

they will got aliasing ~~signal~~ error occurs

⇒ $f_{aliasing} = f_{analog} - f_m = 30 - 24 = 6\ kHz$ X

16

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
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Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) good

(e) ~~poor~~ good

(d) ~~Poor~~ ~~Difficult~~ poor

(f) ~~Good~~ ~~Easy~~ Good

(g) ~~Expensive~~ poor

(h) ~~Reasonable~~ Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

10

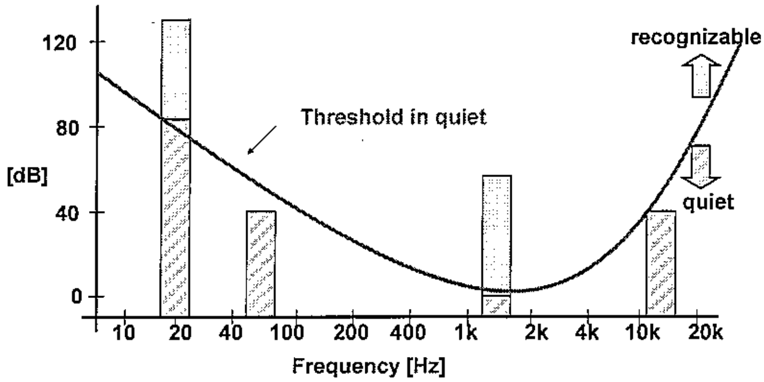
(1) Fourier Transform
Utilize [~~Modified Discrete~~ Cosine] transformation.

(2) Stereo Coding
Utilize the property of [Correlation ~~between~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)

10



3. Video Coding

3.1 Picture format
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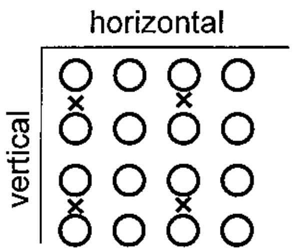

○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$\frac{3840 \times 2160}{4} \cdot 2 = 4147200$ [pixels/frame]]

$\frac{3840 \text{ [pixels/line]} \times 2160 \text{ [lines/frame]}}{4} \cdot 2$

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [data volume $= 3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} = \cancel{3840}\ 3840 \cdot 2160 \cdot 12$

$= 3840\ [\text{pixel/line}] \cdot 2160\ [\text{lines/frame}] \cdot 8\ [\text{bits}] \cdot 3 \cdot \frac{1}{2}$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [

9

datarate = data volume $\cdot$ 30 [frame/sec] $= 3840 \cdot 2160 \cdot 12 \cdot 30$]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[compression ration $= \dfrac{100 \cdot 10^6}{\text{data rate}} = \dfrac{100 \cdot 10^6}{3840 \cdot 2160 \cdot 12 \cdot 30}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans.	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

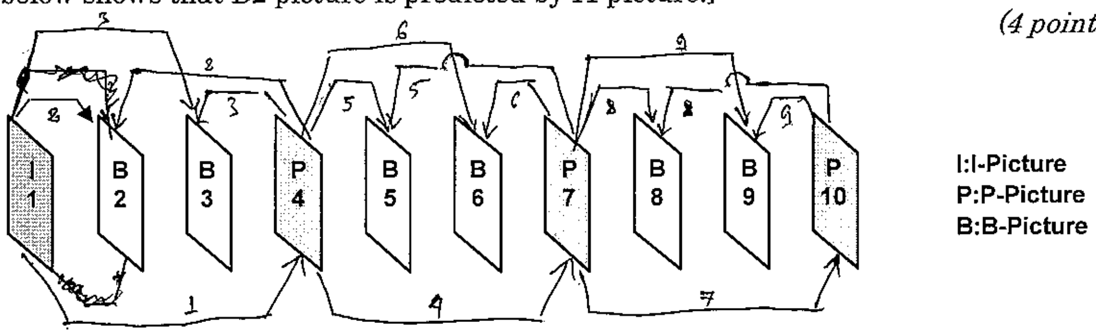

Figure 2.1. Prediction of MPEG1/2 Video coding

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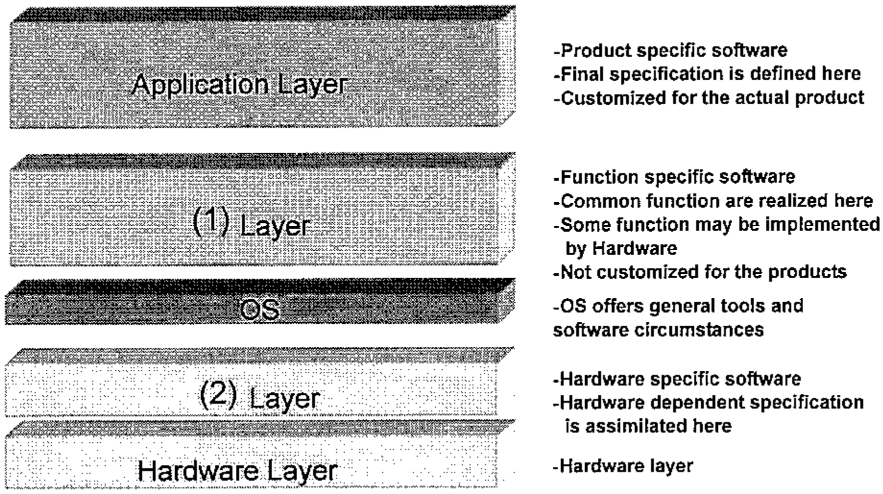

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0

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

14

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Name	NGUYEN ANH TUAN

~~65.5~~

62.5

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

10 1.1 How to prevent "Aliasing"? *(3 points)*

Aliasing 9 $F_s < 2.f_m$

Aliasing freq : $f_a = F_s - f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

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1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2.f_m \rightarrow f_m \leq \frac{f_s}{2} = \frac{48000}{2} = 24000\ Hz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (48 \times 1000) . 16 . 6 = 48000 . 96 = \cancel{4608000}$

(c) Calculate the size of 60[min].

datasize = bitrate . $(60 * 60) = 4608000 . 60 . 60 = \cancel{16588800000}$ bit

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$\Rightarrow$ Alias 18KHz $(f_s - f_m)$

1.4 Following table shows the merit and demerit of analog & digital processing.
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16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)
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Portability	Difficult	Easy

(a) Simple (b) Complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

2

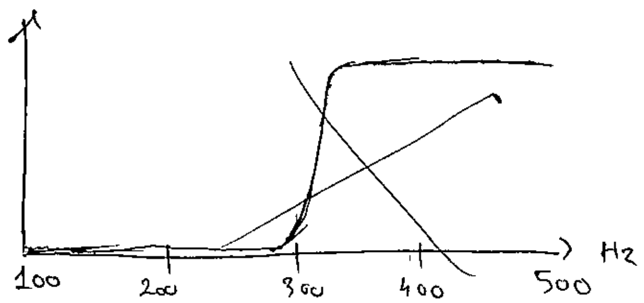
Calculation number

	DFT	FFT
Multiplex (complex)	N^2	$\frac{N(\log_2 N - 1)}{2}$
ADD (complex)	$N(N-1)$	$N \log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1.5

We need to use band pass filter



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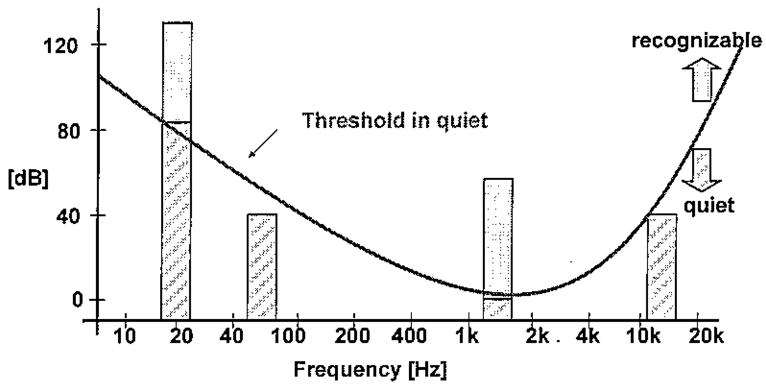
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

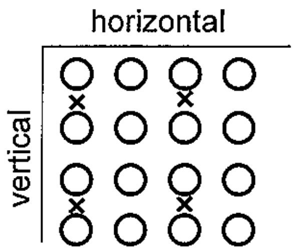
10



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

3840 × 2160 × 8 . 3 . 1/2 = 103372800

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \cdot 2160 \cdot 12 \cdot 30$ [bit/sec]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

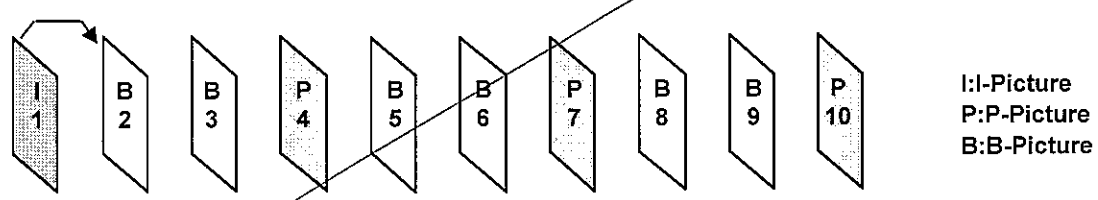
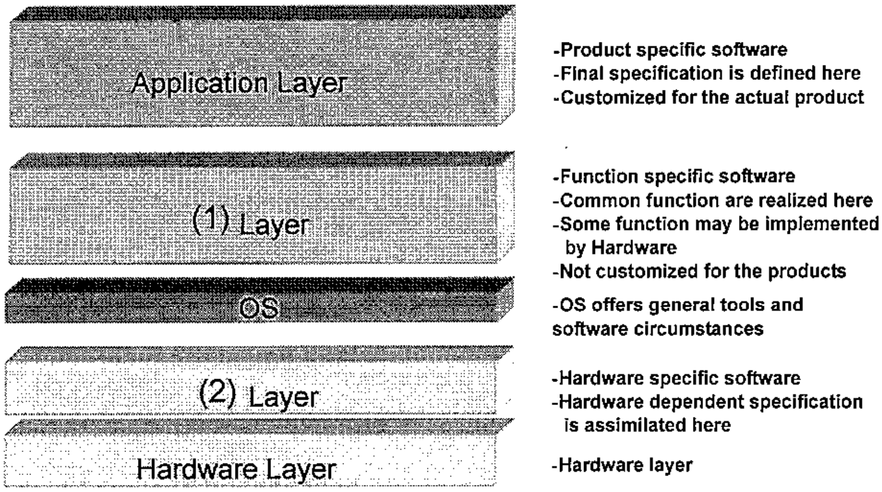


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as a low-level interface for audio video and imaging codes used in embedded device

2 It give application and media frameworks the ability to interface with multimedia codecs and supporting components in a instfied manner

21

ID code	1967
Name	Cuong. The Ton

~~18~~ 86

RVC "System Solution"

Examination

November ~~24~~, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampling frequency at least greater than or equal to two times max frequenc

$f_s \geq 2 f_{max}$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) (-4)

(b) Signed Truncation (-3)

(c) Rounding (-4)

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$$F_{max} = F_s/2 = 48/2 \text{ kHz} = 24 [\text{kHz}]$$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$$\text{Bitrate} = 48 \cdot 10^3 \times 24 \times 6 \ [\text{Bit/sec}]$$

~~4~~

(c) Calculate the size of 60[min].

$$\text{Datasize} = 48 \cdot 10^3 \times 24 \times 6 \times 60 \times 60 \ [\text{bit}]$$

~~4~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliacing is occur ; $F_{alias} = F_s - F_m = 48 - 30 = 18 [\text{kHz}]$

1.4 Following table shows the merit and demerit of analog & digital processing.
16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3 FFT is reducing the calculation compare with original DFT

Number of calculation :	DFT	FFT
multiplication	N^2	$\frac{1}{2}N(\log_2 N - 1)$
addition	$N(N-1)$	$N \log_2 N$

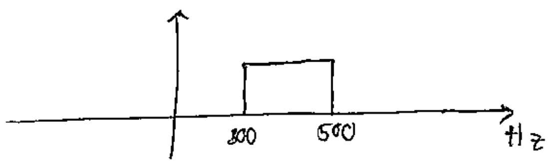
◇ assume calculating 4 point

- FFT ~~were~~ need 2 multiplication & 8 addition
- DFT we ~~n~~ need 16 multiplication & 12 addition

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

Band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

12

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time → Frequency] transformation.

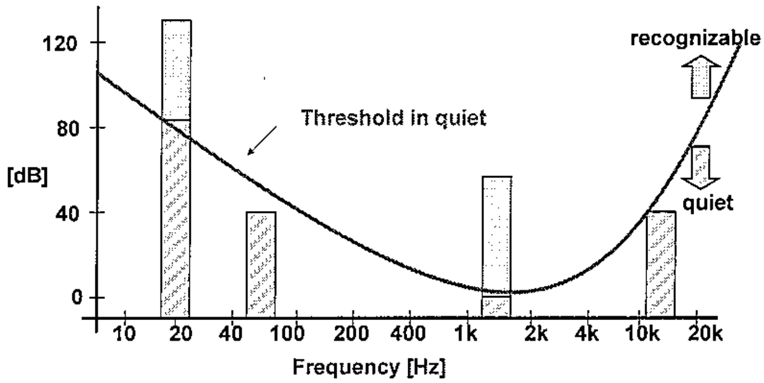
(2) Stereo Coding
Utilize the property of [~~Collerative~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

3

(5 points)

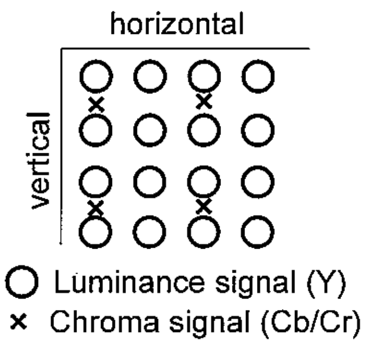


~~Remo~~ Remove the signal in quiet place (lower than threshold) to reduce data size. ~~Re~~ Keep the signal in the recognizable place.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$3840 \times 2160 \times \frac{1}{2}$ unit?]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2}$ unit ?]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 8 \times 3 \times 0{,}5 \times 30$ unit ?]

9

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$[3840 \times 2160 \times 12 \times \cancel{30}] / [100\ 10^6] \sim 2.600$ unit]

3.2 Coding technology (MPEG)
MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT —— a) Probability theory technique

2) VLC —— b) Time Domain technique

3) MC —— c) Frequency domain technique

0

3.3 Prediction method (MPEG)
(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]
(4 points)

4

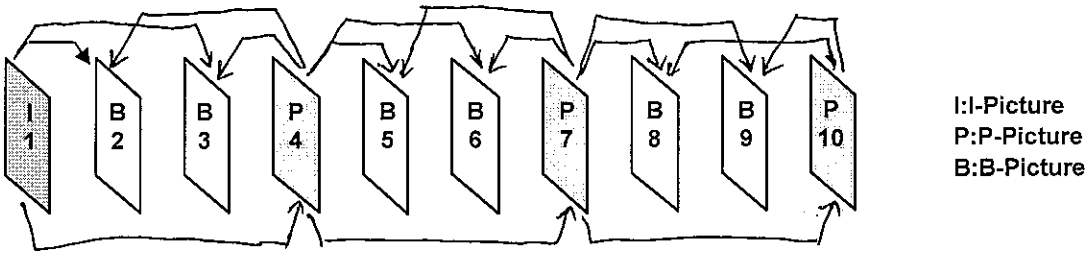
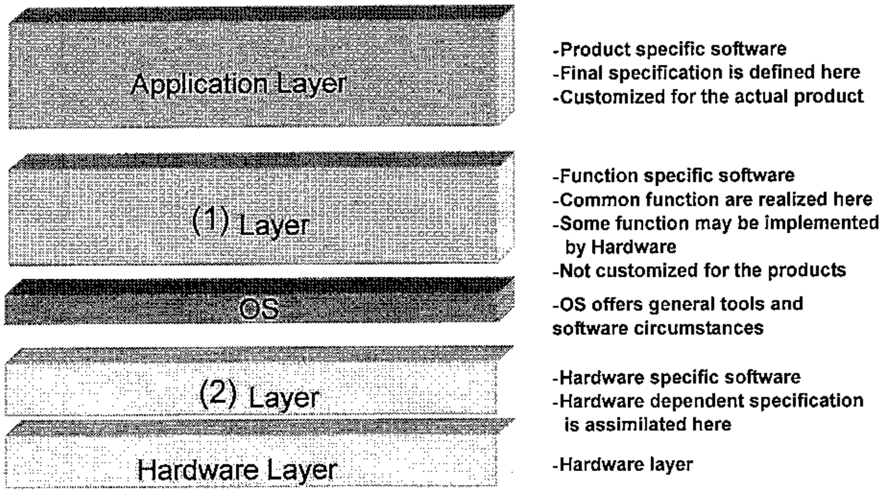


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

It give applications and media frame works the ability to interface with multimedia codecs and supporting components in a unified manner (standar)

2

12 + 3

ID code	1983
Name	Truong Thi Thuy Liem

~~62~~ 70

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 To prevent "Aliasing": $f_s \geq 2 \times f_m$ (where f_s: sampling frequency
f_m: frequency bandwidth).

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) $-\cancel{3}$.

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$= 48\ KHz \times \frac{1}{2}$ x [?]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= 48 \times 1000 \times 24 \times 6$ x [?]

(c) Calculate the size of 60[min].

$= \text{bitrate} \times 60 \times 60 = 48 \times 1000 \times 24 \times 6 \times 60 \times 60$ x [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

aliasing signal appear with $f_{aliasing} = 48\ KHz - 30\ KHz$ [x]

16 1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good.

2 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT has cost lower DFT.

Cost table.	DFT	FFT
multiply(*)	N^2	$\frac{N(\log_2 N-1)}{2}$
addition (+).	$N(N-1)$.	$2N\log_2 N$.

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

2. Audio Coding

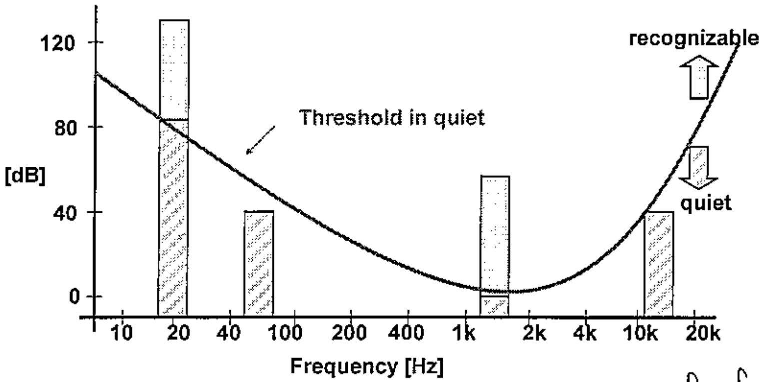
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance.].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)



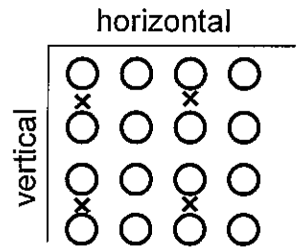
meaning: the voice has frequency smaller threshold that can not recognizable by human.

Purpose: In Audio Encoding, we will remain signals which have frenquency higher threshold.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 (pixels/line) × 2160 (lines/frame)
× 8 × 3 × $\cancel{4}$/3 ~~× 30 (frames/sec)~~]

3) Calculate total data volume of 1 UHD/4K ~~Video~~ data

Ans: [~~3?0~~ $3840 \times 2160 \times 8 \times 3 \times \frac{2}{3}$ × ~~?~~]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \times 2160 \times 8 \times 8 \times \frac{2}{3} \times 30$]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$(3840 \times 2160 \times 8 \times \cancel{8} \times \frac{2}{3} \times 30)/(100 \times 10^6)$.]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

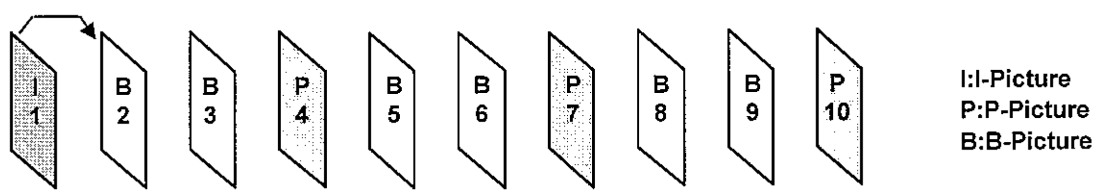
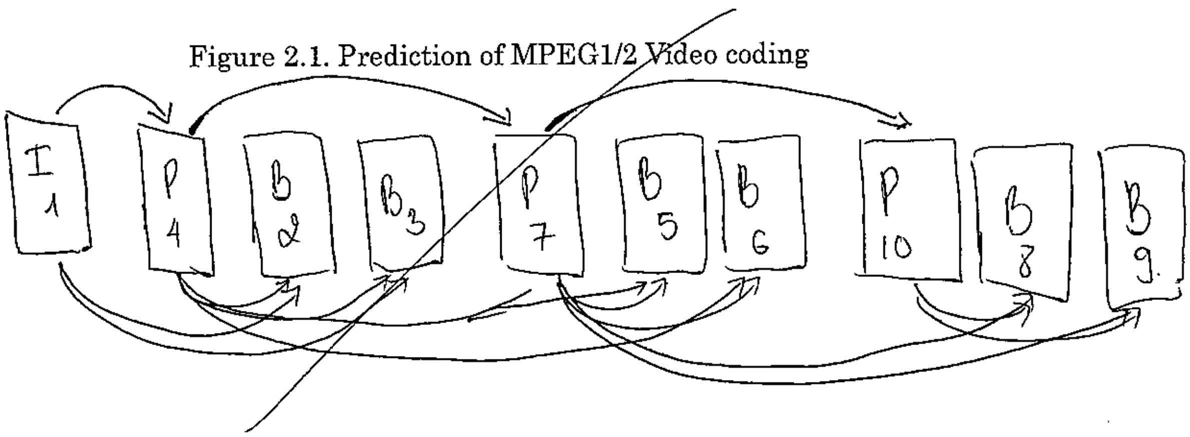
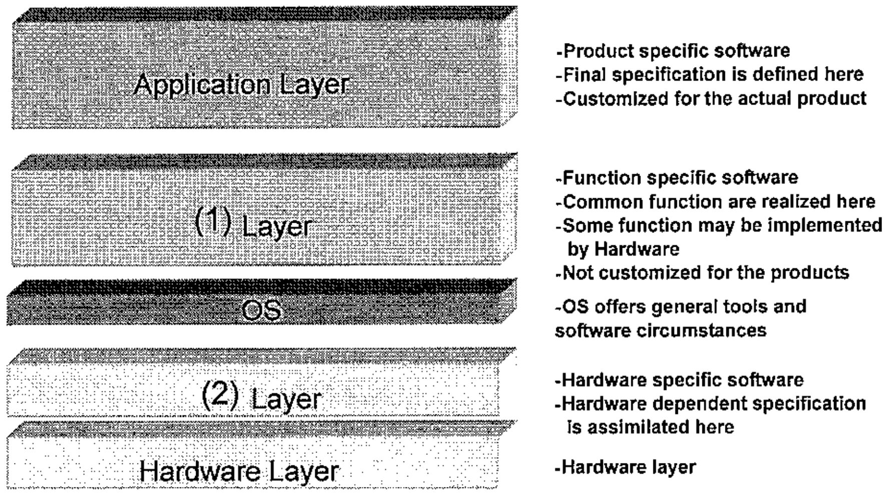


Figure 2.1. Prediction of MPEG1/2 ~~Video~~ coding



4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

19

ID code	1985
Name	Long Mai

68

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 - the sampling frequency should be 2times higher than signal band width (Nyquist frequency).
- If the condition in adapted, the signal can be preproduce from sampled data.

formula: $f_s \geq 2 . f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

-2

(b) Signed Truncation

~~-4~~

(c) Rounding

-3

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

14

(a) Calculate the maximum frequency CD can re-produce.

$\cancel{f_s \geq 2}$ $f_s \geq 2 . f_m \Rightarrow f_m = \frac{f_s}{2} = \frac{48kHZ}{2} = 24kHZ$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48.1000).24.6 = 6912,000 bps

(c) Calculate the size of 60[min].

data size = bit rate .(60.60) = 6912000.3600 = 24883,2 Mbps

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

the aliasing error occour with 18kHZ 1

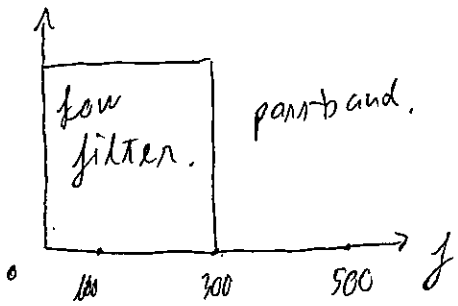
1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)
(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (　　　)	(b) (　　　)
Cost	Reasonable	Expensive
Quality	(c) (　　　) : for original signal (d) (　　　) : for repeating copy & signal transfer	(e) (　　　) : for original signal (f) (　　　) : for repeating copy & signal transfer
Stability	(g) (　　　) : for time variant, etc	(h) (　　　) : for time variant, etc
Portability	Difficult	Easy

(a) Simple　　　　(b) Complex
(c) good　　　　(e) good
(d) poor　　　　(f) good
(g) poor　　　　(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*
1
FFT is not complex than DFT.
?

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*
0
using low filter



2. Audio Coding

2.1 Fill-out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

15

(1) Fourier Transform
Utilize [time — Frequency ~~trans~~ and Fourier] transformation.

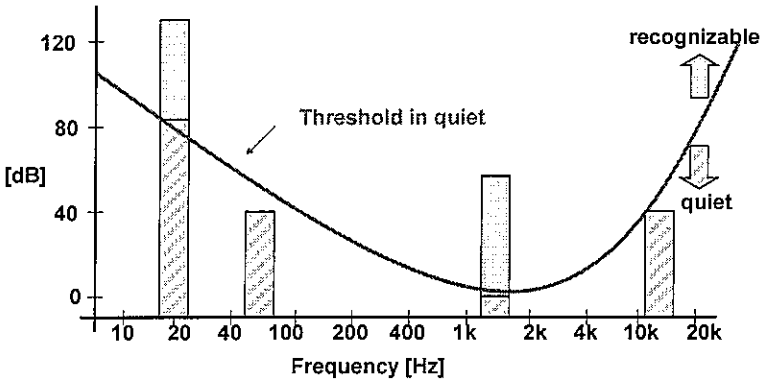
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

(5 points)



keep the ~~adu~~ audio ~~is the~~ low ~~than the~~ threshold to encode the data for unrecognizable.

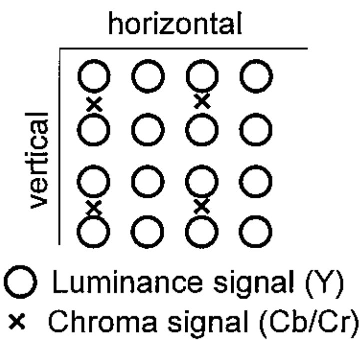
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

3840[pixels/line] × 2160[lines/frame] × 8[bit/pixel] × 2. 1/2

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840[pixels/line] x 2160[line/frame] x 8[bits/pixel] x 3 x $\frac{1}{2}$]

4) Calculate total data rate of UHD/4K Video data above
Ans: [
3840[pixel/line] x 2160[line/frame] x 30 [frame/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

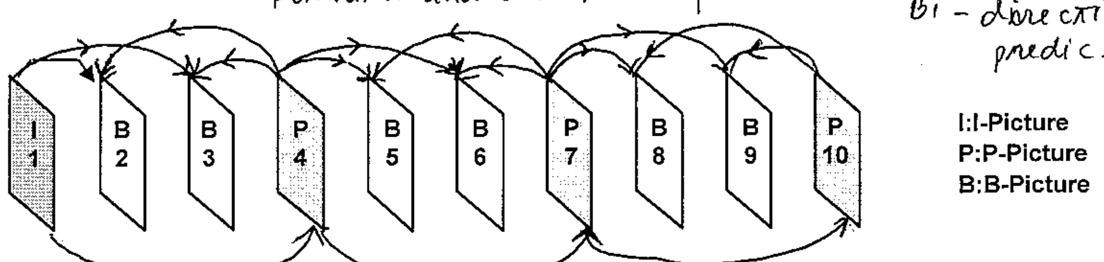
6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

forward and backward prediction → Bi-direction prediction *(4 points)*

4

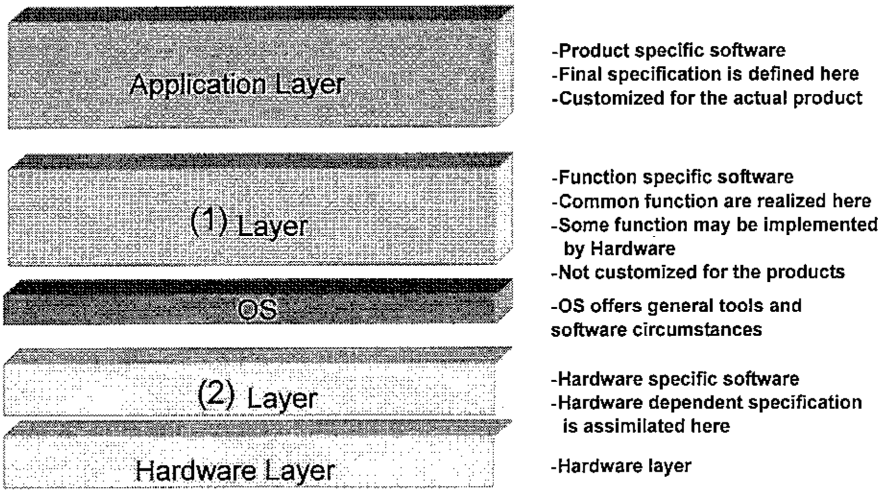


forward ~~and bac~~ prediction

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Cross-platform using C programming interfaces, provides abstraction for routines especially useful for audio, video and image

O

- OpenMax IL serves a low level interface for audio, ~~video~~ video, and imaging codes used in embedded devices.

-

22

ID code	1989
Name	Hồ Phương Ngọc

~~69.5~~

71.5

RVC "System Solution"

Examination

November ~~24, 20~~17

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

To prevent "Aliasing", the sampling frequency should be 2 times higher than the signal bandwidth

$f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off)

~~4~~

(b) Signed Truncation

-3

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~16~~

8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq f_s / 2$

The maximum frequency CD can reproduce is 48 kHz/2 = 24 kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = (48 × 1000) × 24 × 6 [X]

(c) Calculate the size of 60[min].

data size = bit rate × (60 × 60) [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing occurs ($f_m > f_s/2$)

Alias 18 kHz

!

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5 faster

1.6 Suppose a signal whose ~~frequency~~ from 100Hz to 500Hz. Which kind of filter we should use to keep the compone~~nts whose~~ frequency from 300Hz to 500Hz and remove the others? Draw the figure of tha~~t filter~~? *(3 points)*
0 ~~Digital filter~~

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

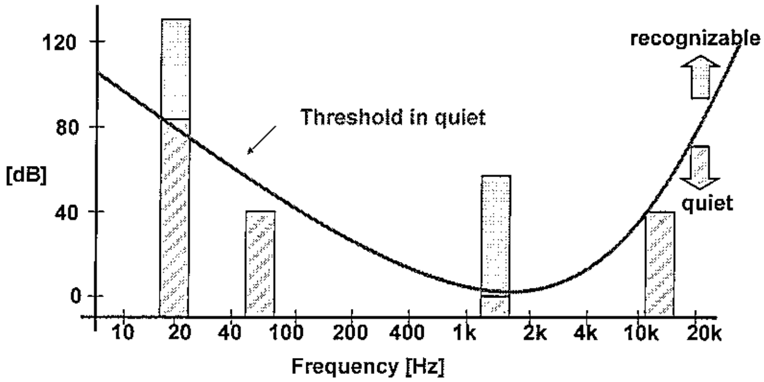
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Describe frequency region and attenuator can be heard by human

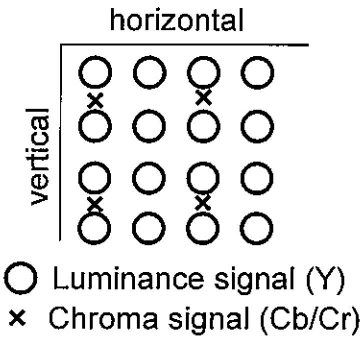
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 × 2160 × 8 × ~~[illegible]~~ × ~~30~~ × 1/2 unit ?]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2 \times \cancel{30}$ unit ?

]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2 \times 30$ unit ?

$= 3840 \times 2160 \times 12 \times 30$]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$3840 \times 2160 \times 12 \times 30 / 100 \cdot 10^6$ unit ?]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT a) Probability theory technique

2) VLC b) Time Domain technique

3) MC c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

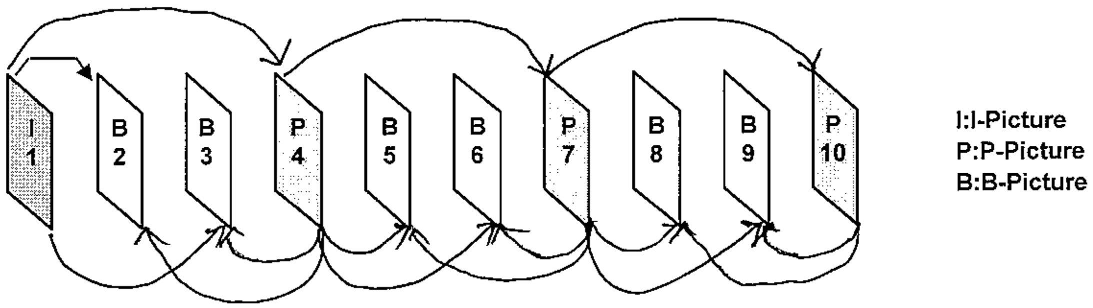
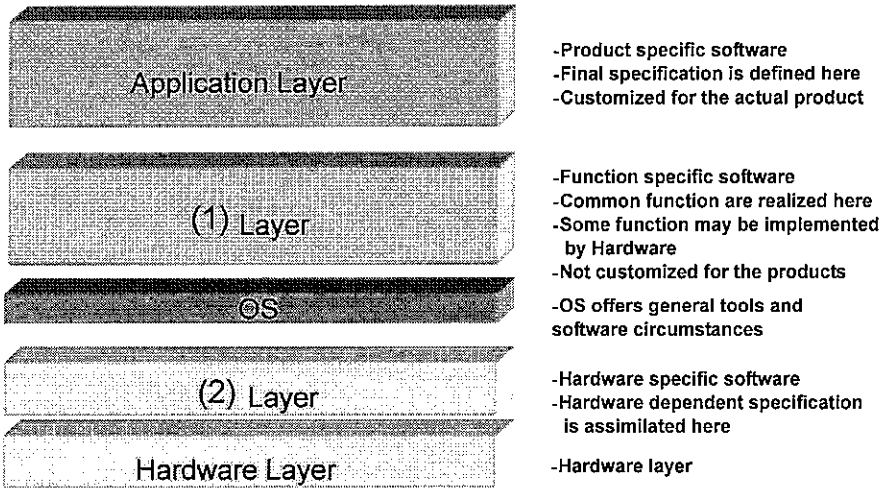


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

18

ID code	1994
Name	Nguyen Van phuong

~~70~~ 78

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 To prevent "Aliasing" we need sample frequency bigger or equal at least 2 times of frequency of target $f(s) \geq 2 \times f(m)$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding ~~-3~~ -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2f_m \rightarrow f_m \leq \frac{f_s}{2} \Rightarrow Max\, f_m = \frac{f_s}{2} = 24\,kHz$ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 . 1000 . 24 . 6 (bit/sec) ✓

(c) Calculate the size of 60[min].

data = bitrate . second = 60 . 60 . 48 . 1000 . 24 . 6 (bit) ✓

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

digitalized signal will be alias
$f_{alias} = 48 - 30 = 18 (kHz)$ ✓

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
12 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (~~Poor~~) : for time variant, etc	(h) (~~Good~~) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) Good

(d) Poor

(f) Good

(g) ~~Poor~~ ~~Difficult~~

(h) ~~Good~~ ~~Easy~~

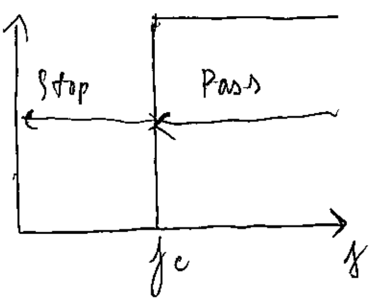
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

High Pass Filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

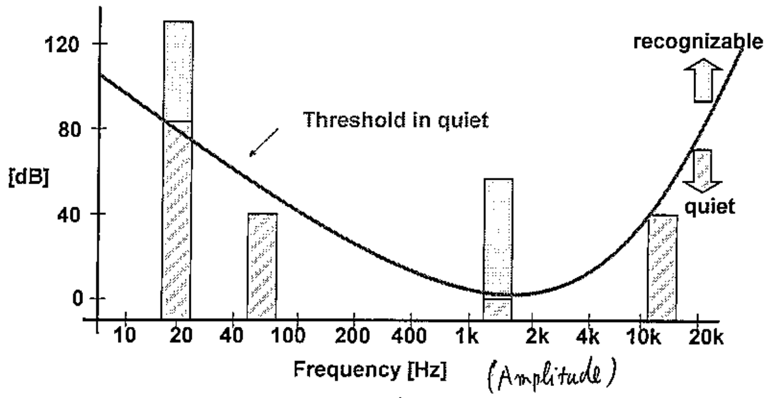
(1) Fourier Transform
Utilize [~~property of correlation~~ time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



This model figure out relation of dB and frequency for human's ears.

for human can't hear (below threshold)

for human can hear (above threshold)

so we can't delete the information that we can't heare → reduce data size of audio.

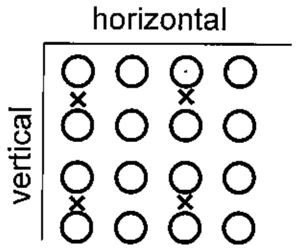
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 bits ※ × 2 × $\frac{1}{2}$]

Cb+Cr

half sample both direction

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/frame] × ~~8[bits/pixel] 3 × $\frac{1}{2}$~~ 8bits × 3 × $\frac{1}{2}$]

~~bits/sample~~ ~~both direction~~

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/lines] × 2160 [lines/frame] × 30 [frames/sec] × 12 [bits/pixel]
= .... [bit/sec]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans: [~~3840~~ $100 \cdot 10^6$ [bit/sec] / {3840 [pixels/lines] × 2160 [lines/frames] × 30 [frames/sec] × 12 [bits/pixels]}]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique — 1 ↔ c

2) VLC — b) Time Domain technique — 2 ↔ a

3) MC — c) Frequency domain technique — 3 ↔ b

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

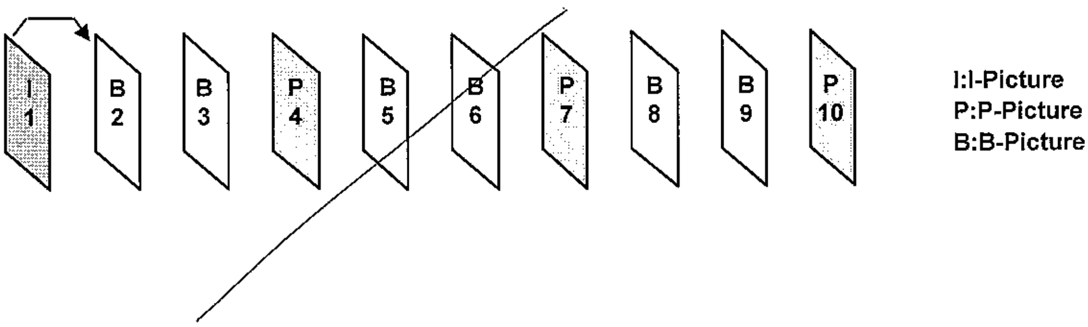
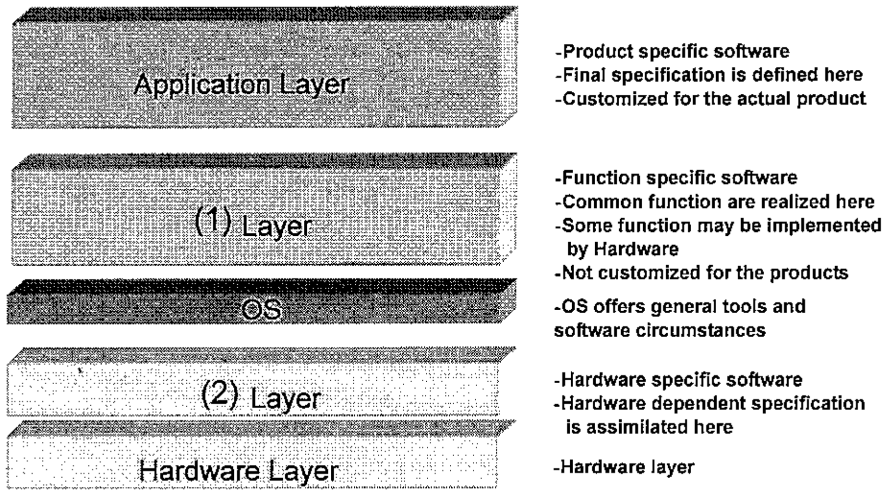


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

20

ID code	SW 1885
Name	Tran Ngoc Quang

65

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1 1.1 How to prevent "Aliasing"? *(3 points)* 0

If the sampling frequency is higher than Nyquist frequency, Aliasing error doesn't occur.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

8

(a) Calculate the maximum frequency CD can re-produce.

$\frac{48}{2} = 24$ [?]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 kHz * 24 bit * 6 channel = 6,9 Mbps

(c) Calculate the size of 60[min].

~~6,9 x 60 = 414 MB~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing error · ~~18 kHz~~ !

1.4 Following table shows the merit and demerit of analog & digital processing.
12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple ✓ (b) Complex ✓

(c) Good ✓ (e) Good. ✓

(d) ~~Good~~ ~~Difficult~~ poor ✓ (f) ~~Easy~~ Good ✓

(g) ~~Good~~ ~~Different~~ (h) ~~Easy~~.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

07 FFT (Fast Fourier Transform)

FFT is fast calculation algorithm of DFT. for $N = 2^m$ case.

- DFT definition:

$$X(K) = \sum_{n=0}^{N-1} x(n) W_N^{kn}$$

$$W_N^{kn} = e^{-j\frac{2\pi kn}{N}}$$ ~~when~~ ~~N~~ (~~N>K~~)

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*
10

High pass filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

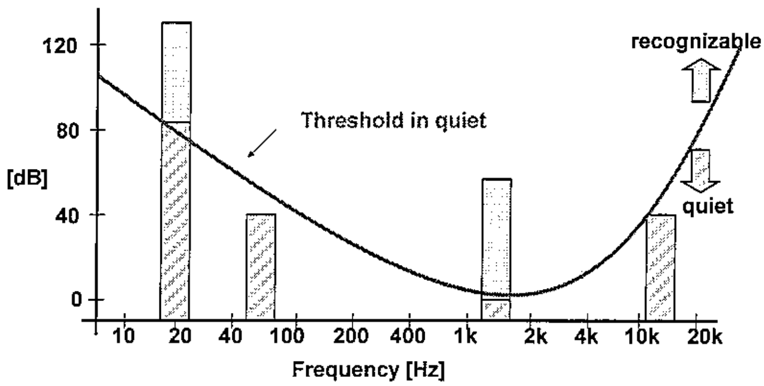
(1) Fourier Transform
Utilize [Time – Frequency] transformation.

(2) Stereo Coding
Utilize the property of [Correlation ~~between~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance.].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

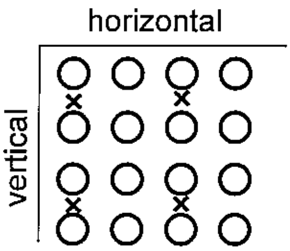
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

$Y = 0.257 \cdot R + 0.504 \cdot G + 0.098 \cdot B + 16$

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

$Cb = -0.148 R + (-) 0.291 \cdot G + 0.439 \cdot B + 128$
]

$Cr = 0.439 R + (-) 0.368 \cdot G - 0.071 B + 128$

$R = 1.164 (Y - 16) + 1.596 (Cr - 128)$
$G = 1.164 (Y$ …

$B = 1.166\ (Y - 16) + 2.017\ (Cb - 128)$.

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixel / line] * 2160 [line / frame] * 8 [bit / pixel] * 3 * 1/2 .]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 * 2160 * 30 [frame / sec] * 12 [bit / frame]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT	c	a) Probability theory technique
	2) VLC	a	b) Time Domain technique
	3) MC	b	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

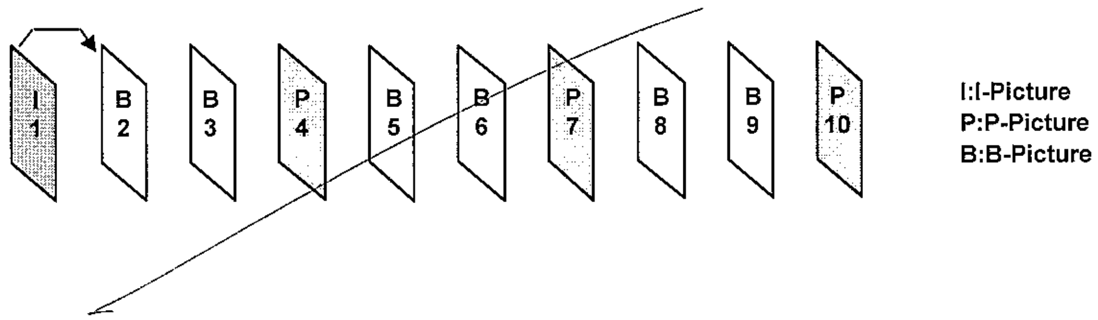
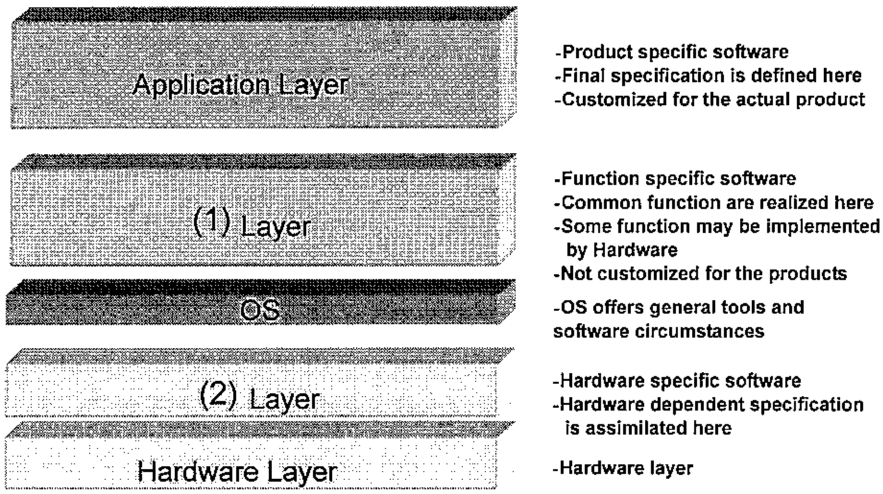


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

+ Open Max is a royalty-free, cross platform set of C language programming interfaces that provides abstractions for routines especially useful for audio, video and still images.
+ open Max IL serves as a low-level interface for audio, video, and imaging codes used in embedded devices.
+ It gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner

20

ID code	1596
Name	VƯƠNG THỊ THI

65

73

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3

1.1 How to prevent "Aliasing"? *(3 points)*

In theory: + The sampling frequency should be 2-times higher than the signal bandwidth
$f_s \geq 2 . f_m$ (*)
+ If (*) true, the signal can be reproduced from sampled data.
+ If the sampling frequency is not higher than Nyquist frequency, Aliasing error occurs.
So, If prevent "Aliasing", need keep sampling frequency higher than Nyquist frequency.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round-off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

16

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 . f_m \Rightarrow f_m = f_s / 2 = 48/2$ (kHz) $= 24$ (kHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = ~~...~~ $(48 * 1000) * 24 * 6$ (bit/sec)

(c) Calculate the size of 60[min].

data size = bit rate $* (60 * 60)$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing error occurs, because $f_s < f_{Nyquist}$
$\Rightarrow f_A = 48 - 30 = 18$ (kHz).

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)
(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple　　(b) complex
(c) good　　(e) good
(d) poor　　(f) good
(g) poor　　(h) good

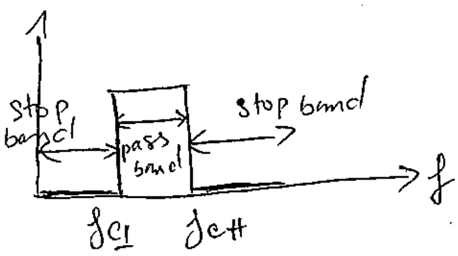
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

we should use band pass filter to keep components with frequency from 300Hz to 500Hz.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

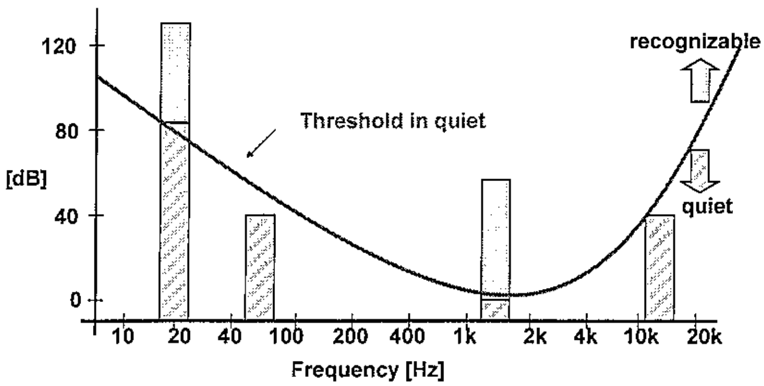
(1) Fourier Transform
Utilize [Time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



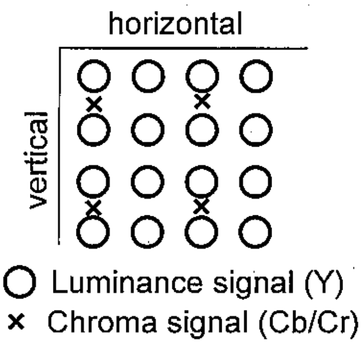
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] x 2160 [lines/frame] x 8 [bits/pixel] x 3 x 1/2

= 3840 x 2160 x 12 (bits/frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 x 2160 x 12 [bits/frame] x 30 [frame/sec]

= 3840 x 2160 x 12 x 30 (bps)]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans: [Compression ratio improve ~~70%~~ from MPEG-1.]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.

1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

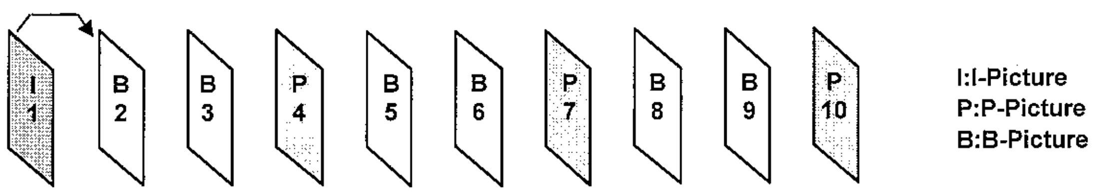
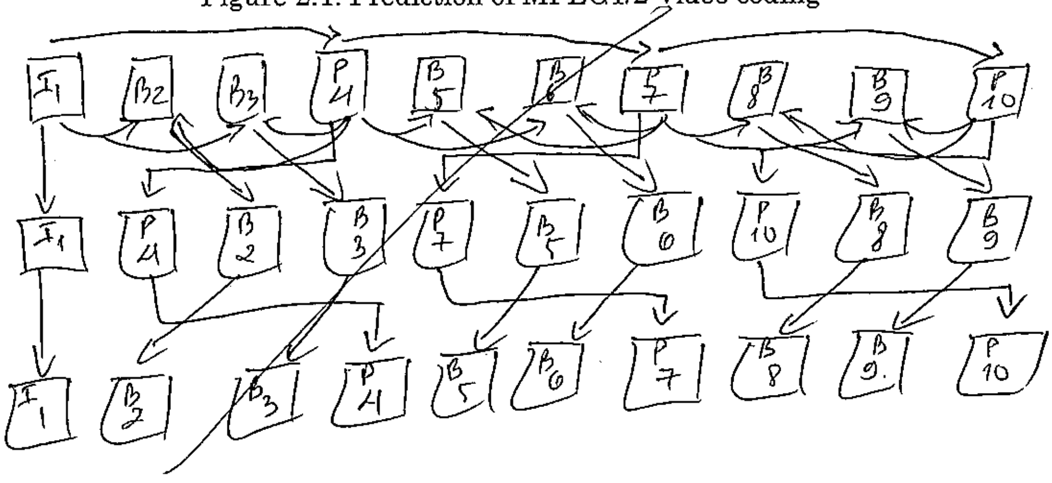


Figure 2.1. Prediction of MPEG1/2 Video coding

original order

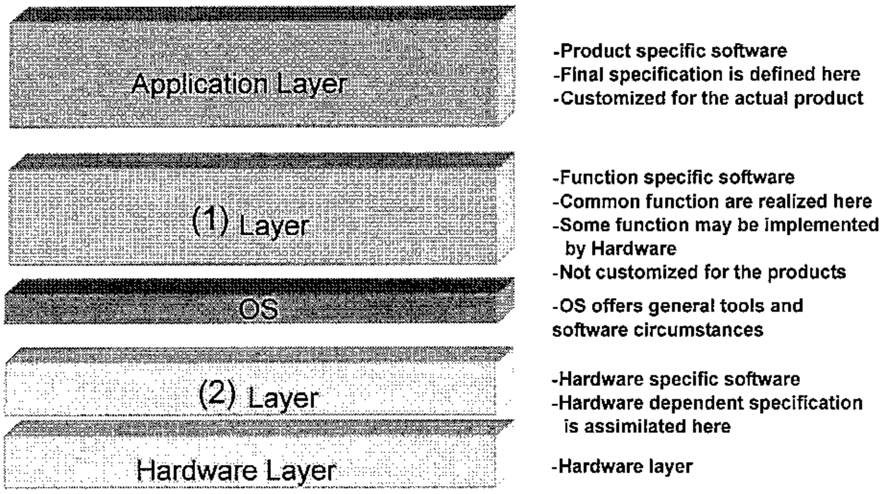
encoding/decoding

displaying



4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- open MAX is a royalty-free, cross-platform, set of C-language programming interface that provices abstractions for routines especially useful for audio, video, still images.

2

- open max IL Server as a low-level interface for audio, video, and imaging codecs used in embedded devices.

-> It gives applications and media frameworks the ability to interface with multimedia codecs & supporting components in a unified manner.

18

ID code	2008
Name	Nguyễn Văn Thật

62

80

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

3

1.1 How to prevent "Aliasing"? *(3 points)*

$f_s \geq 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) -3

(b) Signed Truncation -4

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~

14

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq \frac{f_s}{2} = \frac{48}{2} = 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate $= 48 \cdot 10^3 \times 24 \times 6 = 15925248$ (b/s) ?

(c) Calculate the size of 60[min].

Size = Bit rate . 60 . 60 = 15925248 . 60 . 60 (bit) ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_a = f_s - f_m = 48 - 30 = 18 \Rightarrow$ aliasing

[?] $\triangle$?

1.4 Following table shows the merit and demerit of analog & digital processing.
16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Sim)	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple
(b) Complex
(c) good
(e) good
(d) poor
(f) good
(g) poor
(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

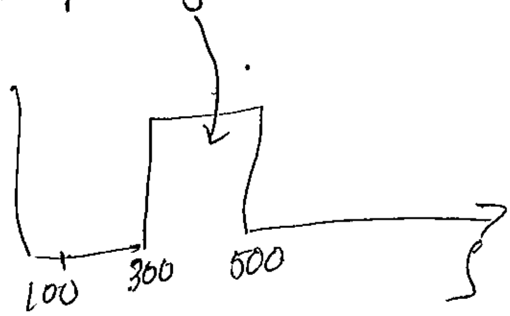
1

less mul & add component

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

=> band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

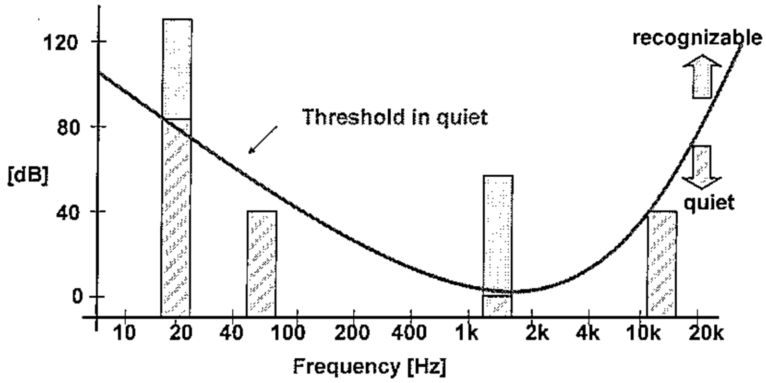
(1) Fourier Transform
Utilize [Time-Freq transform] transformation.

(2) Stereo Coding
Utilize the property of [corelation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



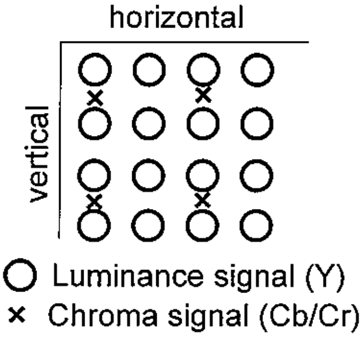
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 pixels/line X 2160 line/fram x 8 x 3]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 pixels/line x 2160 line/frame x 8 x 3 x ~~24 x 30~~ 1/2 (bps)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 pixels/line x 2160 line/frame x 12 x 30 frame/S]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

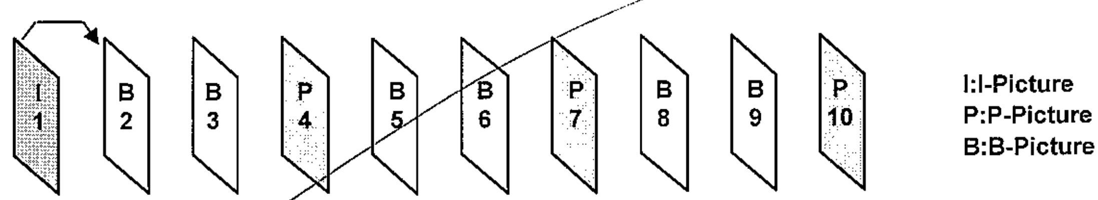
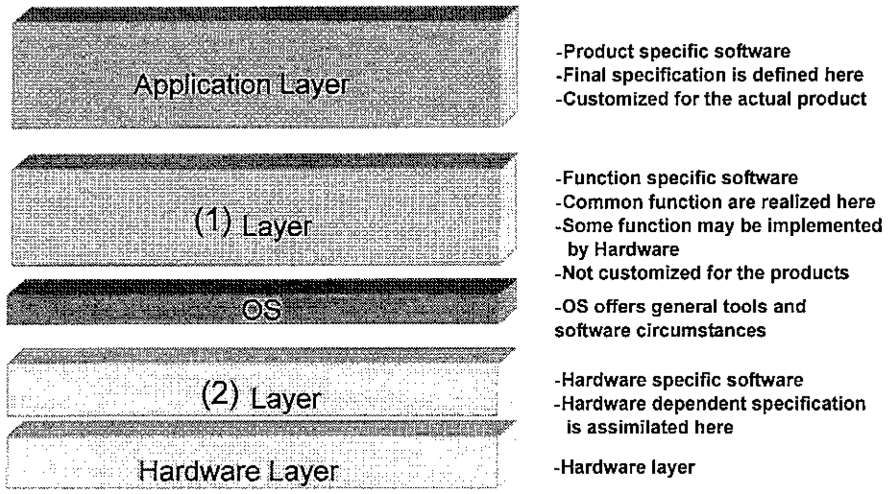


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

13

ID code	2009
Name	Hoang Minh Tuoi

~~50~~

52

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 If the sampling frequency is not higher than Nyquist frequency Aliasing error occurs.

6 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

-4

(b) Signed Truncation

-3

(c) Rounding

~~-3~~

~~8~~ 10 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m <= f_s/2 = 48/2 = 24$ (KHz) ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = f_s . 24 . (Number of channel) = 48 . 1000 . 24 . 6 ✓ (bps) ?

(c) Calculate the size of 60[min].

datasize = bitrate * time = 48 . 1000 . 24 . 6 . 60 ✓ [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing ~~error occurs 18kHz.~~ ✓

16 1.4 Following table shows the merit and demerit of analog & digital processing. Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) Complex
(c) Good
(e) Good
(d) poor
(f) Good
(g) poor
(h) Good

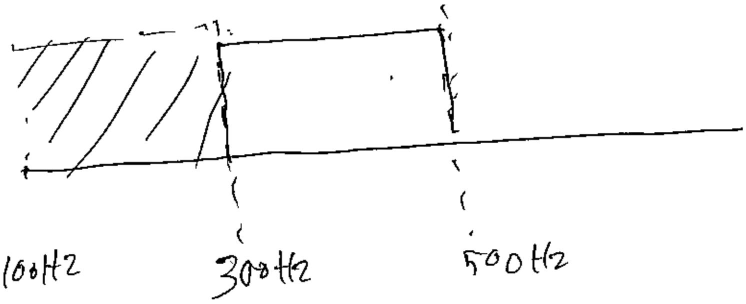
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

00 FFT is easy to use in coding. more than DFT and Simple

FFT provice ability to implement by software

2 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

we should use Bandpass filter for this case or ~~we should use higher pass filter for this case.~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [ ] transformation.

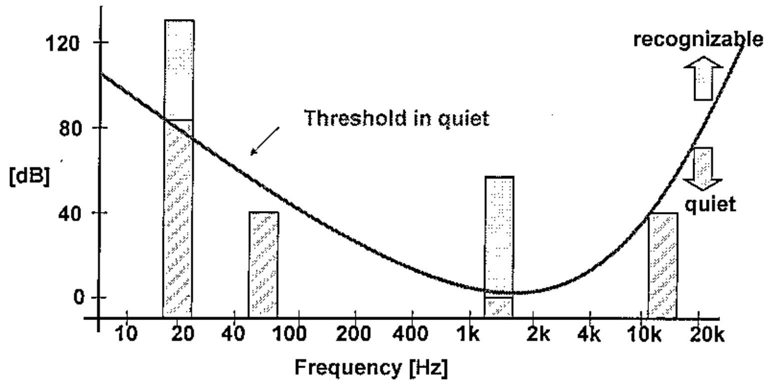
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)

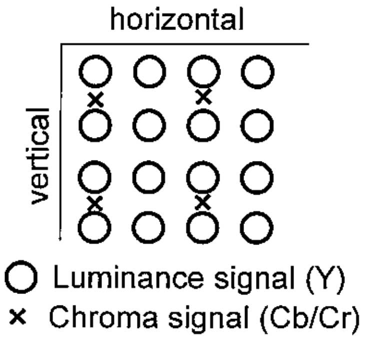


The purpose of this Psych-acoustic model is reject frequency of signal that we cannot re-cognize.
this thing help ~~produce~~ Decrease size of data and easy for signal processing

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line]x2160[lines/frame]] x $\frac{1}{4}$ x 8 x2

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [luminance data + chrominance data

$= 3840 [pixels/line] \times 2160 [lines/frame] \times (1 + \frac{1}{4}) \times 8$]

1/2

4) Calculate total data rate of UHD/4K Video data above

Ans: [datarate = data frame $\times$ frame rate

$= 3840 [pixels/line] \times 2160 [line/frame] \times \cancel{(1+\frac{1}{4})} \times 8 \times 30$]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[Compression ratio $= \dfrac{\text{data rate}}{\text{resulting datarate}} = \dfrac{3840 \times 2160 \times (1+\frac{1}{4}) \times 8 \times 30}{100 \times 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT	a) Probability theory technique	1. c
	2) VLC	b) Time Domain technique	2. a
	3) MC	c) Frequency domain technique	3. b

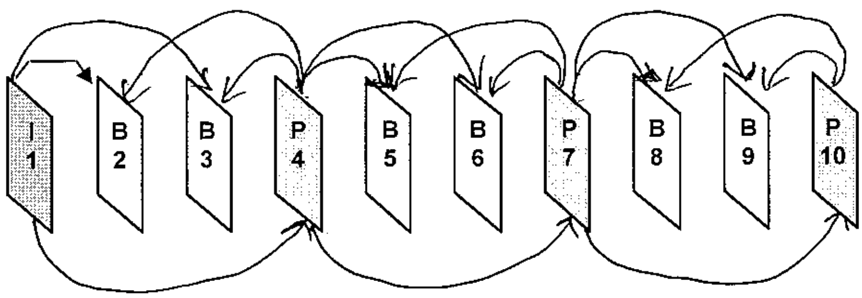
6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

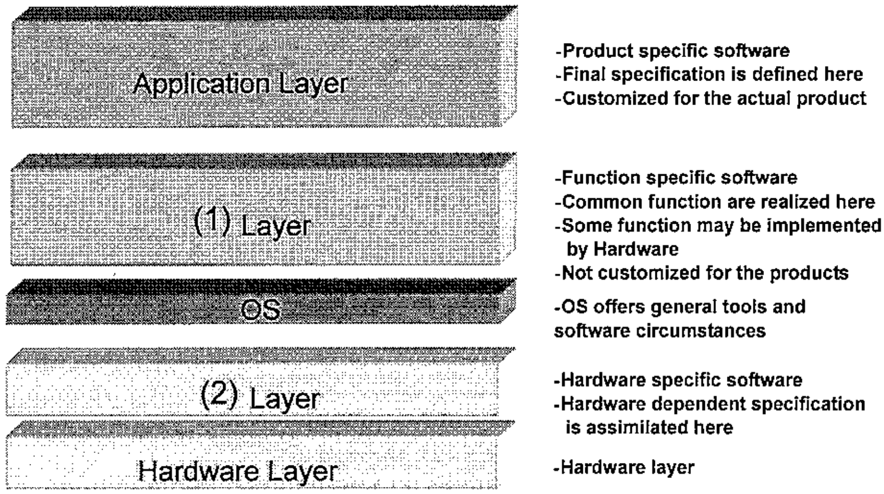


I:I-Picture
P:P-Picture
B:B-Picture

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL is element of API layer
it's Function specific software, provice common function for
Application layer.
it's open source software

0

21

ID code	2016
Name	Truong Quang Hung

~~71~~

79

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 We use formulor: $fs \geq 2fm$.

fs: frequenced sample.

fm: frequence of Signal.

It means frequence take sample is greater than or equal two time of frequence of signal.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) -4

(b) Signed Truncation : -3

(c) Rounding : ~~-4~~ ~~-3~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~12~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$fs \geq 2fm$

$\Rightarrow fm \leq \frac{fs}{2} = \frac{48\ kHz}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$= 48.1000.24.6$ [?]

(c) Calculate the size of 60[min].

$= [48.1000.24.6].60.60$ [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias is happen. Because $fs < 2fm$.

$48kHz < 2 \times 30\ kHz$

16

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3 Advantage of FFT compare with DFT: as table:

	DFT	FFT
Multiplication complex	N^2	$\frac{N(\log_2 N-1)}{2}$
Addition complex	$N(N-1)$	$N\log_2 N$

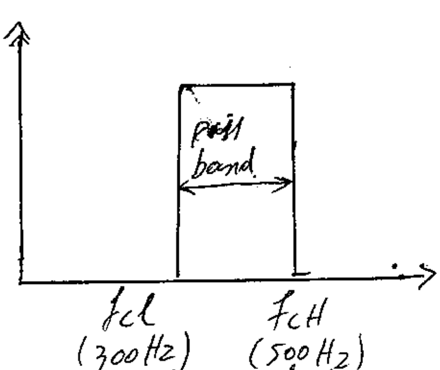
By using FFT, the multiplication complex and addition complex are lower than DFT very much.

2 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

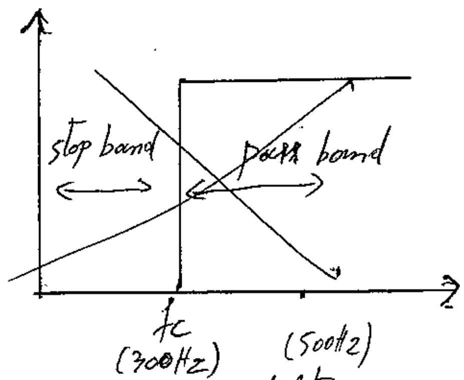
To keep the components whose frequency from 300Hz to 500Hz, we can use band pass filter. ~~or~~

~~or high pass filter.~~

But band pass filter is better.



Band pass filter



High pass filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

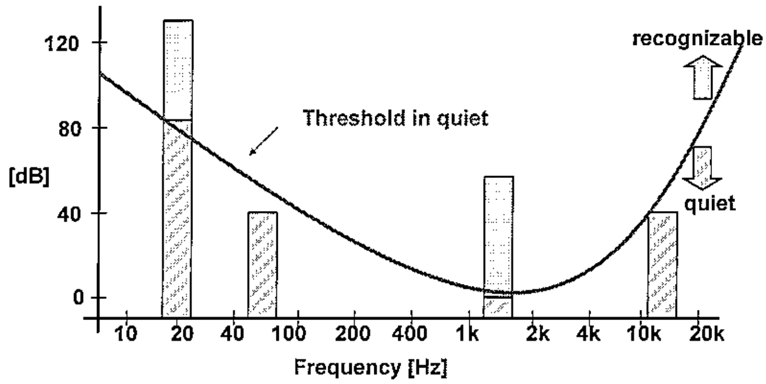
(1) Fourier Transform
Utilize [time - Frequency.] transformation.

(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Meaning : Show that some sound at some frequen we can not ~~here~~ hear

Purpose : We can delete the information that we can not hear. That help we decrease data to stogre

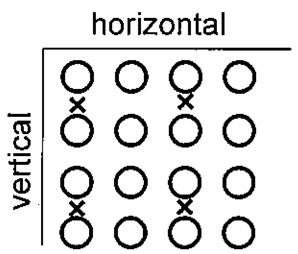
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

$3840 \times 2160 \times 8 \times 3 \times 1/2$

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2$]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 \times 2160 \times 8 \times 3 \times 1/2$ unit ?

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 \times 2160 \times 8 \times 3 \times 1/2 \times 30$ unit ?

]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[

$$\frac{3840 \times 2160 \times 8 \times 3 \times 1/2 \times 30}{10^6 \times 100}$$ unit ?

]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

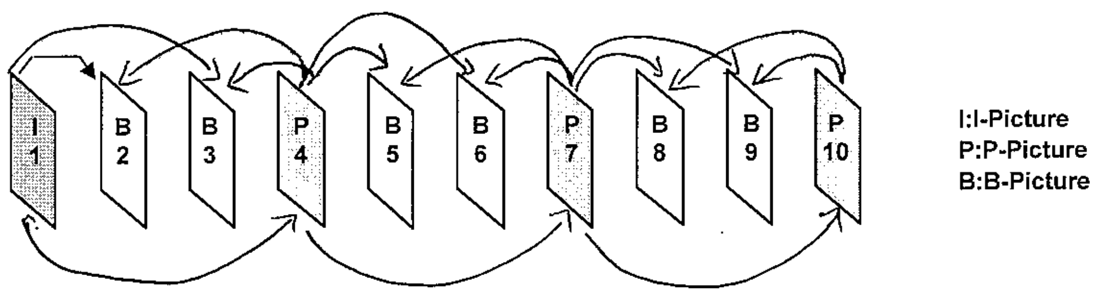
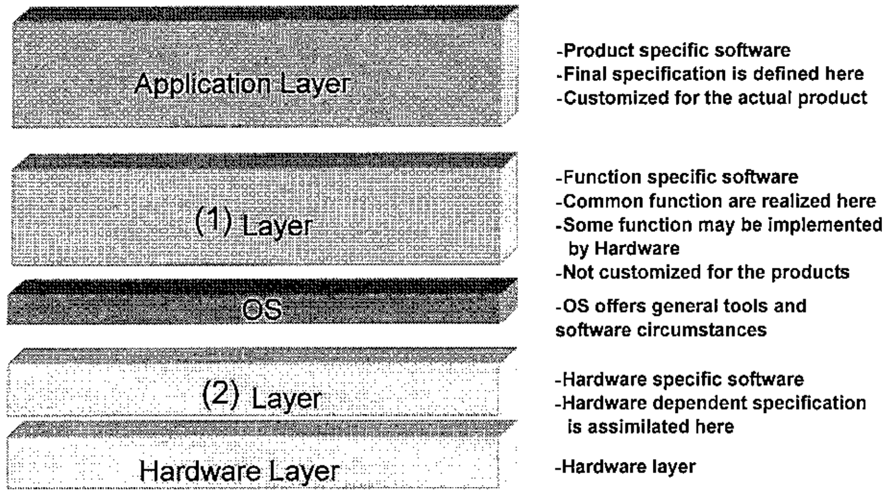


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as low-level interface for audio, video and imaging codec used in embedded devices. It give application and media frameworks the ability to interface with multimedia codecs and supporting components in a ~~m~~ unified manner.

16

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~~64~~ 66

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

- To prevent "Aliasing", the sampling frequency should be higher than Nyquist frequency or we make sure that sampling frequency $\boxed{f_s \geq 2f_m}$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) : $-\cancel{3}$

(b) Signed Truncation : -3

(c) Rounding : $-\cancel{3}$

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~6~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \Rightarrow f_m \leq \frac{f_s}{2} = \frac{48(kHz)}{2} = 24\ (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $(48 * 1000) * 24 * 6$. [x]

(c) Calculate the size of 60[min].

datasize = bitrate * 60 * 60. [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing signal appear : $\boxed{f_a = 18\,kHz}$ △

1.4 Following table shows the merit and demerit of analog & digital processing.
16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex
(c) Good (e) Good
(d) poor (f) Good
(g) poor (h) Good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3 - FFT is fast calculation algorrithm of DFT, for $N = 2^m$ cases. this is as below

	DFT	FFT
Multiplication (complex)	N^2	$\frac{N(\log_2 N - 1)}{2}$
Addition (complex)	$N(N-1)$	$N\log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*
0

2. Audio Coding

2.1 Fill ~~out~~ the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

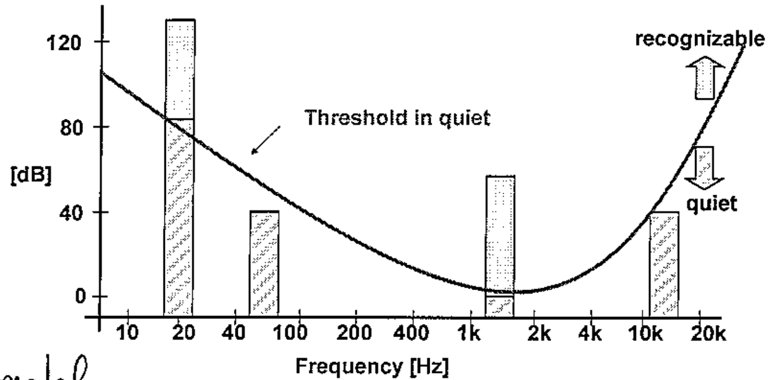
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



-Psych acoustic model - ~~we~~ should use the frequency with condition ~~to~~ sactify with(db) because the threshold in quiet ~~is affected~~ affects to(db) ~~is~~ when unexpected frequency.

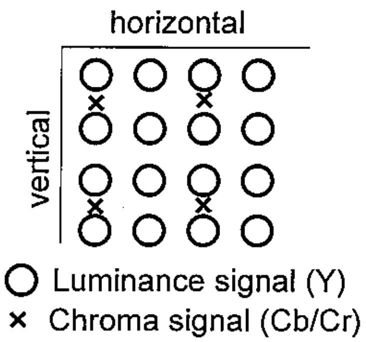
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and ~~Cb~~ total)
Ans: [Chrominace data volume = $\frac{1}{4}$ Luminance pixel number]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 * 2160 * 8 * 3 * \frac{1}{2}$ unit?   ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 * 2160 * 8 * 3 * \frac{1}{2} * 30$ (bps)   ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

4

Ans:[

~~ratio = 100 (Mbps) / 3840 * 2160 * 8 * 3 * 1~~   ~~ratio compression ratio = 100 / data above~~

$\boxed{\text{ratio} = \frac{100}{\text{data above}} (\%)}$

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

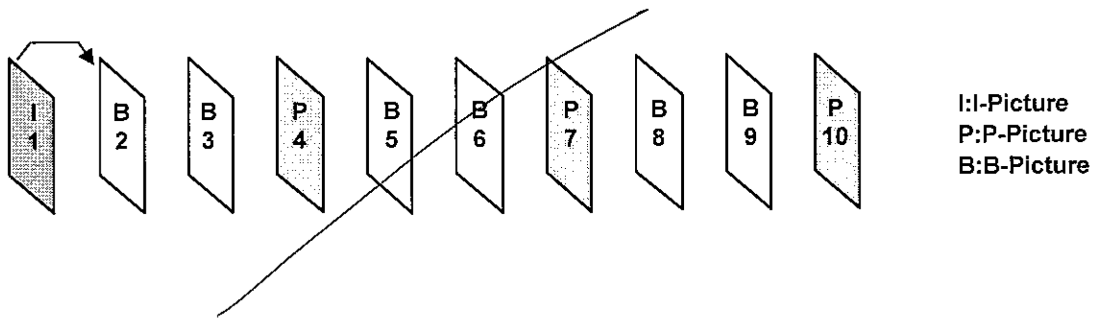
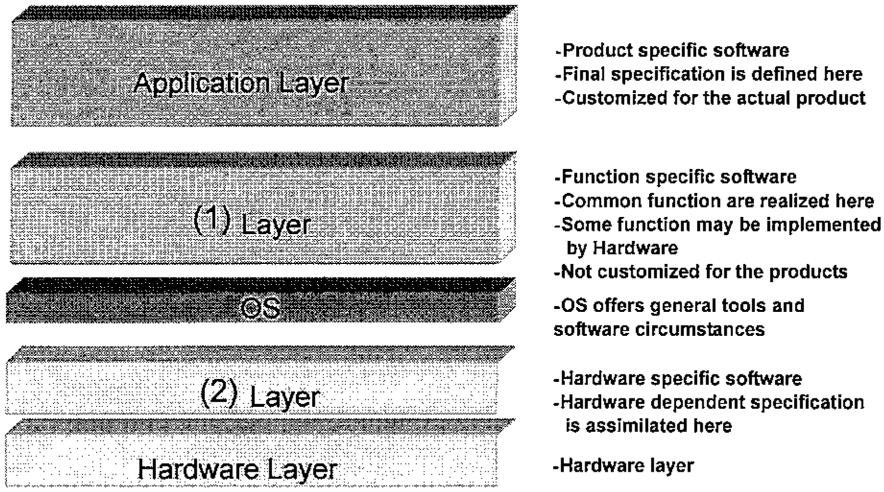


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- OpenMAX IL ~~serves~~ was a low-level Interface for audio, video and imaging codecs used in embedded devices

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13

~~47~~ 55

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

~~Keep $f_s \geq 2^* f_m$~~

keep the sampling frequency smaller than 2 times of maximum frequency of ~~pro~~reproduce ($f_s \geq 2f_m$)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) 3,75

(b) Signed Truncation 0

(c) Rounding - 3,875

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

8

(a) Calculate the maximum frequency CD can re-produce.

$\cancel{f_s \geq 2f_m} \Rightarrow f_m \leq f_s/2 \Leftrightarrow f_m \leq 48/2 \Leftrightarrow f_m \leq 24\,kHz$ ✓ OK

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48 * 1000) * 24 * 6 X

(c) Calculate the size of 60[min].

datasize = 60 * 60 * bitrate X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~aliasing will happened~~ X

14

1.4 Following table shows the merit and demerit of analog & digital processing. Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Complex~~ Simple

(b) ~~Simple~~ Complex

(c) ~~Good~~ ~~Poor~~

(e) Good

(d) ~~Good~~ Poor

(f) Good

(g) Poor

(h) Good

2

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

	DFT	FFT
Multiplex (Complex)	N^2	$\frac{N(\log_2 N - 1)}{2}$
ADD (complex)	$N(N-1)$	$N \log_2 N$

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

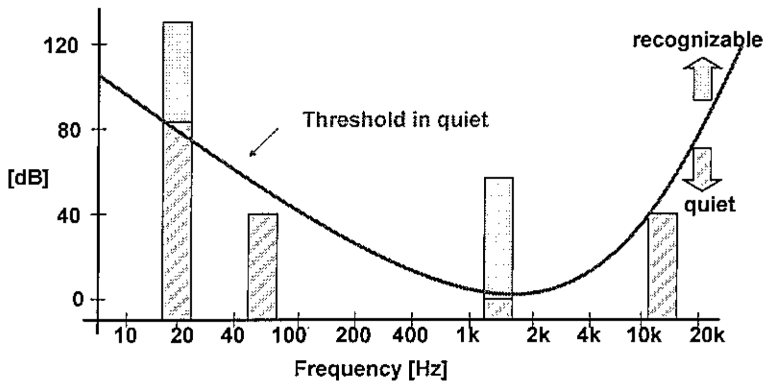
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

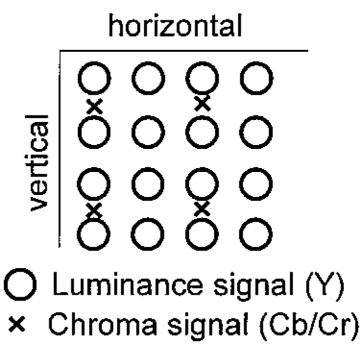
2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$\frac{3840}{2}$ [pixels/line] x $\frac{2160}{2}$ [lines/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [~~data volume = 3840 [pixels/lines] * 2160 [lines/frame] * 30 [frames/sec]~~

data volume = 3840 [pixels/line] * 2160 [lines/frame] * 24 [bits/frame]]

2

4) Calculate total data rate of UHD/4K Video data above

Ans: [~~data~~

datarate = datavolume * 30 [frames/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

ratio = ~~datarate * 100 * 10^6 [bit]~~ datarate ~~* 100~~ * 10^6 [bits/sec]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

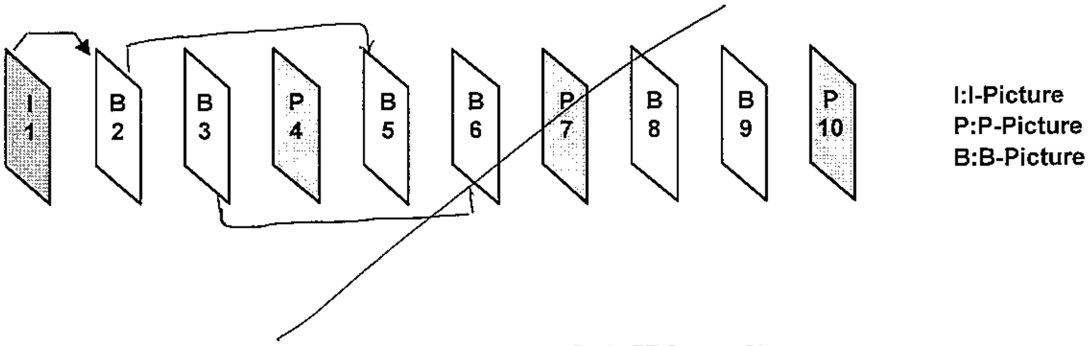
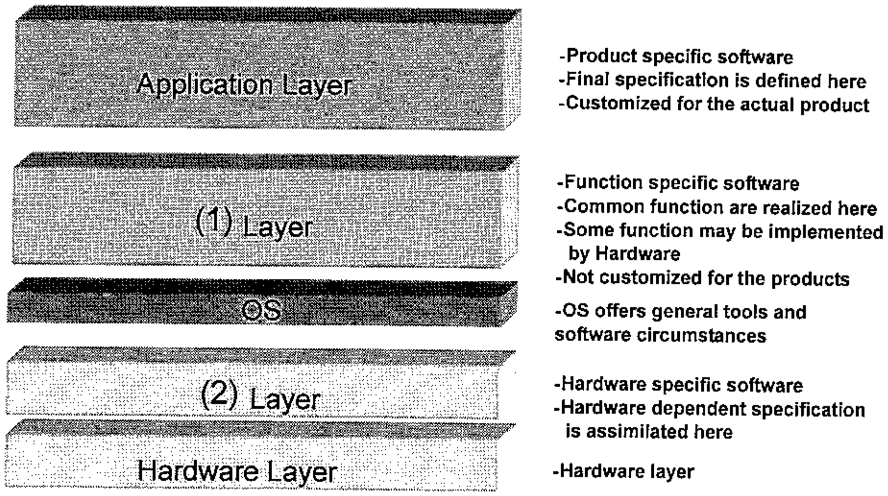


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Serves a low level interface for audio, video & imaging codecs used in embedded system

2

- It gives application & media frameworks the ability to interface with multimedia codecs & supporting components in a unified maner.

8

ID code	2038
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~~22~~

26

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$f_{sampling} \geq 2 f_m$ (1)

- (1) is realized, signal can be reproduced by digital signal.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~16~~

4

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 48kHz \Rightarrow f_m = \frac{f_s}{2} = \frac{48}{2}$ (kHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = f_s ~~× 1000 × 16 × 2 = 48 × 1000 × 16 × 2 [bit/sec]~~ =

(c) Calculate the size of 60[min].

datasize ~~= 48 × 1000 × 24 × 56 × 60 × 2~~ =

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

10

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple

(b) Complex

(c) ~~Good~~ ~~Poor~~

(e) Good

(d) ~~Good~~ Poor

(f) Good

(g) ~~Good~~ ~~Difficult~~

(h) Easy

1

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

	DFT	FFT
ⓧ Multipler	N	$\frac{N(\log_2 N-1)}{2}$
⊕ ADD	$N(N-1)$	$N\log_2 N$

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

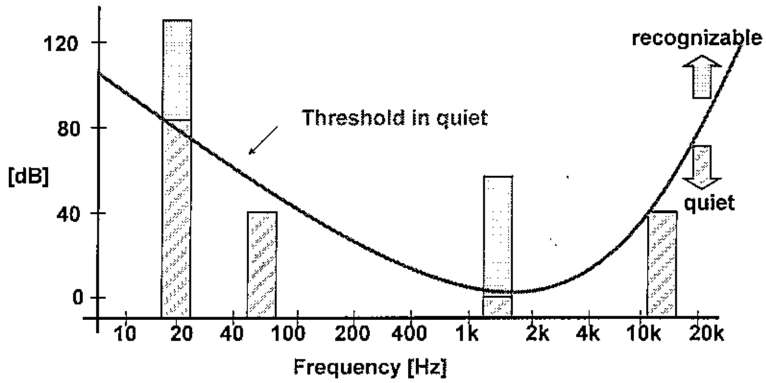
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

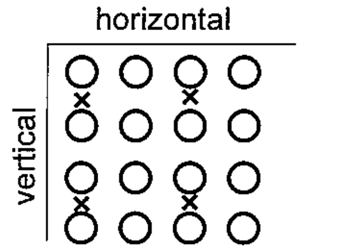
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 × 2160 × 8[bits/frame~~

~~3840 [pixels/line] × 2160 [lines/frame] × 8[bits/frame]~~]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 [pixels / line] × 2160 [lines / frame] × 8 × $\frac{1}{2}$ [bits / frame] × 30 [frames / sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans: [ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

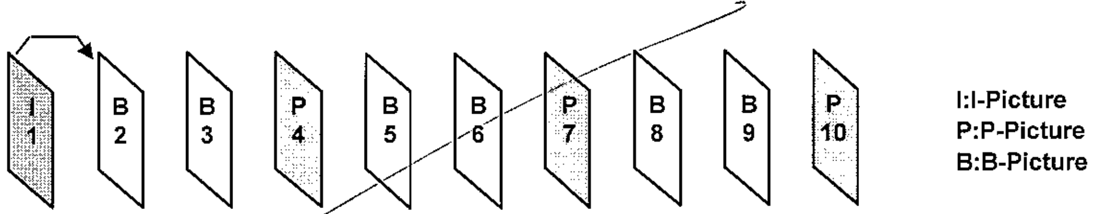
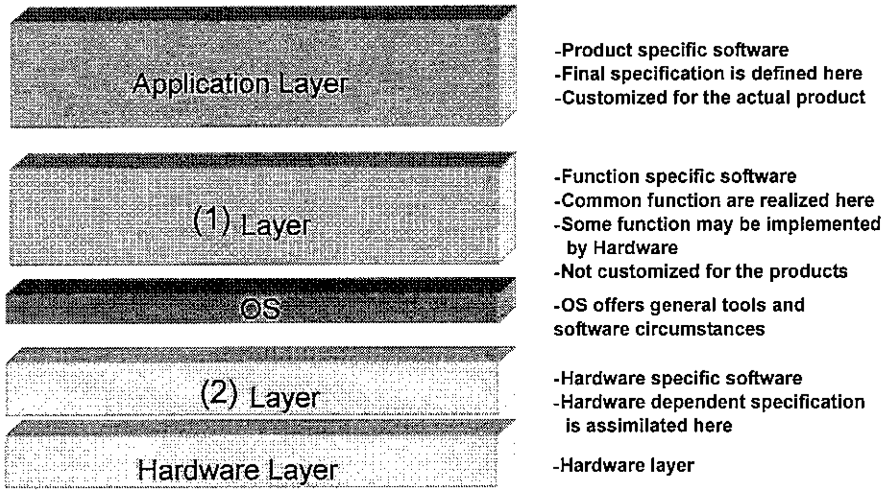


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) ~~a) API~~ b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

9

ID code	2039
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~~14~~
16

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

00 1.1 How to prevent "Aliasing"? *(3 points)*

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

00

(a) Truncation (round off)

3,00

(b) Signed Truncation

3

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~02~~
02

(a) Calculate the maximum frequency CD can re-produce.

$fs >= 2^* fm \rightarrow fm <= fs/2$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~bitrate = (48 * 1000) * 24 * 2~~

(c) Calculate the size of 60[min].

datasize = (60 * 60) * bitrate [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

2

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Simple~~ ~~Complex~~

(b) ~~Complex~~ ~~Simple~~

(c) ~~Poor~~

(e) Good

(d) ~~Difficult~~

(f) ~~Easy~~

(g) ~~Expensive~~

(h) ~~Reasonable~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1

faster
smoother
higher quality

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2: Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [frumer Sense] transformation.

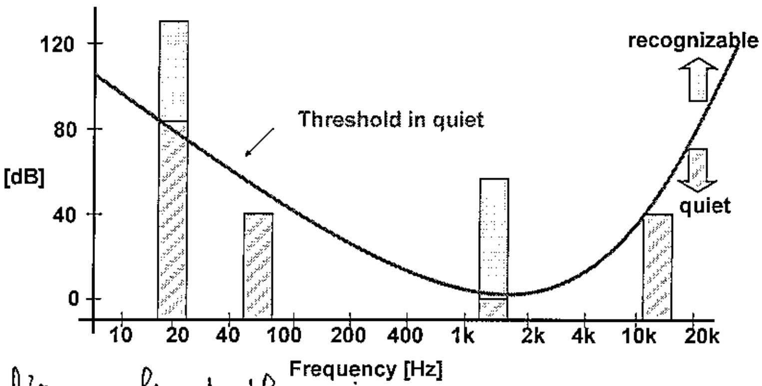
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)

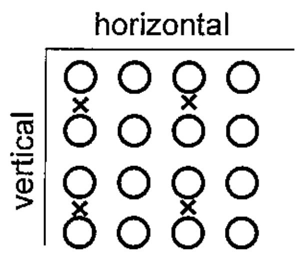


The figure shows that:
we just need to code and recognization for the audio part which is ~~no~~ not quiet area.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

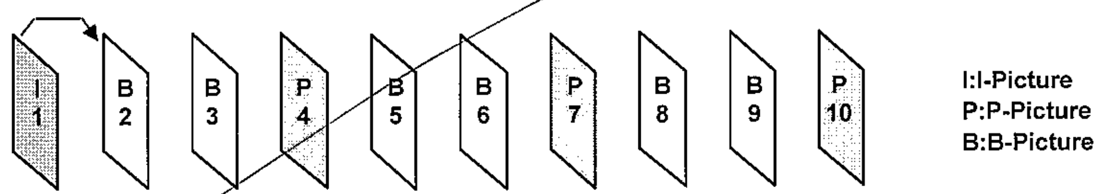
3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

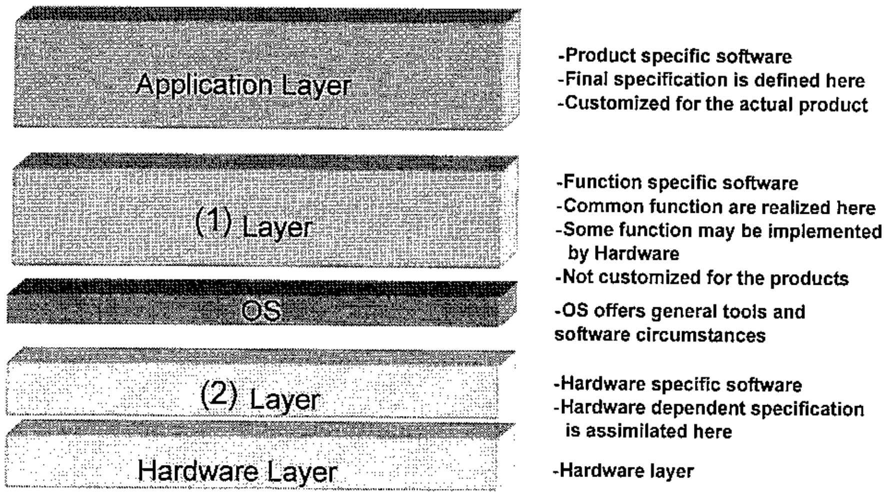


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) ~~a)~~ API   b) Middleware   c) RTL   d) Driver

(2) a) API   b) Middleware   c) RTL   d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Help processing video quality, playing video and process it

0

15

ID code	2040
Name	Tran Trung Hieu

~~56~~

62

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

sampling frequency has to be bigger than signal bandwidth 2 times

$f_s > 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) [~~-4~~]

(b) Signed Truncation [~~-4~~]

(c) Rounding [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~

10

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq \frac{f_s}{2} = \frac{48}{2}$ [x]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$(48 \times 1000) \times 24 \times 6$ [x]

(c) Calculate the size of 60[min]. [x]

bit rate $\times 60 \times 60$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_m = 30kHz$

$f_s = 48kHz \Rightarrow$ aliasing : $f_a = 48 - 30 = 18kHz$

14

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) complex

(c) Good (e) Good

(d) Poor (f) ~~Poor~~

(g) Poor (h) Good

2

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- Calculate number

	DFT	FFT
Multiple (Complex)	N^2	$\frac{N(\log_2 N-1)}{2}$
ADD (Complex)	$N(N-1)$	$N\log_2 N$

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

Digital filters should ~~use~~ be used.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

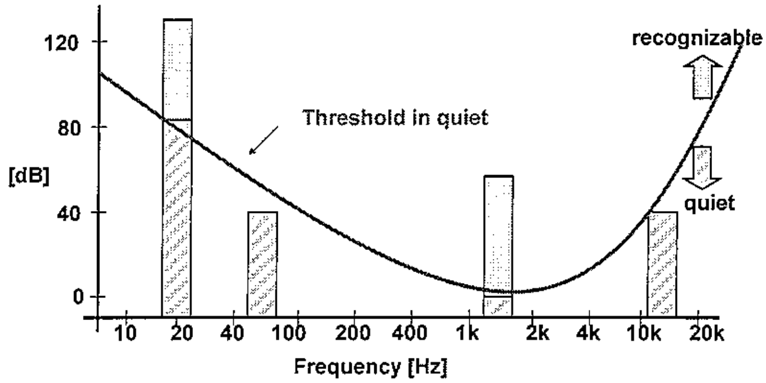
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



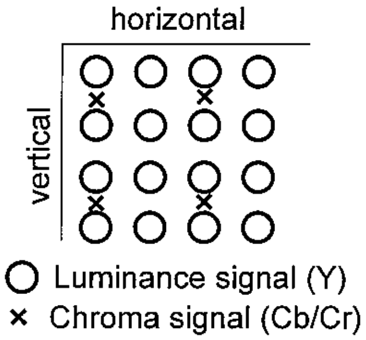
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] x 2160 [lines/frame] x ~~16~~ 8 x $\frac{1}{2}$ [bits/frame]
]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

6

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

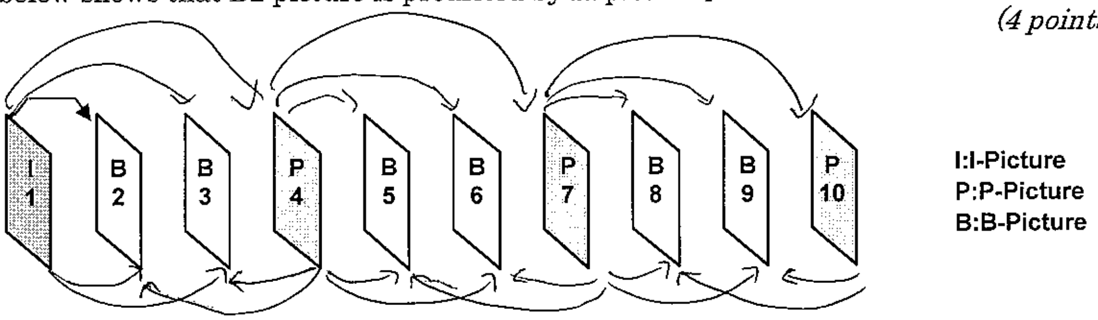
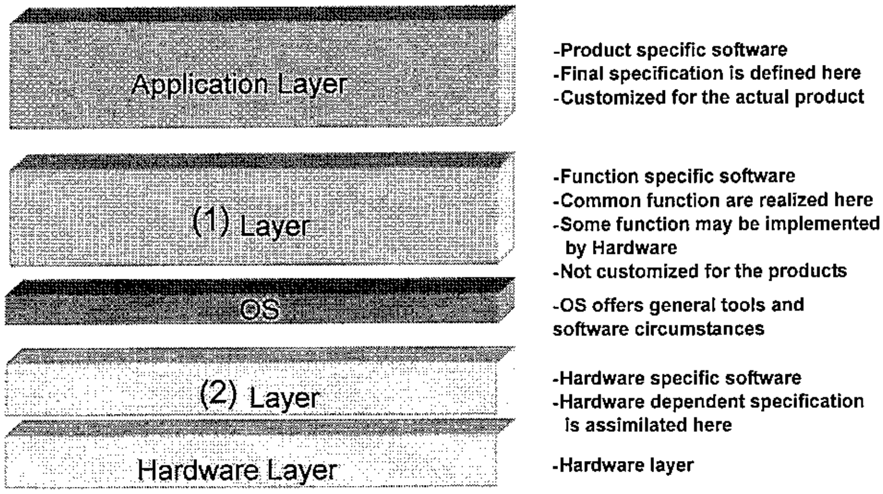


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

8

ID code	2041
Name	Truong Phuc Huy

~~60.5~~ 64.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Use the sampling frequency more than signal frequency

$f_s \geq 2 \times f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq \frac{f_s}{2}$ => maximum frequency is 24kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $(48 \times 1000) \times 24 \times 6$ [X]

(c) Calculate the size of 60[min].

datasize = bitrate $\times 60 \times 60$ = $48 \times 1000 \times 24 \times 6 \times 60 \times 60$ X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

It will cause the aliasing.

Alias = frequency − sampled frequency

= 18 kHz

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

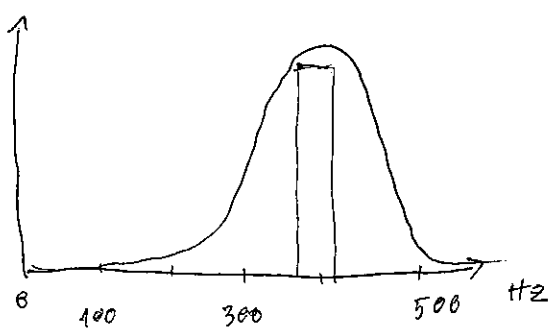
(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 It easy and faster with Fast Fourier Transform and Discrete Fourier Transform.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

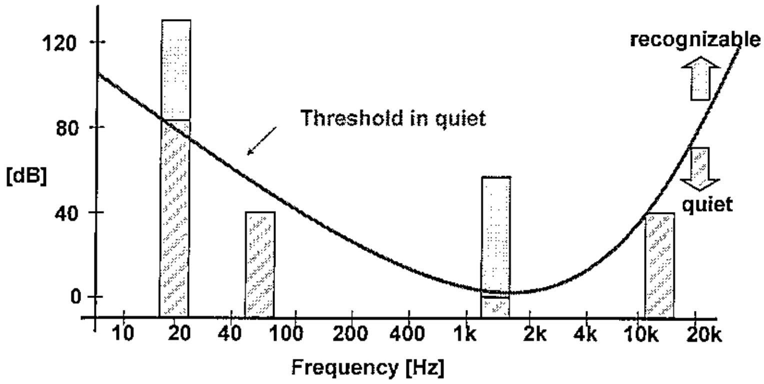
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

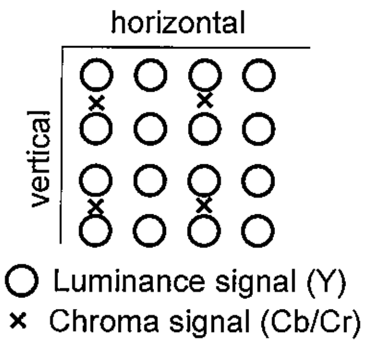


- To cut down the data size by remove the "quiet"
- less the data size but not effect much to quality of sound

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume (Cr and Cb total) 4 : 2 : 0
Ans: [$3840 \times 2160 \times 8 \times 2 \times \frac{1}{2} \times 30$]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3$]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2}$ unit ?]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT a — a) Probability theory technique

2) VLC c — b) Time Domain technique

2

3) MC b — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

from I or B

0

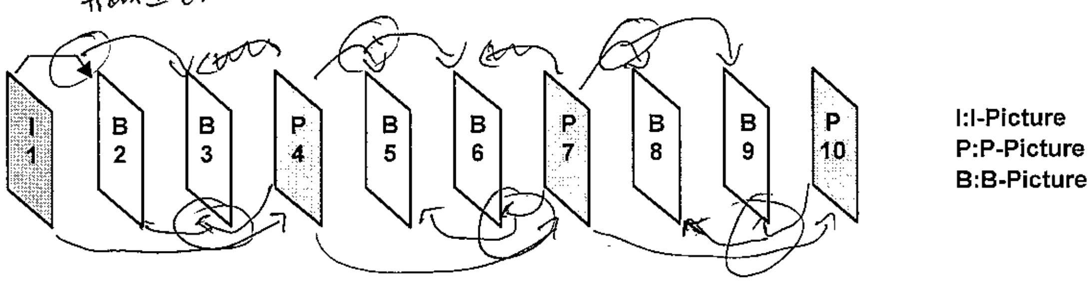
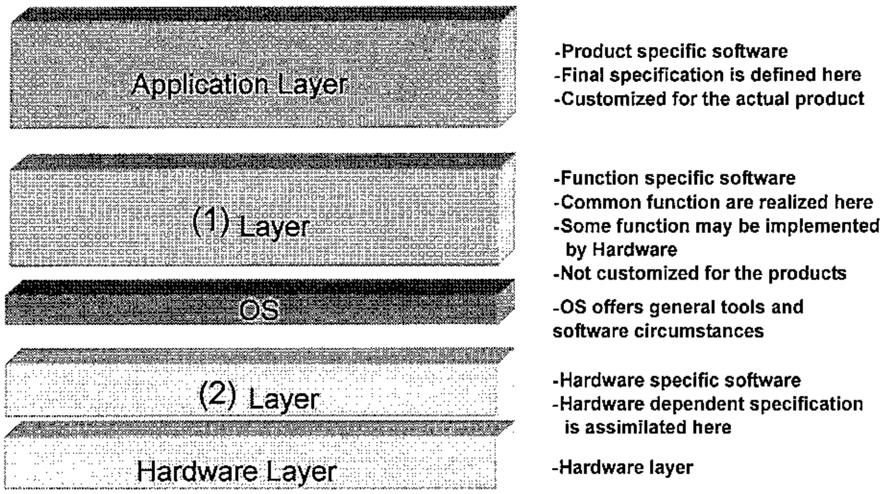


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

10

ID code	2042
Name	Tran Chi Kha

~~55~~ 58

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 ~~The~~ $f_s \geqslant 2 f_m$

The sampling frequency should be 2 times higher than the signal banwidth.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~12~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 48 \Rightarrow f_n = \frac{f_s}{6} = \frac{48}{6}$ ~~$= 8$ (kHz)~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = 48 * 1000 * 24 * 6 = ~~6192000~~ (bits/s) ok

(c) Calculate the size of 60[min].

dataSize = ~~48 * 1000 * 56 * 60 * 6 = 86768 0000~~ (dB)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$\begin{cases} f_m = 30\text{kHz} \\ f_s = 48\text{kHz} \end{cases} \Rightarrow f_a = 48 - 30 = 18 (\text{kHz})$

16

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (poor) : for time variant, etc	(h) (~~poo~~ Good) : for time variant, etc
Portability	Difficult	Easy

(a) simple

(b) complex

(c) Good

(e) Good

(d) poor

(f) Good

(g) poor

(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0 Bit reverse operation useful for operation reordering

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

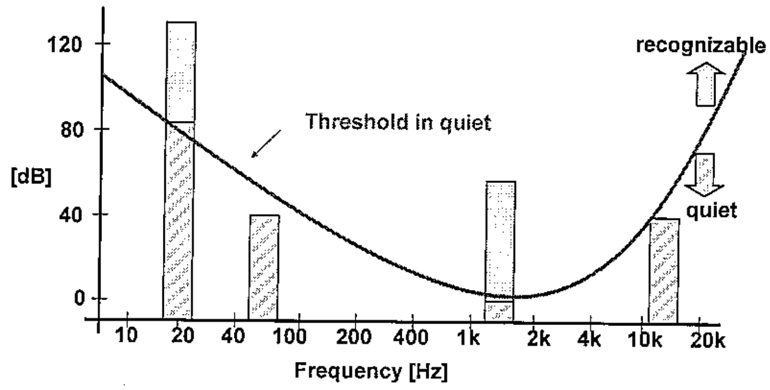
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [the correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



— We can hear in hearing range and hearing threshold. For this figure, we can delete the information that we cannot hear. When a big sound exists, There is "masking" effect around that sound

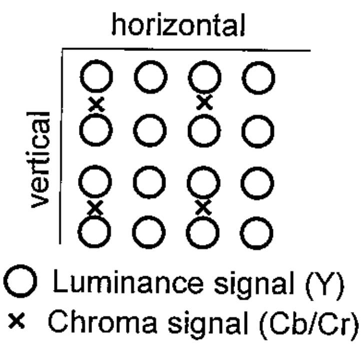
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 * 2160 * 24 * 30 =
~~29 85984000 bps~~
597 968 000 (bit/s)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 * 2160 * 24 * \frac{1}{2} = 99532800$ (bit/s)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 * 2160 * 24 * \frac{1}{2} * 30 = 2985984000$ (bit/s)]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

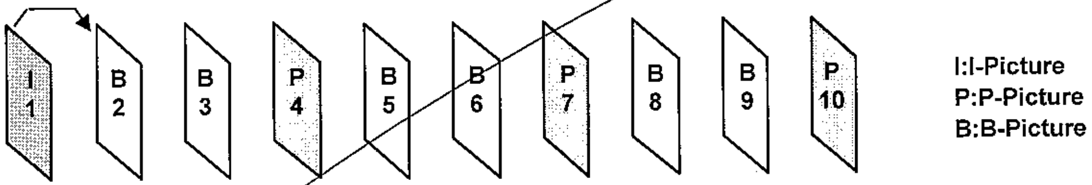
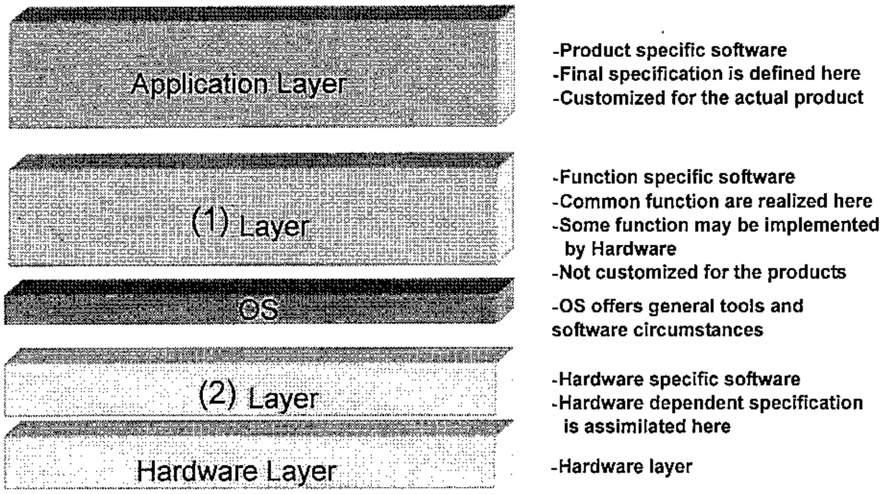


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

0

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL gives the applications and media frameworks
2 the ability to interface with multimedia codes
and supporting components in a unifered manner.

16

ID code	~~BH001 & BH002~~ 2043
Name	Nguyen Phuc Khang

~~53.5~~

58.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

If sampling frequency is not higher than Nyquist frequency, aliasing error occurs. So, the way to prevent "Aliasing" is: $f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) 0 (V)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 6

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48\,kHz}{2}$ ✓ (KHz) X

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$\frac{48}{2} \times 1000 \times 24$ (bit/sec) X

(c) Calculate the size of 60[min].

$\frac{48}{2} \times 1000 \times 24 \times 60 \times 60$ (bit/sec) ✓ X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

=> "Aliasing" error occur

"Aliasing" value is : 18 KHz ⚠

16

1.4 Following table shows the merit and demerit of analog & digital processing.
Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (simple)	(b) (complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) (b)

(c) (e)

(d) (f)

(g) (h)

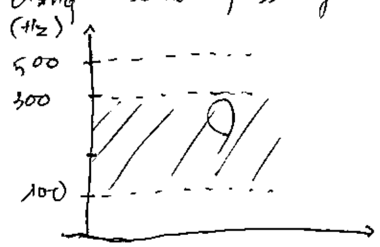
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.5

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

=> Using band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

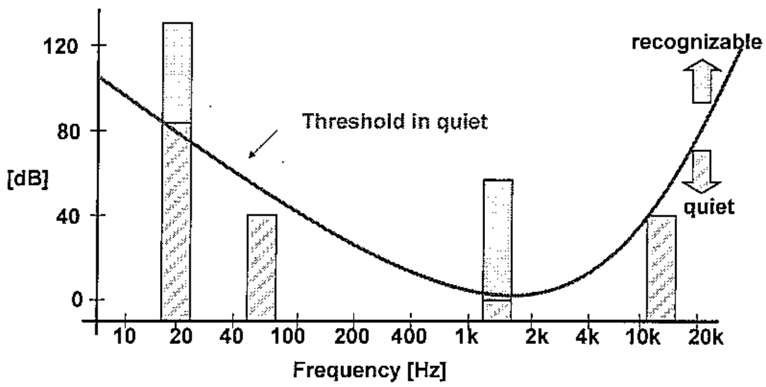
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

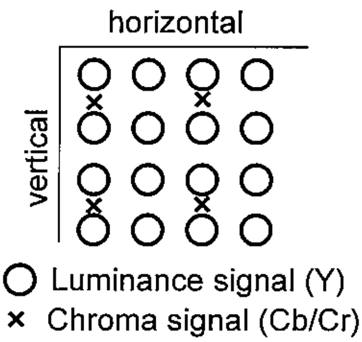


3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [Cb =]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 × 2160 × 8 × 3 × 1/2 (bit/frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 × 2160 × 12 (bps) ×30]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? ($1\ \text{Mb} = 10^6$ bit)

Ans:[$\frac{25}{100 \times 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

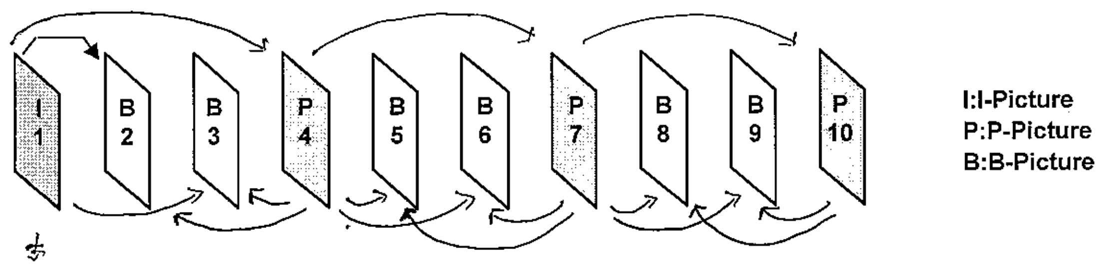
Ans. 1) DCT	c	a) Probability theory technique
2) VLC	a	b) Time Domain technique
3) MC	b	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4



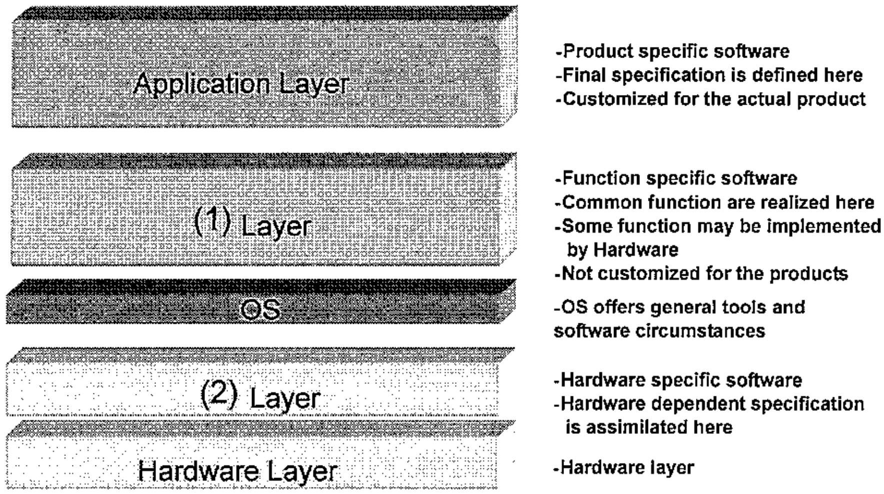
Displaying

I B B P B B P B B P

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

3

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

10

ID code	2044
Name	Nguyen Duong

~~57~~

59

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sampling frequency should be 2 timers higher than the signal bandwidth (Nyquist frequency)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) ~~-4~~

(b) Signed Truncation 3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~00~~ 02

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \rightarrow \cancel{f_m} \leq f_s/2$ X

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48 * 1000) * 24 * ~~2~~ X

(c) Calculate the size of 60[min].

data size = bitrate * (60 * 60) [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 4,1 kHz~~ X

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

2 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- Calculation number : DFT FFT

Multiplex (complex) N^2 $\frac{N(\log_2 N-1)}{2}$

ADD (complex) $N(N-1)$ $N\log_2 N$

- bit reverse operation : useful operation reodering

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

Hight pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

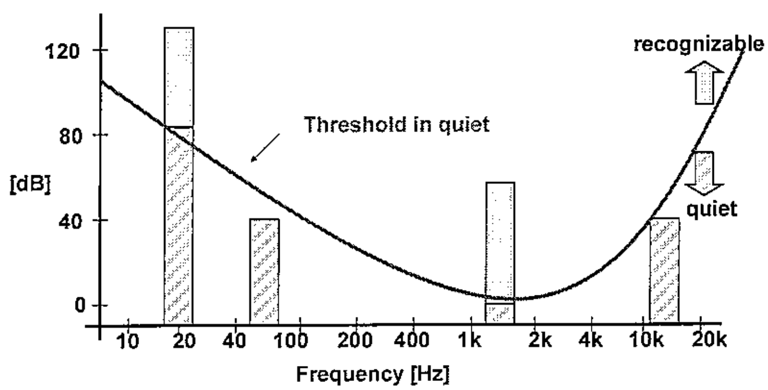
(1) Fourier Transform
Utilize [~~Frequency~~ time-Frequency transformation] transformation.
Fourier transformation, MDCT

(2) Stereo Coding
Utilize the property of [correctation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearence].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



The hearing sensation that corresponds to sound levels is the loudness of the sound. Hearing range and hearing threshold are exist. We can delete the information that we can't hear.

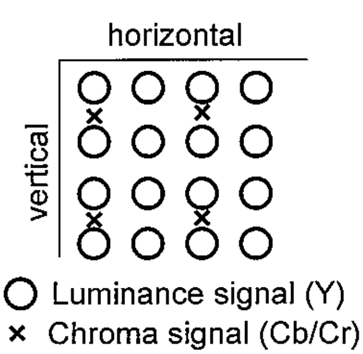
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

0

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

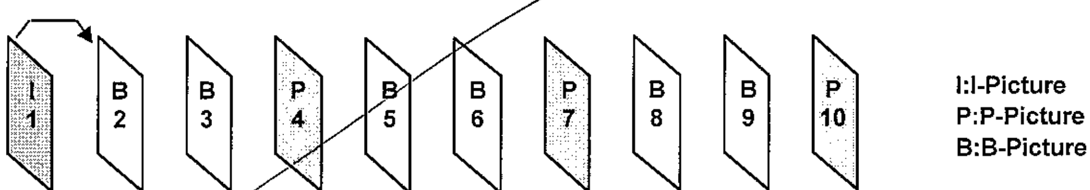
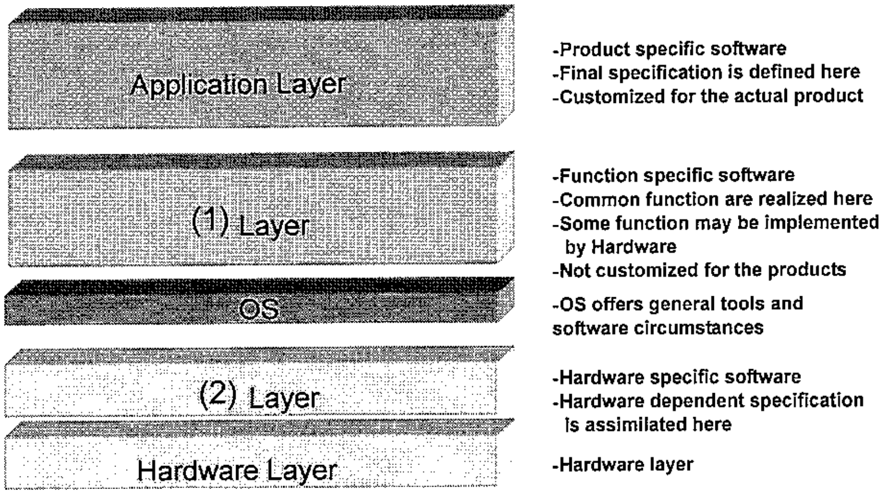


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Serves as low level interface audio, video and imaging codecs used in embedded devices.

2

It gives applications and media frameworks, the ability to interface with multimedia codes and supporting components in a unified manor

18

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Name	Nguyễn Hữu Biên

~~41.5~~

49.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampling frequency is more than double of Maximum frequency of bandwidth of signal. $F_S \geq 2.F_M$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$F_S = 48$ KHz

$\rightarrow F_M = \frac{F_S}{2} = 24$ (KHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 × 1000 × 24 × 6 (bit/sec) 4

(c) Calculate the size of 60[min].

48 × 1000 × 24 × 6 × 60 × 60 (bit) 4

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

according to sampling theory: $F_S \geq 2\times F_M$

Aso we can see in this context, the F_S = 48 (kHz) < $2.F_M = 2.30$(kHz)

→ causing the aliasing signal.

10

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~complex~~ simple

(b) ~~simple~~ complex

(c) good

(e) ~~poor~~

(d) ~~poor~~ ~~difficult~~

(f) ~~good~~ ~~easy~~

(g) ~~difficult~~

(h) ~~easy~~

1.5

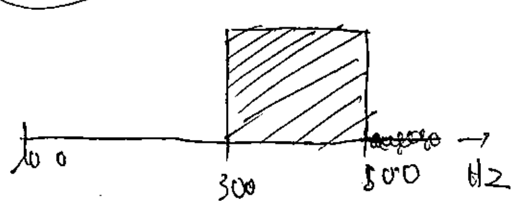
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT (Fast Fourier Transform) is method that can reduce the calculating time ~~to~~ for Fourier Transform ~~to~~ between Time domain and frequency domain.

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We should the high-Pass filter to keep components whose frequency from 300 to 500 Hz



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

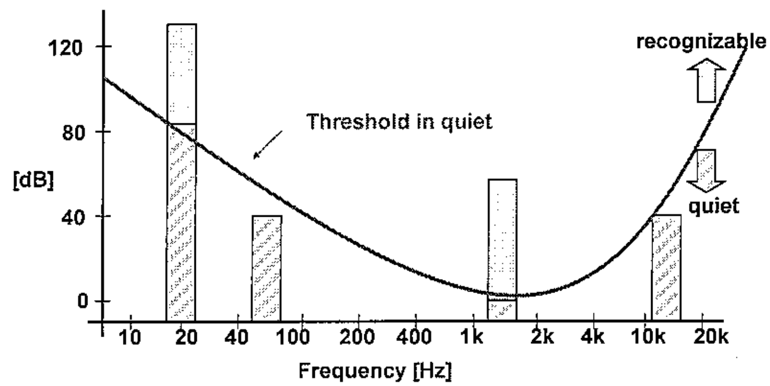
(1) Fourier Transform
Utilize [FFT] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

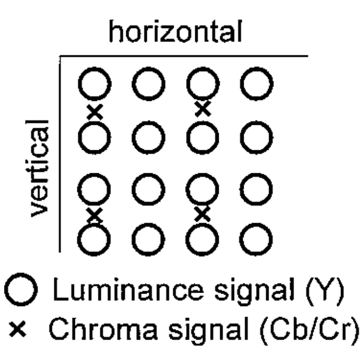


The human ears just can hear the sound ~~that~~ whose of frequency from 20 Hz → 24000 Hz. The Psych-acoustic model will keep the frequency of sound signal located in this range, reject sound whose frequency out of this range. This model help people to reduce the ~~data volume~~ size of data.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 × 2160 × 8 × 3 × 1/2~~ ( )

3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] × 3 × 1/2

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [~~3840 [pixels/line] × 2160 [lines/frame]~~ + ~~3840 [pixels/line] × 2160 [lines/frame]~~

3840 × 2160 × 8 + 3840 × 2160 × 8 × 3 × $\frac{1}{2}$ [bits/frame] ~~× 8 × 3 × $\frac{1}{2}$ [bits]~~]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 × 3 × $\frac{1}{2}$ [bits/pixel] × 30 [frames/s]

= 3840 × 2160 × 12 × 30 [bits/s]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

6 Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT c) a) Probability theory technique

6 2) VLC a) b) Time Domain technique

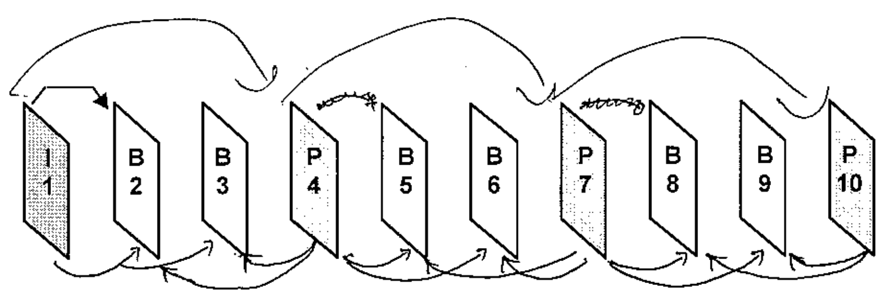
3) MC b) c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

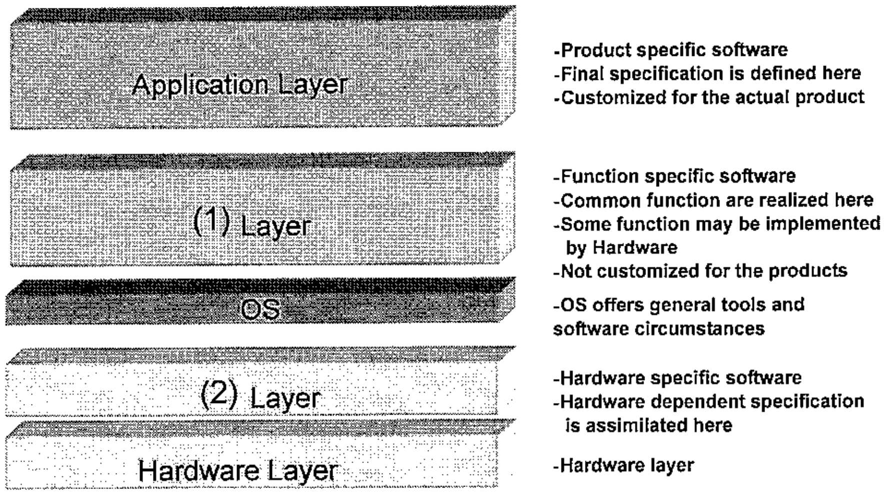


I:I-Picture
P:P-Picture
B:B-Picture

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6 (2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

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2

~~31~~ 41

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

If $f_s < 2f_m$ → cause "Aliasing"

⇒ to prevent "Aliasing" we need to keep $f_s \geq 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

-4

(b) Signed Truncation

~~3.75~~ -3

(c) Rounding

-4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

12

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \Rightarrow f_m \leq \frac{f_s}{2} = \frac{48}{2}$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (\underbrace{48}_{\text{sample}} * 1000) * \underbrace{24}_{\text{linear PCM}} * \underbrace{6}_{\text{number of channels}}$ (bit/sec)

(c) Calculate the size of 60[min].

data size of 60 [min] = bitrate * (60 * 60)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~

12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple

(b) complex

(c) ~~high~~ good

(e) ~~high~~ good

(d) ~~low~~ poor

(f) ~~high~~ good

(g) ~~low~~ ~~difficult~~

(h) ~~high~~ ~~easy~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

8

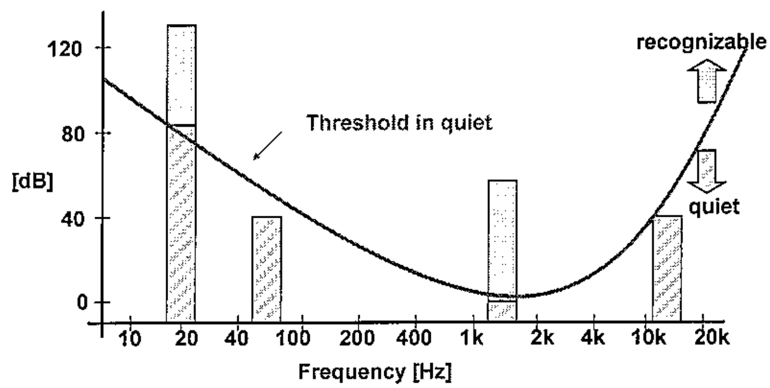
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

3 *(5 points)*



We don't need to keep the information of audio which almost ~~prop~~ human ears can not ~~to~~ hear → reduce the size of data.

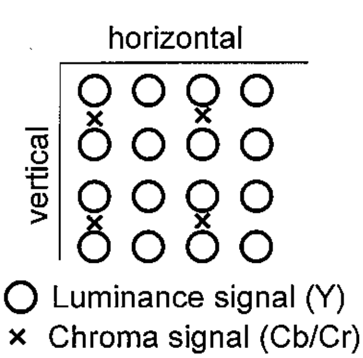
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

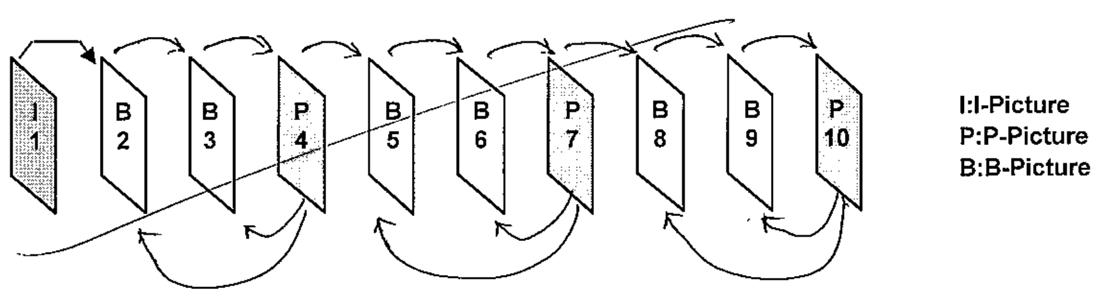
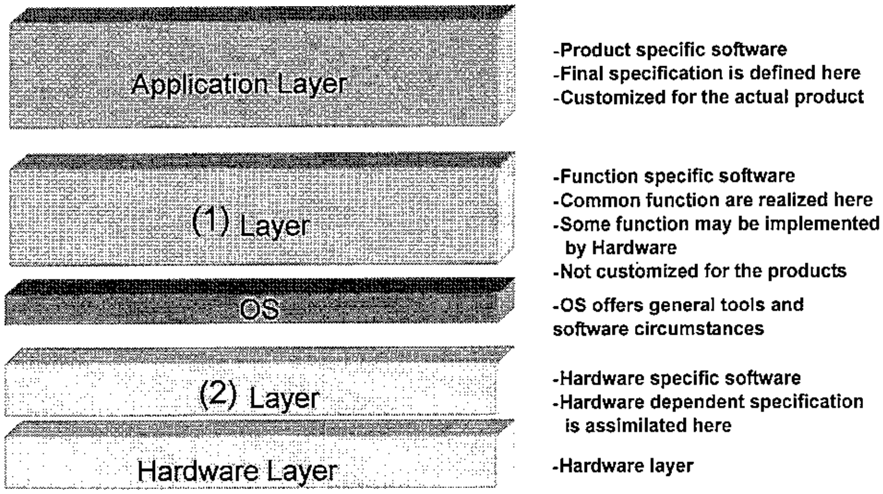


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

12

ID code	2051
Name	Trần Quang Thi

~~58~~

RVC "System Solution"

Examination

November 24, 2017

62

1. Digital Signal Processing

1

1.1 How to prevent "Aliasing"? *(3 points)*

To prevent "Aliasing", in sampling phase, the sampling frequency must be higher than (at least is equal) Nyquist frequency.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) ~~3.75~~

-4

(b) Signed Truncation - ~~3.75~~

-3

(c) Rounding

-4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f = \frac{48}{2} = 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = 24 × 1000 × 24 × 6 [X]

(c) Calculate the size of 60[min]. [X]

datasize = bitrate × 60 × 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing will occur.~~ X

12

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Complex~~ Simple

(b) ~~simple~~ complex

(c) Good

(e) Good

(d) poor

(f) Good

(g) ~~Reasonable~~ Difficult

(h) ~~Reasonable~~ easy

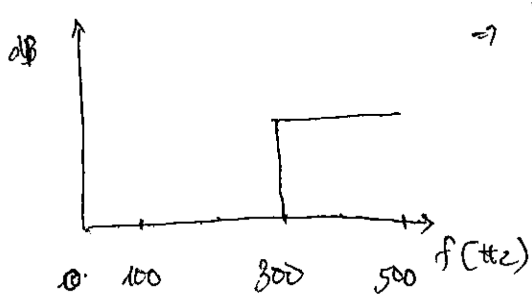
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

→ Low pass filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

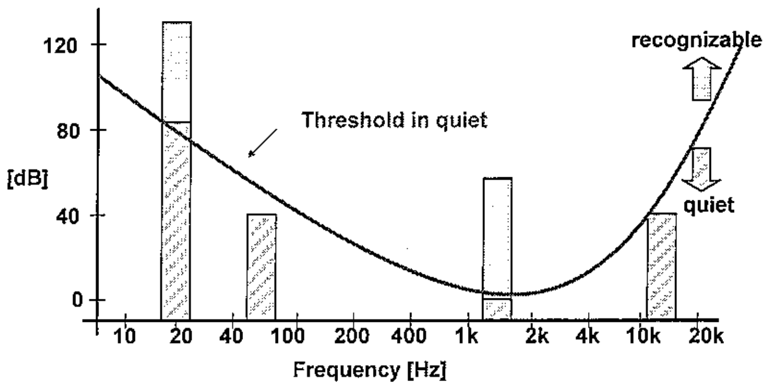
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

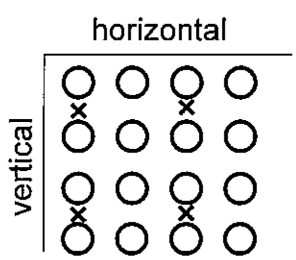


Psych - acoustic model present the signals which we can recognize above threshold in quiet line.
The purpose : This model will separate the signal intensity which we can recognize and eliminate the signal intensity too quiet which we can not recognize.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above

Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

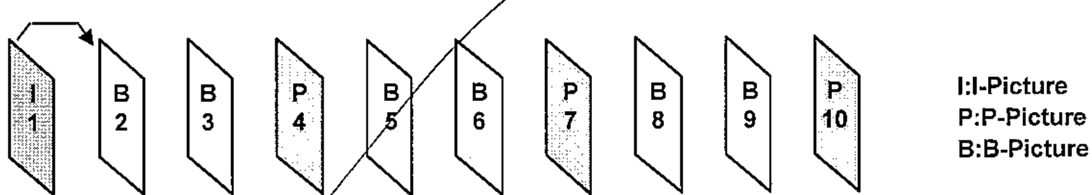
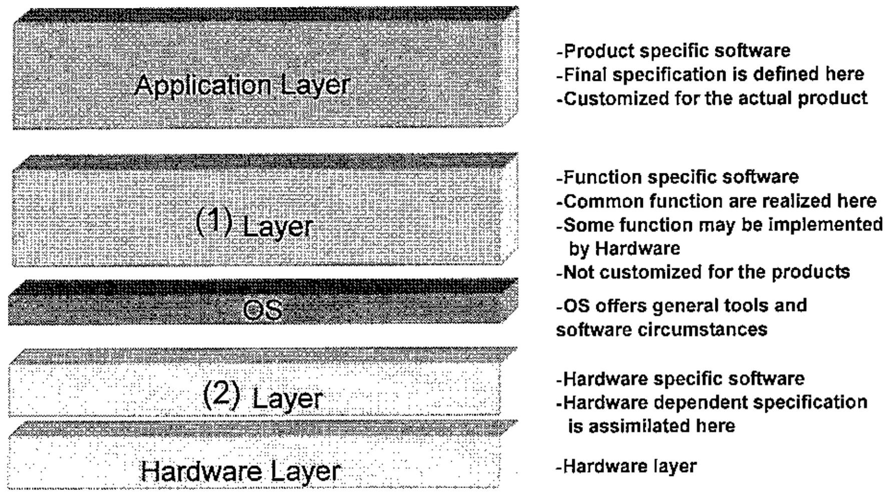


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- OpenMax IL serves as a low-level interface for audio, video and imaging codecs used in embedded device.

0

14

ID code	2052
Name	Nguyen Minh Tien

RVC "System Solution"

Examination

November 24, 2017

~~61~~ 63

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

– The sampling frequency ~~shou~~ should be 2 times higher than the signal band width

$f_s > 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

The result: −4

(b) Signed Truncation

The result: −3

(c) Rounding

The result: −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~4~~ 6

(a) Calculate the maximum frequency CD can re-produce.

~~? 24 kHz~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48.10^3.24.6$ [bit/sec] = ?

(c) Calculate the size of 60[min].

$48.10^3.24.6.60$ [bit/sec] = ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~The aliasing signal will happen~~ = ?

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) Good

(d) Poor

(f) Good

(g) Poor

(h) Good

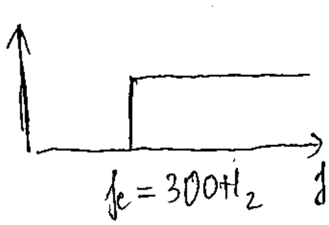
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

• ~~bth~~ We should use High pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

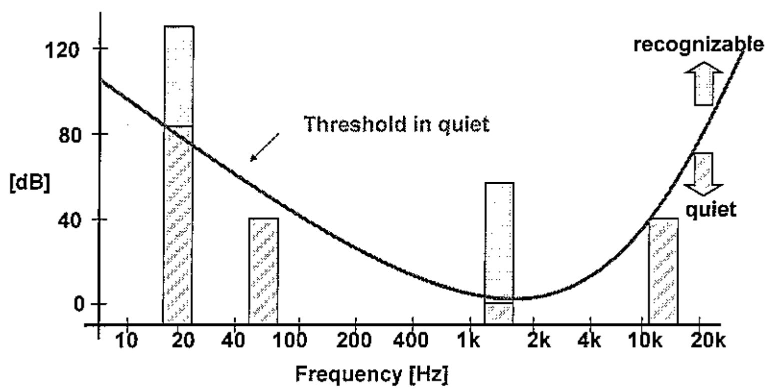
(1) Fourier Transform
Utilize [time - frequency ~~trans~~] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

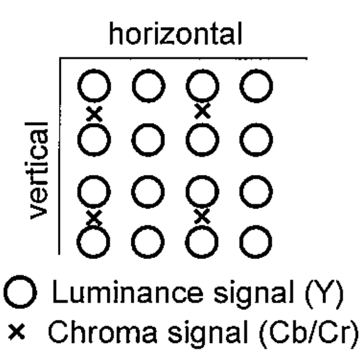
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

~~3840, 2160~~.

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

~~3840, 2160~~

3840 [pixels/line] x 2160 [lines/frame]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 \cdot 2160 \cdot 8 \cdot 3\cancel{0} \cdot 1/2 \times 3$ ~~[bit/frame]~~ ~~[bps]~~ [bit/frame]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 \cdot 2160 \cdot 8 \cdot 30 \cdot \frac{1}{2} \times 3$ [bps]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

The result: $\frac{3840 \cdot 2160 \cdot 8 \cdot 30}{2 \cdot 100 \cdot 10^6}$

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

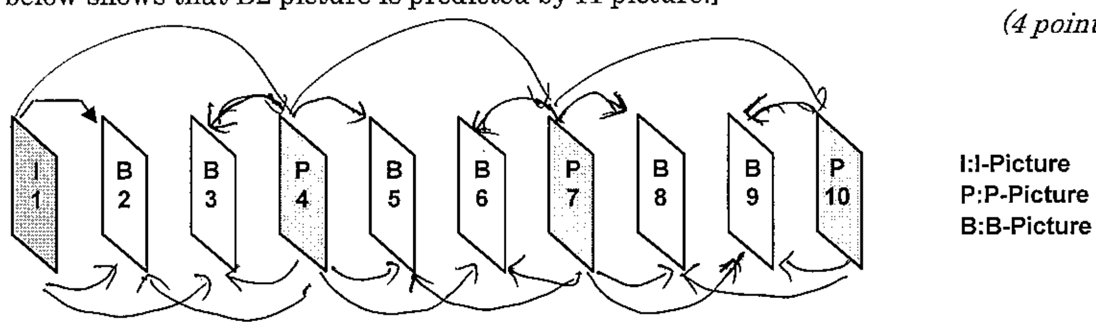
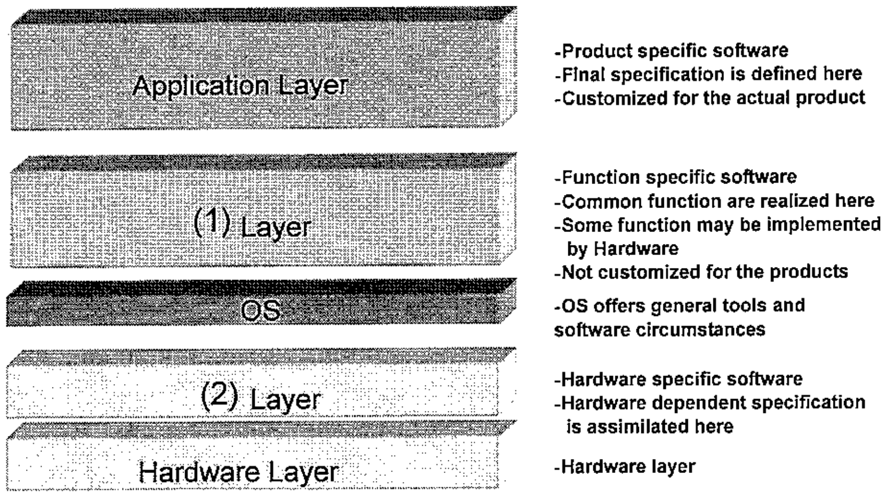


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) ~~a) API~~ b) Middleware c) RTL ~~d) Driver~~

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

-Open max set of C-language programing interfaes. for routines especially useful for audio, video, image

-Open max IL service is low-level inter faces used in embedded deices

-It gives application and media framwork the ability to interface with multimedia codecs and supporting components in a unified manner

8

ID code	2053
Name	Nguyễn Quang Trí

47

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

- Maintain $f_s \geq 2f_m$ and aliasing signal will not appears

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

4

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \Rightarrow f_m \leq f_s/2$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~bit rate = (48 * 1000) * 24 * 6 * 2~~

(c) Calculate the size of 60[min].

data size = bit rate * 60 * 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias = 48KHz − 30KHz = 18KHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) good

(d) Poor (f) good

(g) Poor (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

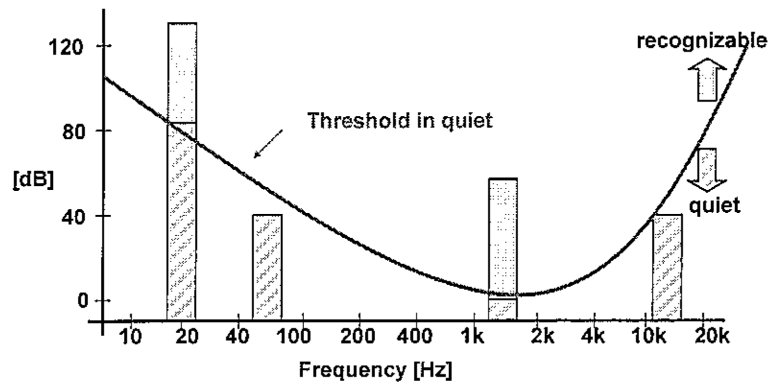
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - Frequency ~~transformation~~] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

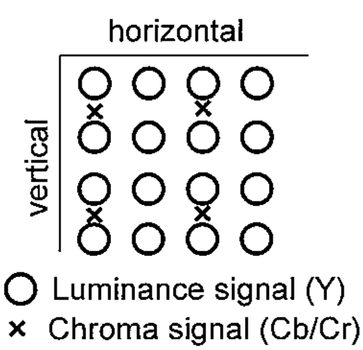
2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)



The sensitivity of the human being is not constant for the frequency of the signals

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above

Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2 — 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

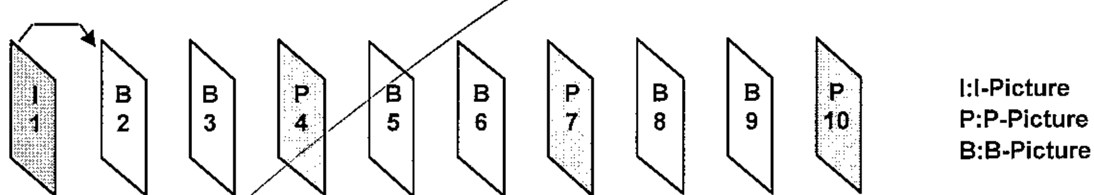
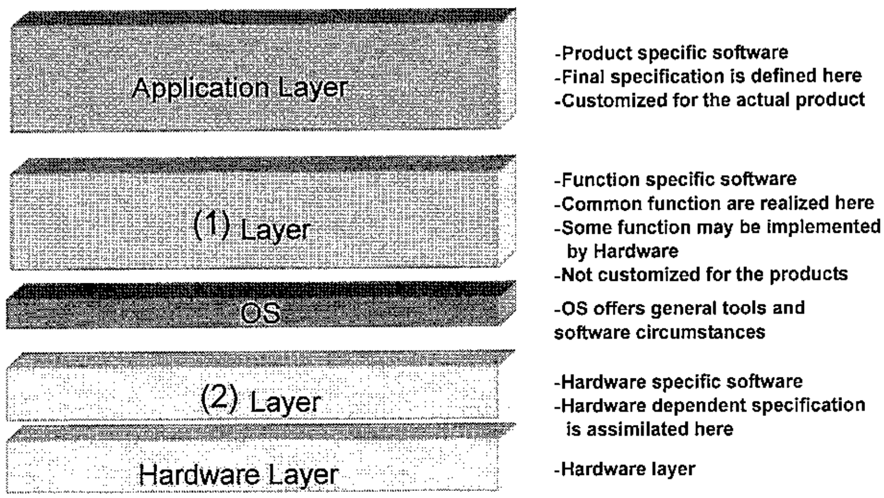


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

10

ID code	2054
Name	Pham Quốc Văn

~~55.5~~

61.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

to prevent "Aliasing" then a sampling frequency : $f_s \geq 2 * f_m$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~

10

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \Rightarrow f_m <= \frac{f_s}{2} = 24 kHz \Rightarrow f_{max} = 24 kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (44.1 * 1000) * 24 * 6 (bit/s) X ✓

(c) Calculate the size of 60[min].

datasize = bitrate * (60 * 60) [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

→ ~~Aliasing , because $f_s = 48 kHz < 2 f_m = 2 * 30 = 60 kHz$~~ X

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex
Cost	Reasonable	Expensive
Quality	(c) (good) : for original signal (d) (poor) : for repeating copy & signal transfer	(e) (good) : for original signal (f) (good) : for repeating copy & signal transfer
Stability	(g) (porr) : for time variant, etc	(h) (good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) good

(e) good

(d) poor

(f) good

(g) poor

(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

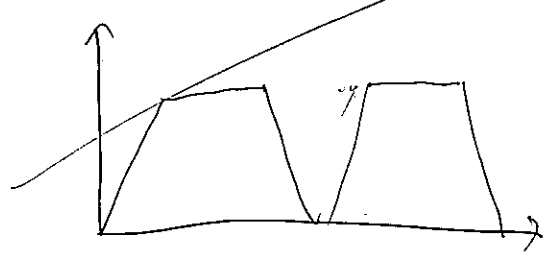
1.5

the advantage of FFT is fast Calculation algorithm of DFT for $N \to$ M casin.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

fa: ~~Band-pass~~ High-pass



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

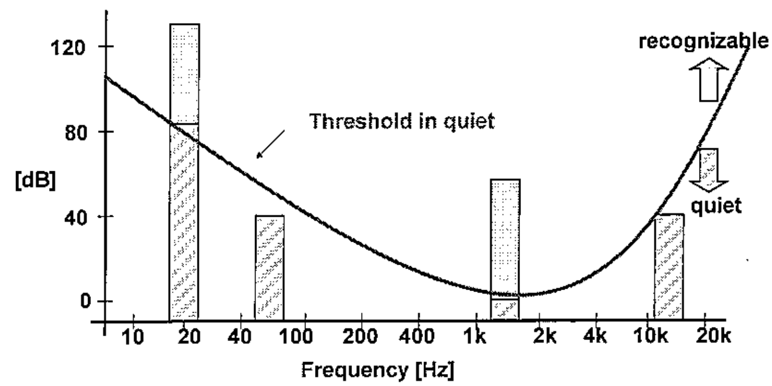
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



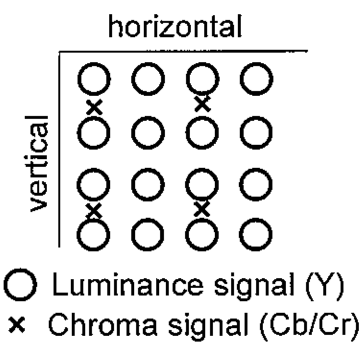
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840[pixels/line] × 2160[lines/frame] × 2 ×~~
3840[pixels/line] × 2160[lines/frame] × 8[bit]] × 2 × $\frac{1}{2}$

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [~~Picture~~ ~~to~~ 3840 [pixels/line] × 2160 [lines/frame]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3820 [pixels/line] × 2160 [lines/frame] × 30 [frame/s] × 8 [bit]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0 Ans:[$\frac{3820 \times 2160 \times 30 \times 8}{100 \times 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

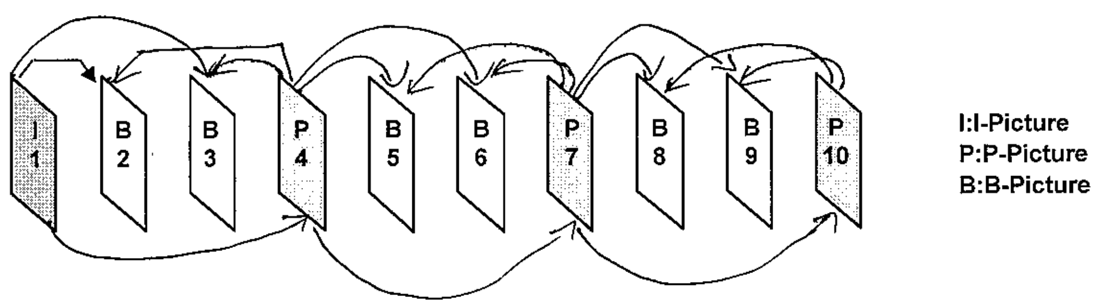
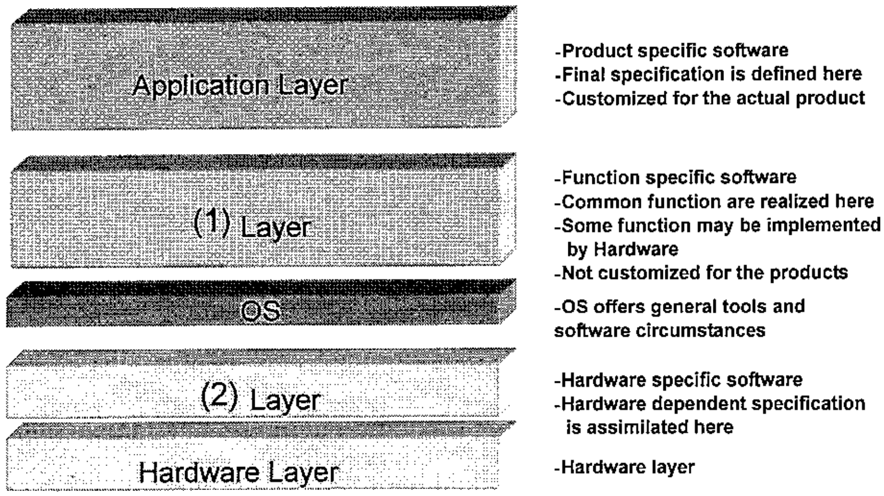


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

17

ID code	2055
Name	Nguyen Thanh Dat

53

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

- ~~for~~ Sampling frequency $F_s > 2f_m$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) ~~3.75~~

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

2

(a) Calculate the maximum frequency CD can re-produce.

~~48 . 2 . 6 96 KHz~~ X

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~(48.1000) . 24 . 2.6 =~~ X

(c) Calculate the size of 60[min].

(48.1000) . 24 . 2.6 . 60 . 60 X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~ △

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (simple)	(b) (complex)
Cost	Reasonable	Expensive
Quality	(c) (good) : for original signal (d) (poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

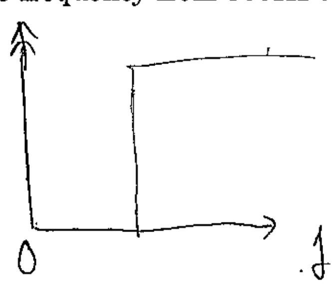
(a) simple (b) Complex
(c) good (e) Good
(d) poor (f) Good
(g) poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0



Use filter : high pass.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

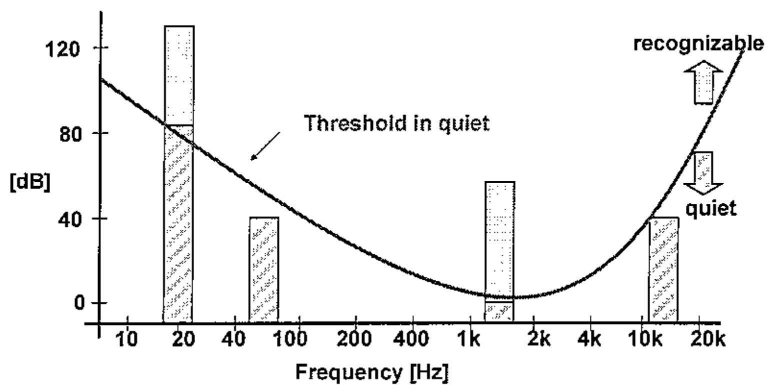
(1) Fourier Transform
Utilize [time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

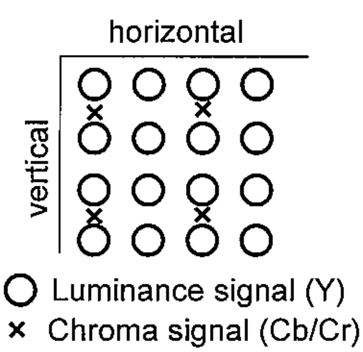


3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 x 2160 x 8]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 128 \times 5 \times 1/2 = 3840 \times 2160 \times 12$ unit?]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 12 \times 30$ unit?]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT (c) a) Probability theory technique

2) VLC (a) b) Time Domain technique

6

3) MC (b) c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

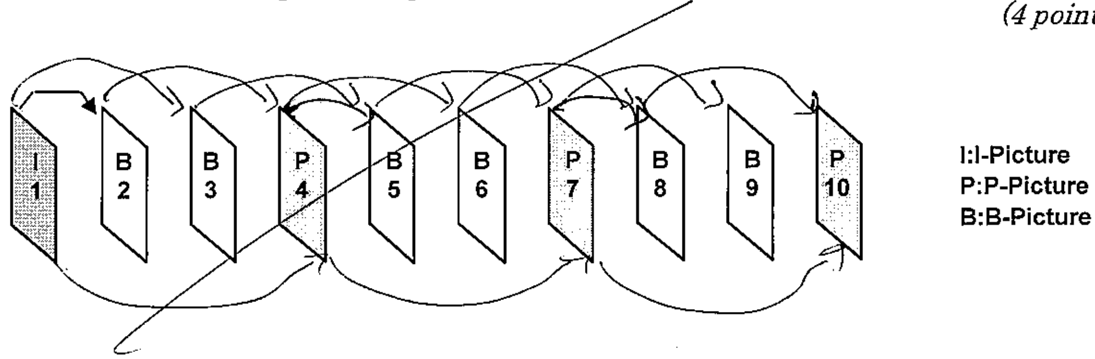
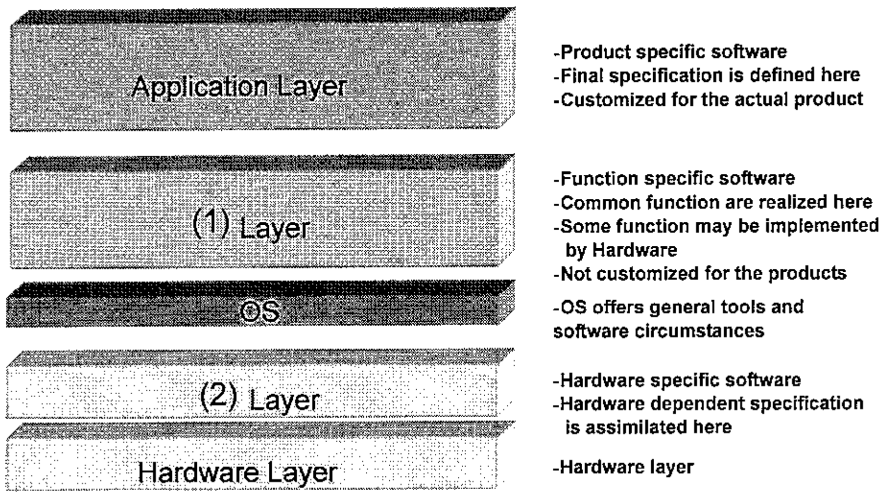


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a)~~ API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- royalty-free, cross-platform set of C-library
- provide abstration for rountines

2

- Gives app and media frameworks the ability to interface with multimedia codec and supporting components in ~~fix~~ unified manner.

18

ID code	2057
Name	Dang Trung Hieu

65

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0 Optimizing ~~the differ betwent~~ between analog signal ~~and digitalized~~ signal sampled.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) ~~-3~~

(b) Signed Truncation ~~-4~~

(c) Rounding ~~-3.5~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

12

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq \frac{48}{2} = 24$ kHz ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate = (44 * 1000) * 24 * 6 = ~~6336000~~ (bit/sec)

(c) Calculate the size of 60[min].

size = 60 * 60 * (6336000) = ~~22809600000~~ ✓

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz? ~~Alias = 4 18 kHz~~

Alias = 48 - 30 = 18kHz ✓

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 fast, save time

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

- kind of filter : ~~Z tranform~~ ~~Band Pass filter~~
Band rejection filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

16

(1) Fourier Transform
Utilize [Time – Frequency] transformation.

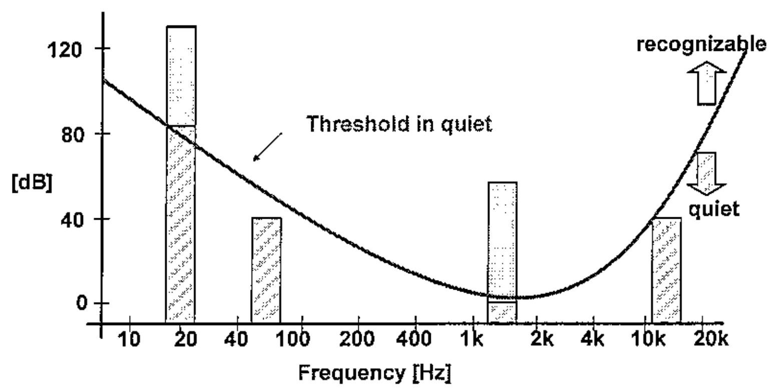
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

3

(5 points)

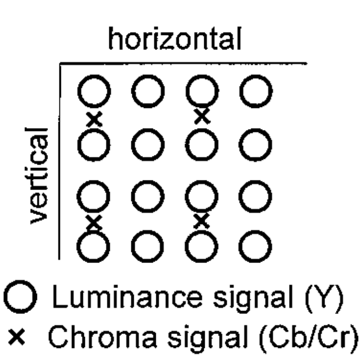


Remove the element which down to Psych-acoustic line
It means remove some/all frequency component wich people cannot hear.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

3840 * 2160 * 8 * 3

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 * 2160 * 2~~]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 * 2160 * 8 * 3 * 0,5 (bits/frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 * 2160 * 12 * 30 (bps)]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

1 - c

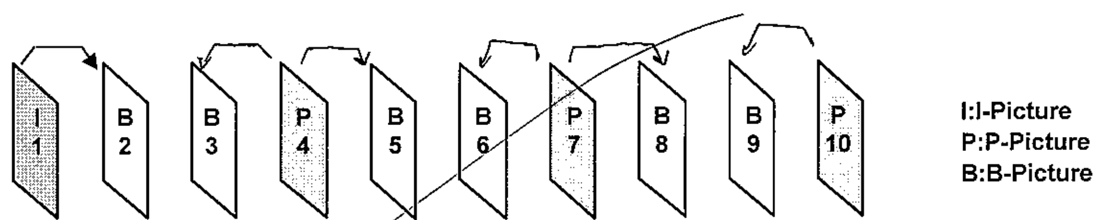
6 2 - a

3 - b

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

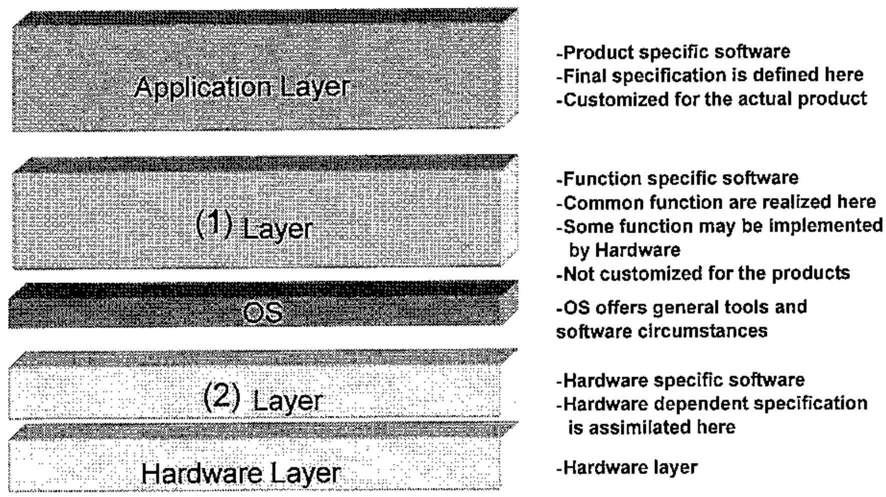


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

It gives app and media frameworks the ability to interface with multimedia codes and supporting

12

ID code	2059
Name	Nguyen Ba Khanh

~~31~~

39

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

~~Increase sampling rate.~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) ~~-3~~

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{48 kHz}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate = 48000 . 24 . 6

(c) Calculate the size of 60[min].

size = 48000 . 24 . 6 . 60 . 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~The quality decreases.~~

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) Difficult : for time variant, etc	(h) (Easy) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Difficult (h) Easy

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

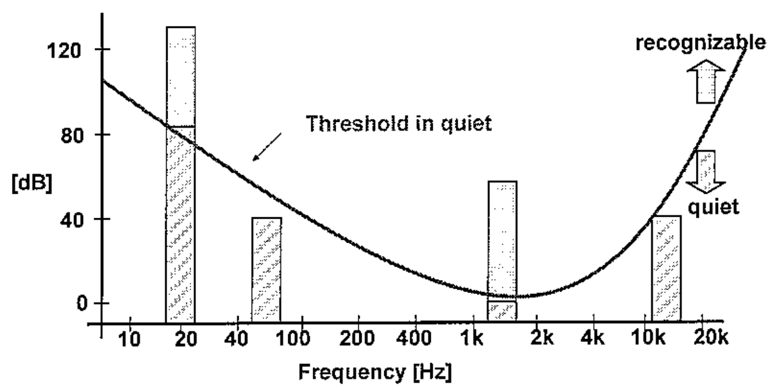
(1) Fourier Transform
Utilize [frequency domain] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



It shows the denpendance of sound amplitude to frequency the the people can hear.

Ex: in 20Hz, people can't hear the sound below 80dB.

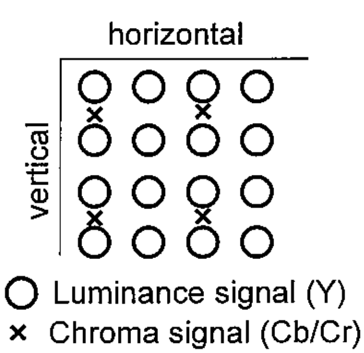
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) $= 3840 . 2160 \cdot \frac{2}{3}$

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

$= 3840 . 2160 \cdot \frac{1}{3}$

]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$= 3840 \cdot 2160 \cdot 8$]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$= 3840 \cdot 2160 \cdot 8 \cdot 30$]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

$= \dfrac{3840 \cdot 2160 \cdot 8 \cdot 30}{10^8}$

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT - c	a) Probability theory technique
2) VLC - a	b) Time Domain technique
3) MC - ~~a~~ b	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

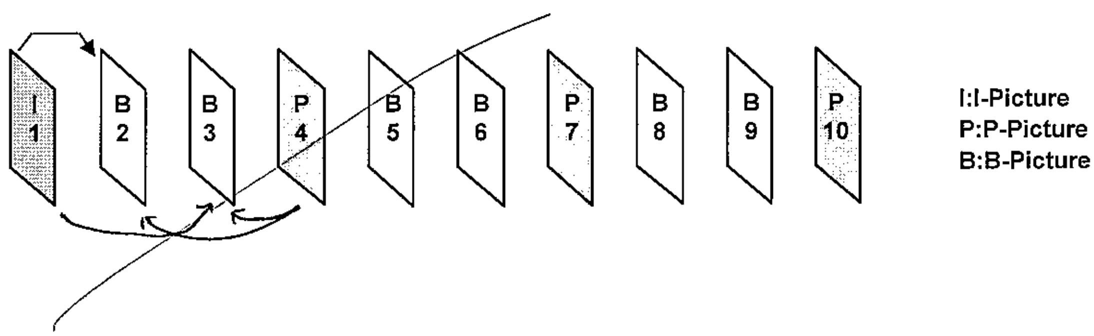
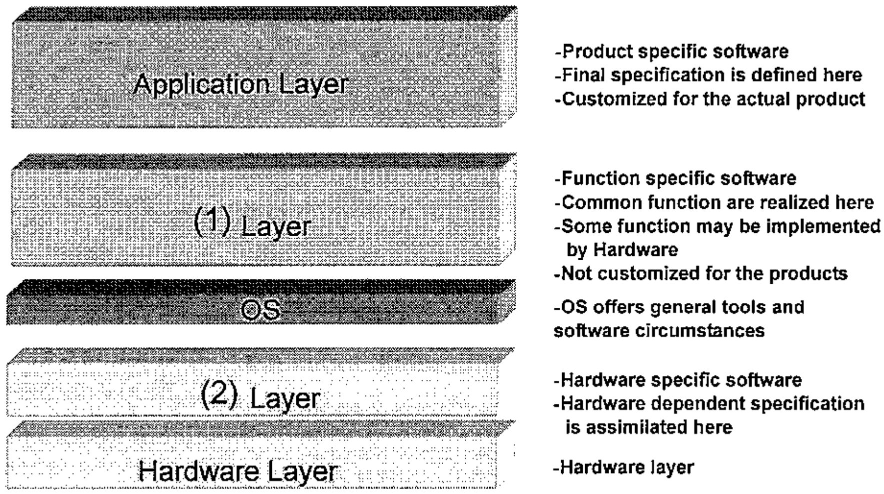


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

9

ID code	2061
Name	Lê Duy Manh

~~45~~ 53

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

0 1.1 How to prevent "Aliasing"? *(3 points)*

Reduce the gap between Analog - Digital

0 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

~~4~~ 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

12 (a) Calculate the maximum frequency CD can re-produce.

fmc = 48/2 (kHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = (48 * 1000) * 24 * 6 (bit/sec)

(c) Calculate the size of 60[min].

data size = bit rate * (60 * 60) (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing 18 kHz

12 1.4 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) ~~Poor~~

(d) ~~Good~~

(f) Good

(g) Poor

(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

Entrophy Coding (Huffman Coding)

2. Audio Coding

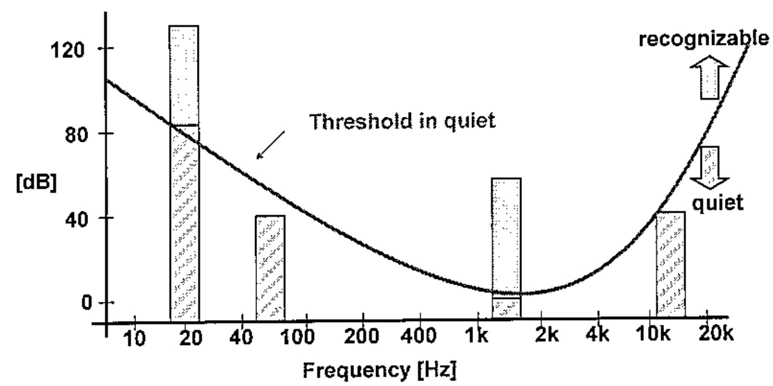
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [~~Frequency, QMF, MDCT~~ Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation between] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)



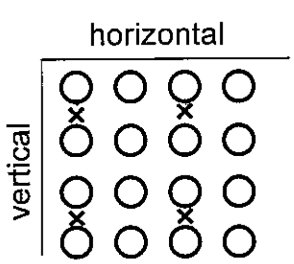
The quiet part (bellow the threshold) is the not-important part (mostly unrecognizable for human's ears).

So they will be eliminated in encoding process ..

So that the data size of audio file can be reduced.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) ~~3840 [pixels/line] x 2160 [lines/frame]~~
~~4 [pixels/line] x 4 [pixels/line] = 16 [pixels/frame]~~

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~(3840/2) x (2160/2)~~
(3840 [pixels/line]/2) x (2160 [pixels/line]/2)) x 2]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [8 294000 [pixels/frame] + 8 294 000 (pixels/frame) / 4]

4) Calculate total data rate of UHD/4K Video data above

Ans: [~~total data volume / 829400 (pixels/frame)~~

~~total data volume~~ total data volume * 30[s] (bps) /]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

3 Ans:[100[Mbps] * 1000000 / ~~total data rate~~ (bps) /]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

0 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

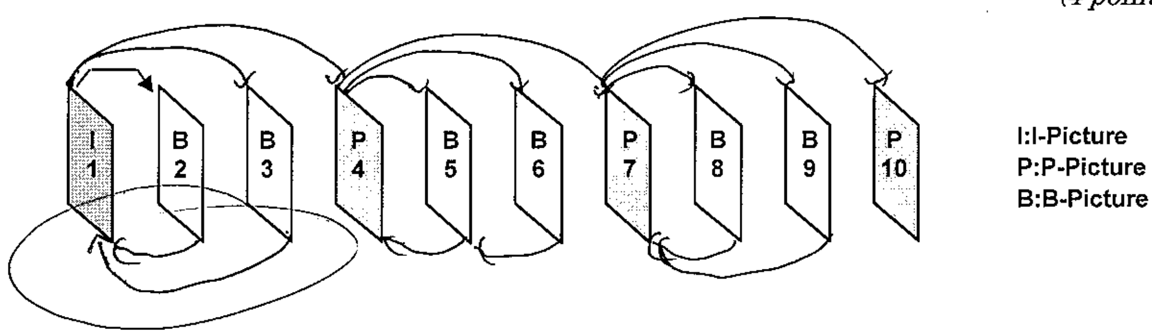
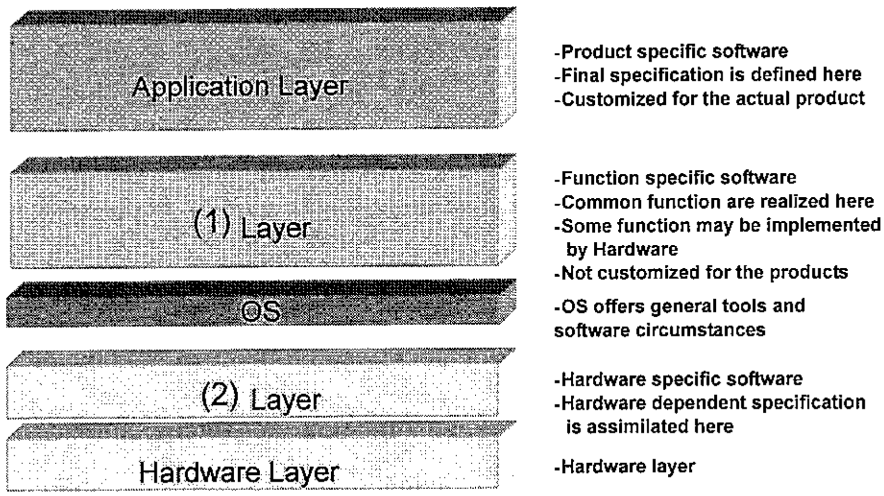


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

2

ID code	2062
Name	Lê Anh Nam

~~52~~

RVC "System Solution" **Examination** November 24, 2017

56

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Use the sampling frequency ~~bigger~~ bigger or equal to 2 times of maximum frequency of signal.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_{sampling} = 48kHz \Rightarrow$ max frequency: $f_m = \frac{f_{sampling}}{2} = 24kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= f_m \times 24 \times 6 = 24 \cdot 10^3 \times 24 \times 6$ (bit/sec)

(c) Calculate the size of 60[min].

$=$ bitrate $\times 60 \times 60 = 24 \cdot 10^3 \times 24 \times 6 \times 60 \times 60$ (bits)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

minimum value of sampling frequency is $2 \times 30kHz = 60kHz > 48kHz$
$\rightarrow$ not satisfy the condition of sampling frequency

12

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (complex)	(b) (complex)
Cost	Reasonable	Expensive
Quality	(c) (good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (good) : for original signal (f) (good) : for repeating copy & signal transfer
Stability	(g) (Reasonable) : for time variant, etc	(h) (good) : for time variant, etc
Portability	Difficult	Easy

(a) ~~complex~~ (b) complex

(c) good (e) good

(d) Poor (f) good

(g) ~~Reasonable~~ (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

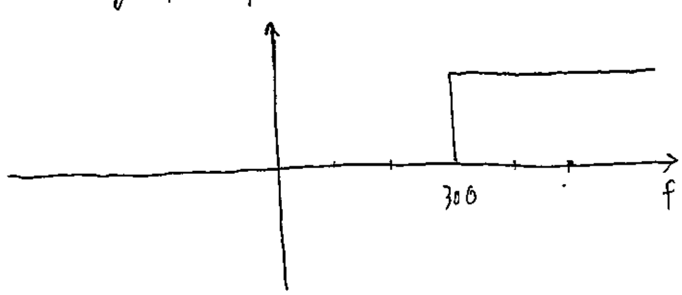
1

- ~~in~~ Be able to be implemented with discrete time domain
- more simple
- easy to apply into programming

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

High pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

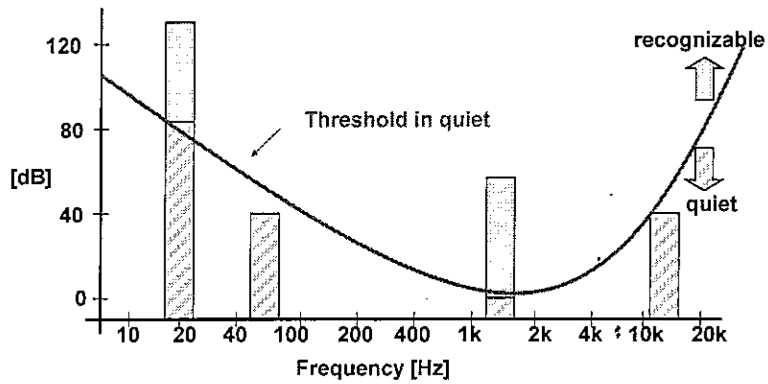
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation ~~be~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~#~~ data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



- Psych-acoustic model determine ~~the~~ ~~in~~ the thresold at which human ears still regconise the sound based on the frequency and amplitude of signals.
- Its purpose is serving for designing a suitable filter with an effective operation.

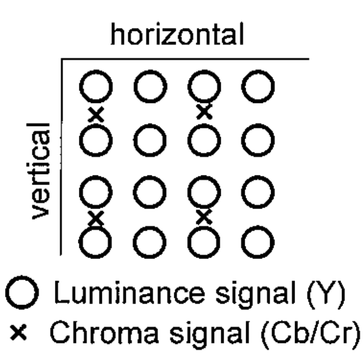
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] x 2160 [lines/frame] x 1/4 x 2 [pixels/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \times (\frac{1}{4}+\frac{1}{2}) \times 8 \times 3$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

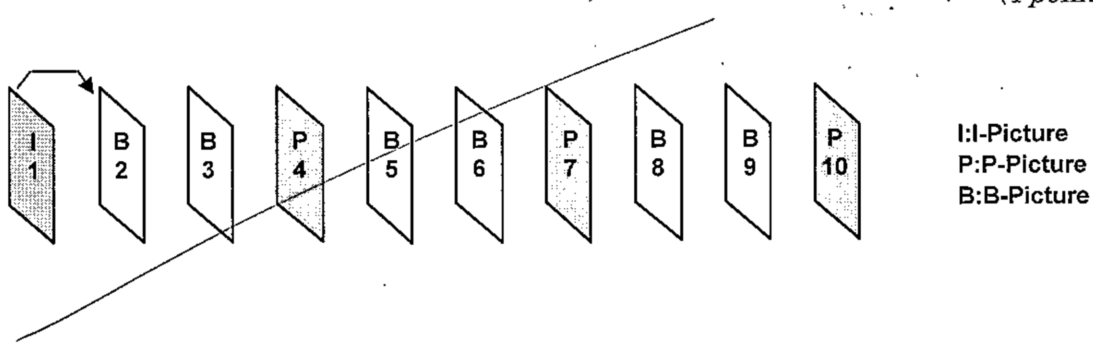
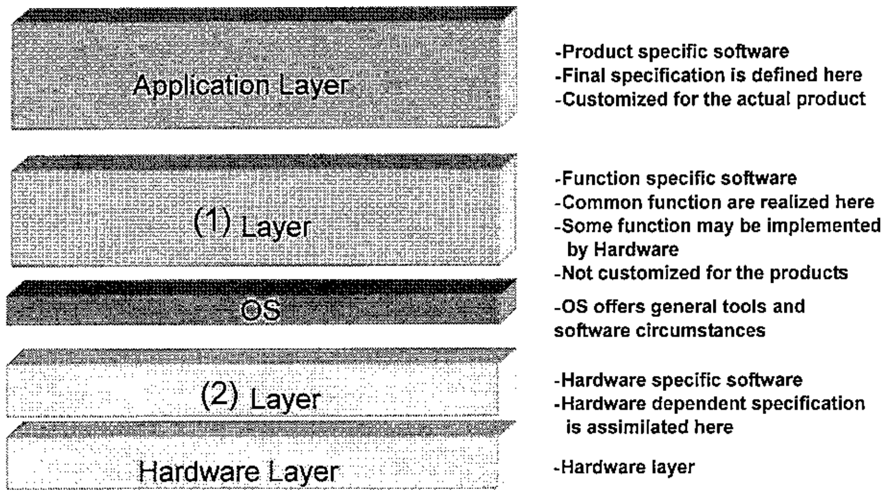


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

6

ID code	2072
Name	~~Dan~~ TRAN THANH AN

RVC "System Solution" **Examination** November 24, 2017

~~22~~

24

1. Digital Signal Processing

0 1.1 How to prevent "Aliasing"? *(3 points)*

9 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

~~4~~ 6 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_m <= \frac{f_s}{2} = \frac{48}{2} = 24$ kHz ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= (48 * 1000) * 24 * \cancel{2}$ X

(c) Calculate the size of 60[min].

data size = bit rate * 60 * 60 (X)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz? X

0 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) (b)

(c) (e)

(d) (f)

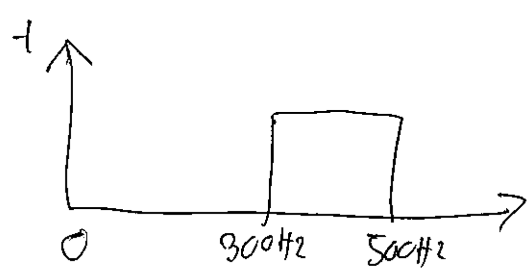
(g) (h)

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3



We use band pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

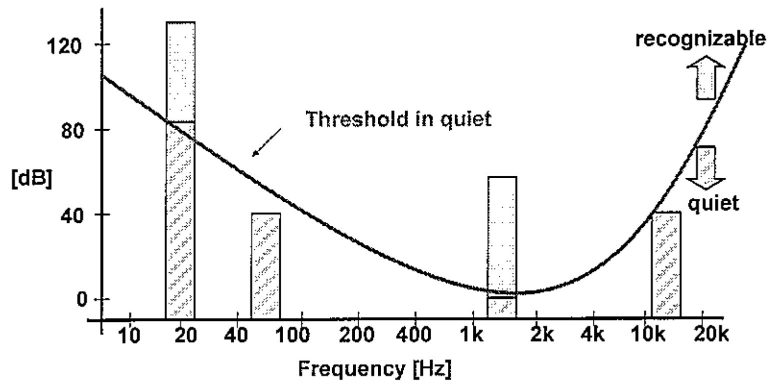
(1) Fourier Transform
Utilize [   ] transformation.

(2) Stereo Coding
Utilize the property of [   ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [   ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



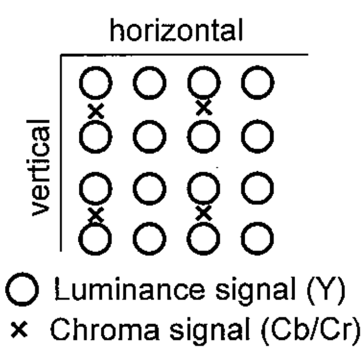
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

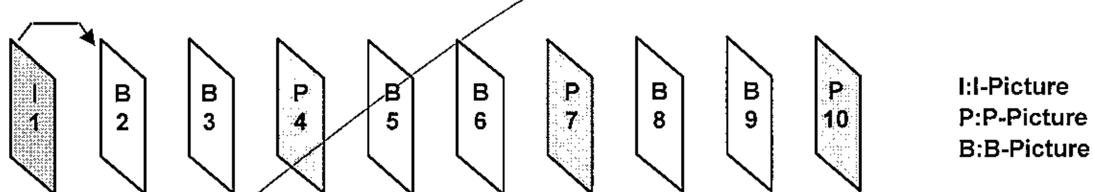
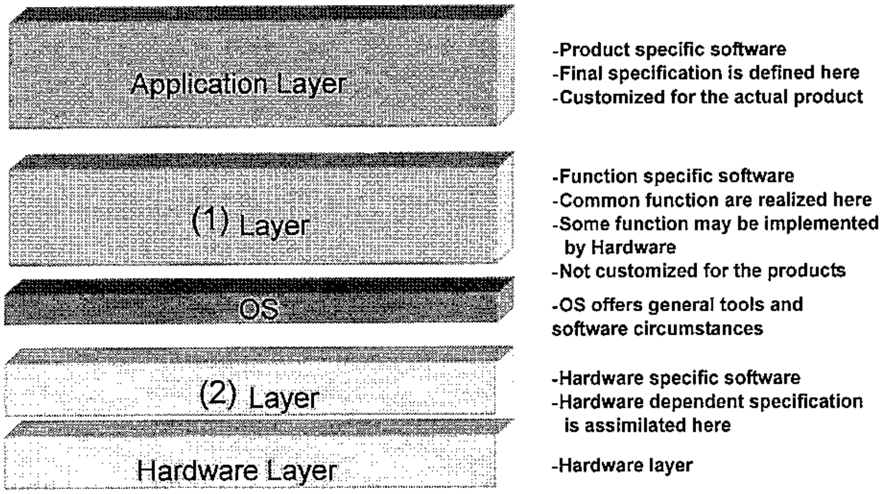


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

24 + 3

ID code	2073
Name	Võ Trọng Ân

~~81~~ 85

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

3

1.1 How to prevent "Aliasing"? *(3 points)*

~~The sampling frequency has to satisfy the Nyquist theory : bigger or at least equal the double maximum sampled signal~~

$f_s \geq 2 \cdot f_m$ → sampled signal

f_s → sampling signal.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) : −4

(b) Signed Truncation : −3.

(c) Rounding : −4

~~8~~ 12

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 48kHz \geq 2f_m \Rightarrow f_m = \frac{f_s}{2} = \frac{48}{2} = 24$ kHz.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = 48 . 1000 . 24 . 6 = ? bit/s.

(c) Calculate the size of 60[min].

size(60 min) = 48 . 1000 . 24 . 6 . 60 . 60 = ? bit.

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

It will be aliased with ~~f_a = 48 kHz.~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) Good

(d) Poor

(f) Good

(g) Poor

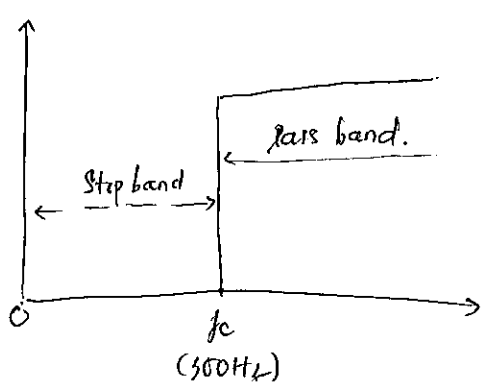
(h) Good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 FFT is more simple than DFT while the result is similar.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0 We should use high pass filter with fc = 300Hz.



2: Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

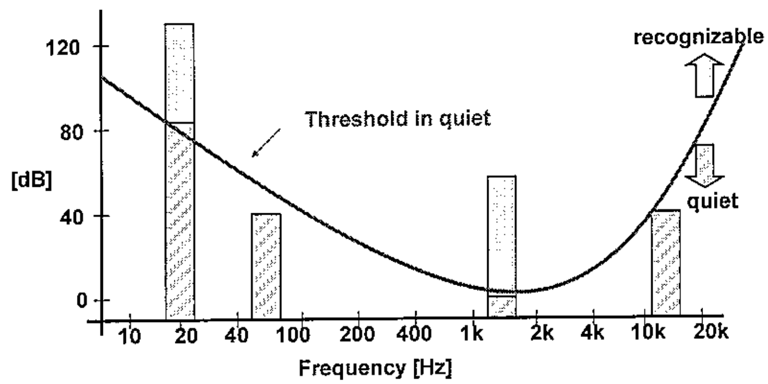
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

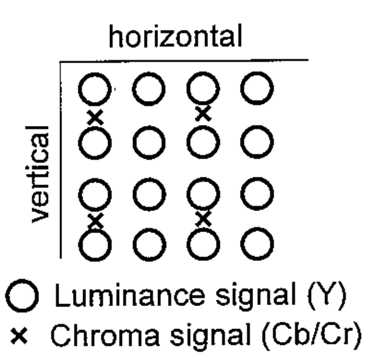


The model shows the sensitivity of the human beings to the sound in specific frequency domain.
It is not constraint for the frequency of the signal.
The model helps scientist choose proper frequency sound based on the specific purpose.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 (pixel/line) x 2160 (lines/frame) x 8 (bit) x3x 2/12~~
$3840 \times 2160 \times 8 \times 3 \times \frac{2}{12}$ (bits/frame)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2}$ ~~×30~~ (~~bps~~) (bit / frame).]

4) Calculate total data rate of UHD/4K Video data above
Ans: [
$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} \times 30$ (bps)]

9

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$\dfrac{3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} \times 30}{100 \times 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans.	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

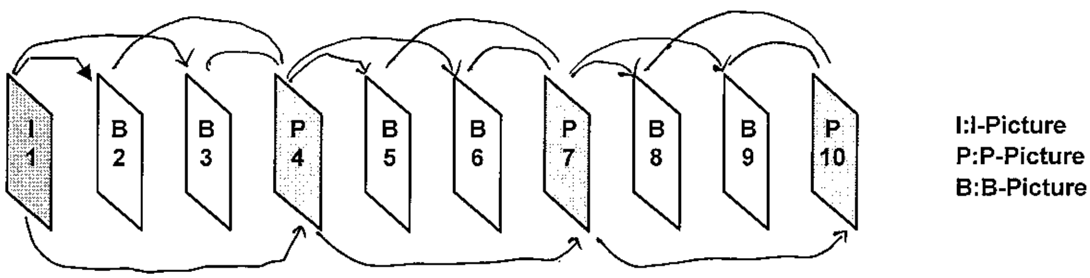
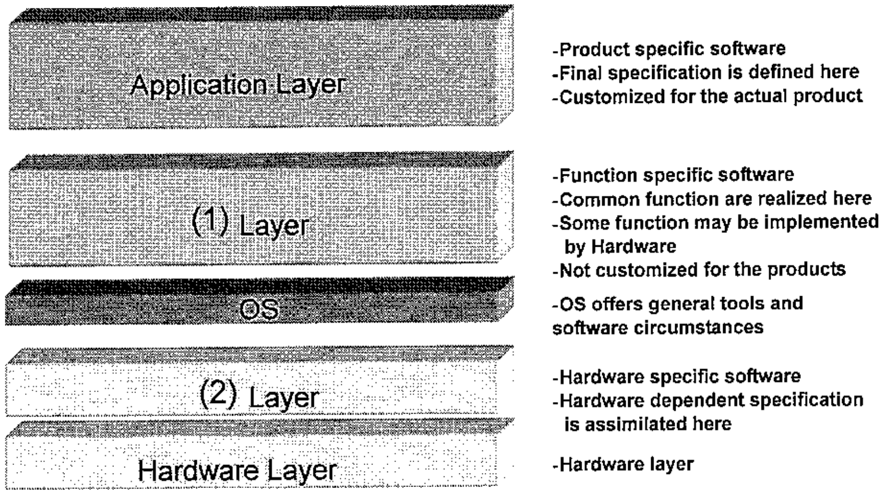


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6 (1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as a flow-level interface for audio, video and image codecs used in embeded devices.

2 It gives application and media frameworks the ability to interface with multi media codes and supporting components in a unified manner.

24

ID code	2074
Name	Nguyễn Đình Anh

~~86~~
90

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

sample frequency must be larger than double max frequency

$f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) ~~-3~~ -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq \frac{f_s}{2} = \frac{48.000}{2} = 24.000$ Hz.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = (48×1000)× 24 × 6

(c) Calculate the size of 60[min].

size = (bit rate) ×(60×60)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing 18 KHz~~ !

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex
(c) good (e) good
(d) poor (f) good
(g) poor (h) good

3

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

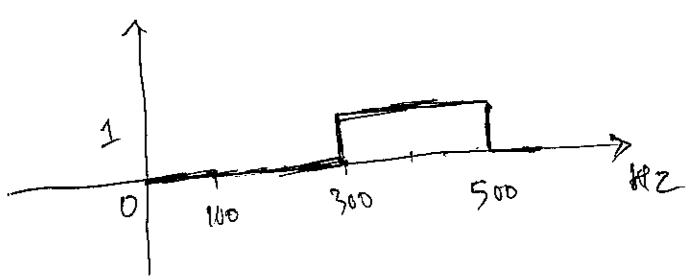
decrease the calculation number

	DFT	FFT
Multiplication	N^2	$\frac{N(\log_2 N - 1)}{2}$
addition	$N(N-1)$	$N \cdot \log_2 N$

3

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

– use the band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

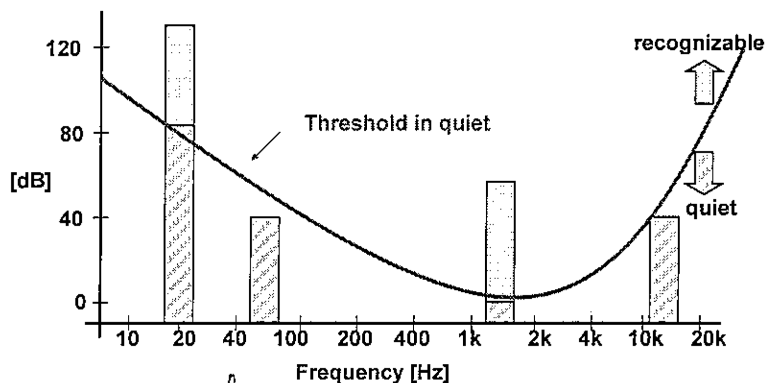
(1) Fourier Transform
Utilize [Time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



– a signal have large ~~amplitude~~ amplitude, will cover some signal near itself and people can not hear ~~sensity~~ them,

– we can remove them, to reduce data but not effect to ~~quality~~ ~~quality~~ quality.

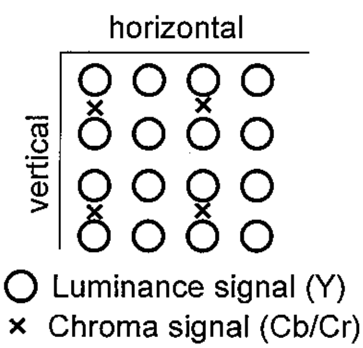
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$\frac{3840 [\text{pixels/line}] \times 2160 [\text{lines/frame}]}{4}$] × 2

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times \frac{(8 \times 3)}{2}$ (fps) ?]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 12 \times 30$ (bps)]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

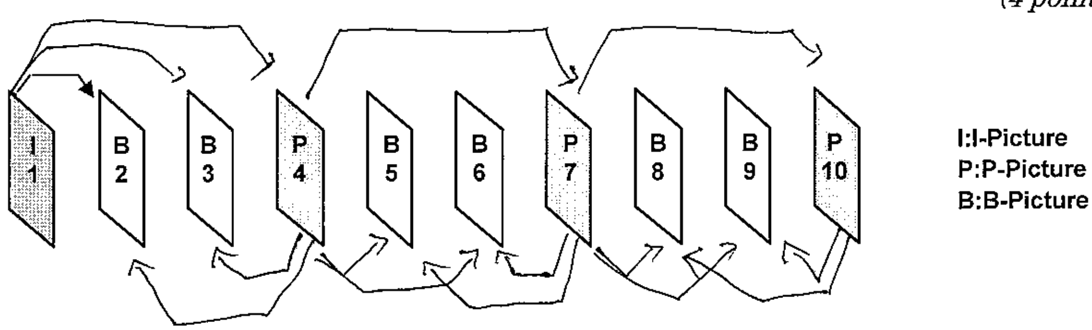
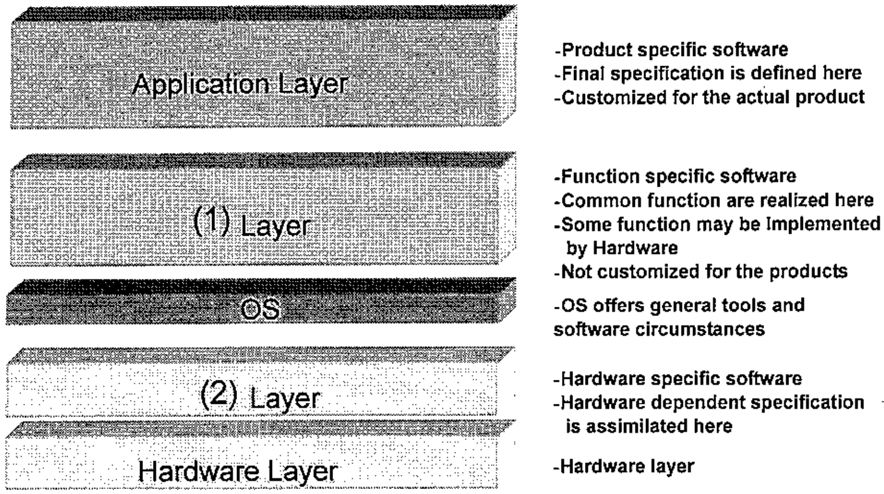


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMax IL serves as a Low-level interface for audio, video & imaging codecs used in embedded device.

2

It give applications & media framework the ability to interface with multimedia codecs & supporting component in a unified manner.

26

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~~83~~
85

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 To prevent "aliasing" ~~we need to~~ the sampling frequency must satisfy the nyquist condition:

$$f_s > 2f_{max}$$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

-4.00

(b) Signed Truncation

-3.00

(c) Rounding

- 4.00

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~8~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$$f_{max} < \frac{f_s}{2} = \frac{48\,kHz}{2} = 24\,kHz$$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$= 48 * 1000 * 24 * 6$ [x]

(c) Calculate the size of 60[min].

$= 48 * 1000 * 24 * 6 * 60 * 60$ (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~aliasing with f_a = 18 kHz.~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex
(c) good (e) good
(d) poor (f) good
(g) poor (h) good

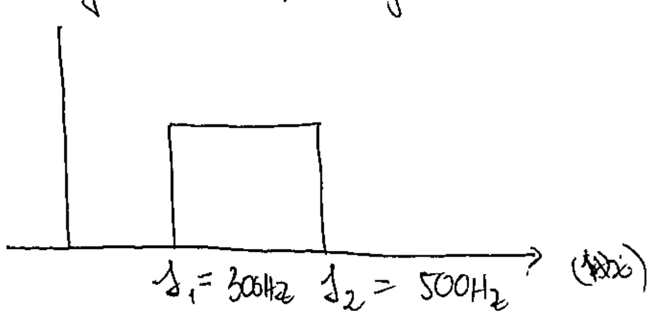
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 ~~FT~~ FFT is faster than DFT and more simple.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

⇒ We should use band pass filter
* figure of band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

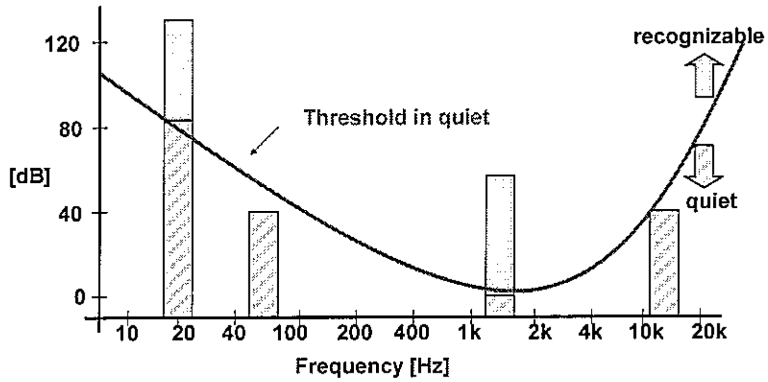
(2) Stereo Coding
Utilize the property of [correlcation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)



⇒ The Psych-acaustic is to determine which amplitude (dB) of each frequency that can be recognied.

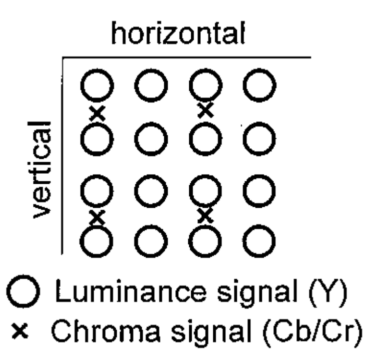
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{6}$ (bit/frame)]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \times 24 \times \frac{1}{2}$ (bit/frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \times 2160 \times 24 \times 1/2 \times 30$ (bit/s)]

10

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[compression ratio = $\dfrac{3840 \times 2160 \times 24 \times 30 \times 1/2}{100 \times 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.

1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

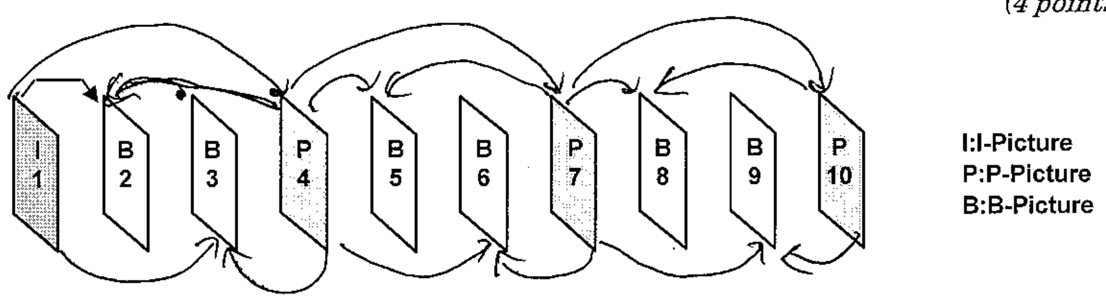
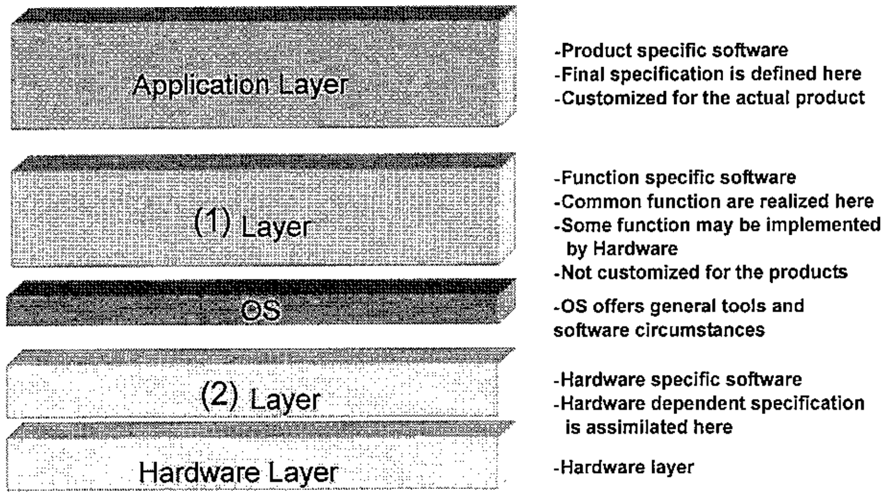


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

14

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~~59~~

RVC "System Solution" **Examination** November 24, 2017

69

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

Follow the Sampling Theory, to prevent aliasing, the sampling frequency must be greater than or equal to the double of the maximum frequency of ~~signal~~ sampled signal

$$f_s \geq 2 \times f_{max} \quad \begin{cases} f_s : \text{sampling freqency} \\ f_{max} : \text{maximum frequency of sampled signal} \end{cases}$$

9 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) −4

(b) Signed Truncation −3

(c) Rounding −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

14

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 48\ kHz \Rightarrow f_m \leq f_s/2 \Rightarrow Max[f_m] = \left\lfloor f_s/2 \right\rfloor (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (f_s \times 1000) \times 24 \times 6$ (bps)

(c) Calculate the size of 60[min].

Straoage space = bitrate $\times 60 \times 60$ (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

⇒ Aliasing will happend.

12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) ~~Poor~~ Good (e) Good

(d) Poor (f) Good

(g) ~~Poor~~ ~~Difficult~~ (h) ~~Good~~ ~~Easy~~

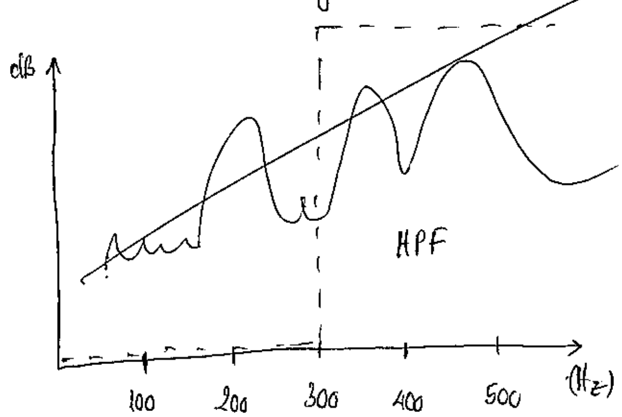
0 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT : Fast Fourier Transform ⟹ Faster Transform

DFT : Discrete Fourier Transform

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? Assume that ~~all~~ there is no frequency greater than 500 Hz *(3 points)*

⟹ We could use the High Pass Filter to ~~do~~ this.



→ Only allow High frequency passes

⇒ Remove freq < 300 Hz.

We can use band pass filter to get exactly the signal in range 300 - 500 Hz

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

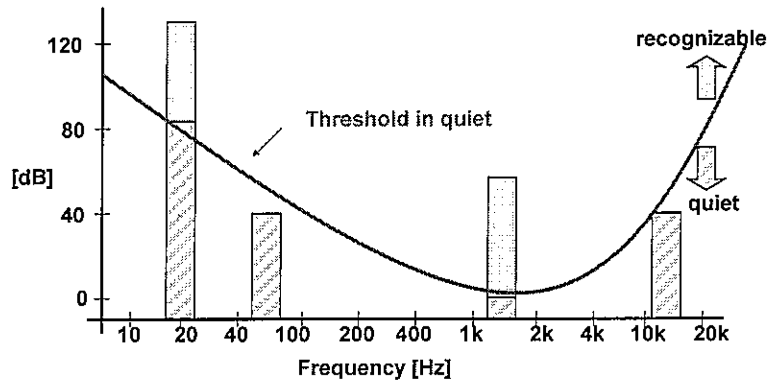
(1) Fourier Transform
Utilize [Time - Frequency ~~transformation~~] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~correlation~~ data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Human ears can recognize the sound in range ~~20 - 20kHz~~ 20 Hz ÷ 20 kHz

~~Therefore~~ And in this range, each of sound frequency has an different amplitude,

⇒ Therefore, we can use this model to only filter and process the frequency that human's ears can recognize, neglect the others.

⇒ Reduce the range of frequency, reduce the HW consumption and processing time

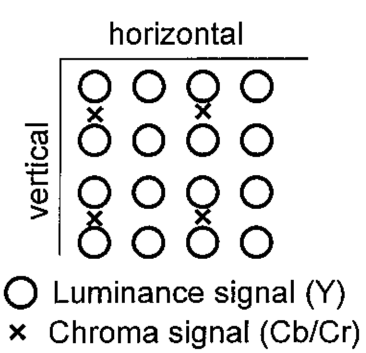
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) = 3840 [pixels/line] × 2160 [lines/frame]

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [[3840 [pixels/line] × 2160 [lines/frame] × $\frac{1}{2}$ × 8 × 30]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT → c) Frequency domain technique

6 2) VLC → a) Probability theory technique

3) MC → b) Time Domain technique

Ans. 1) DCT a) Probability theory technique

2) VLC b) Time Domain technique

3) MC c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

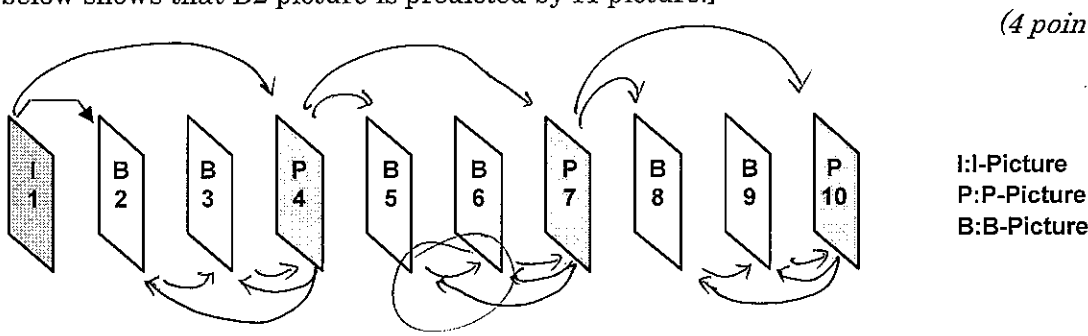
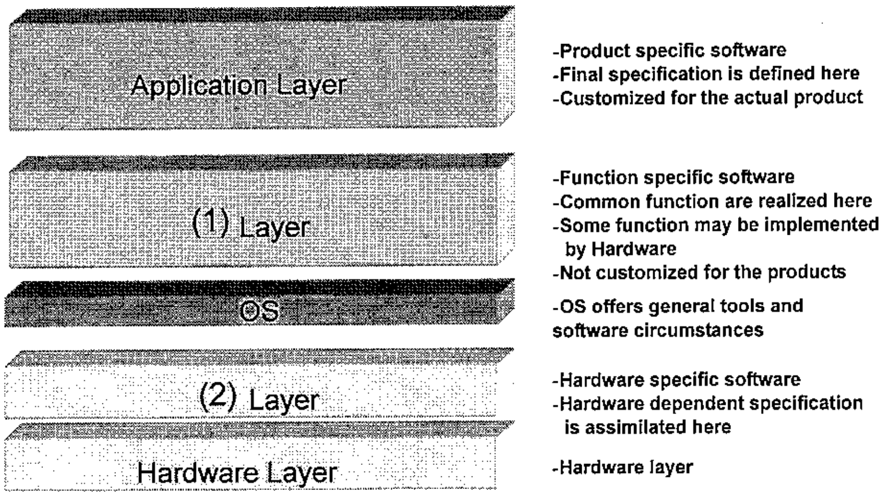


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMax IL serves as a low-level interface for audio, video, and imaging ~~decodes~~ codecs used in embedded devices.

2

→ It gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner

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20

~~81~~

83

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

In order to prevent "Aliasing", the sampling frequency need to be higher or equal Nyquist frequency.

$$\underbrace{f_s}_{\text{Sampling frequency}} \geq \underbrace{2 \times f_m}_{\text{Nyquist frequency}}$$ — f_m: maximum frequency of signal

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off)

−4

(b) Signed Truncation

~~−4~~

(c) Rounding

−4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~14~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 \times f_m \Rightarrow f_m = \frac{48}{2} = 24 (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$BR = 48 \times 1000 \times 24 \times 6 = 6.912.000\ (bps) = 6,912\ (Mbps)$

(c) Calculate the size of 60[min].

$DS = BR \times 60 \times 60 = 82944 0000\ (bit)$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_m \times 2 = 30 \times 2 = 60 kHz$

$f_s < 2 \times f_m \Leftrightarrow 48 < 60 \Rightarrow$ aliasing happen with $f_a = 48 - 30 = 18 kHz$

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) poor (f) Good

(g) poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

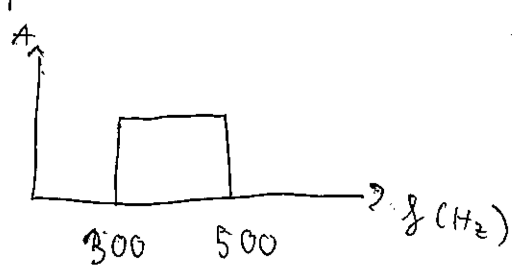
1

FFT took less time to complete than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

Band pass filter should be used to keep the component whose frequency from 300 Hz to 500 Hz



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

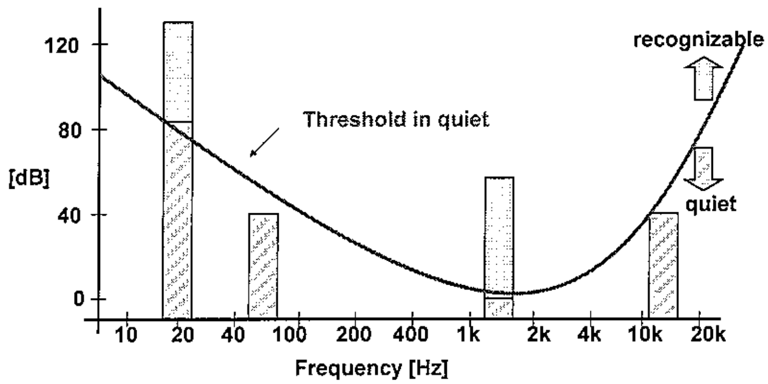
(1) Fourier Transform
Utilize [Time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

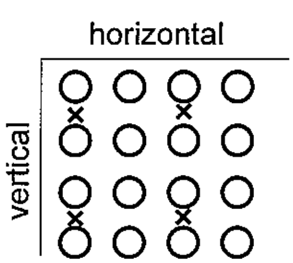


The meaning and purpose of this Psych-acoustic model in Audio Encoding is to remove the sound that we ~~can not~~ human can not hear in order to reduce the data information. It was used for the purpose of ~~lighter~~ reduce the data size of audio file

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times (24/2)$ (bit)

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times (24/2) \times 30$ (bit/sec)

]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$\frac{100 \times 10^6}{3840 \times 2160 \times (24/2) \times 30}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

2

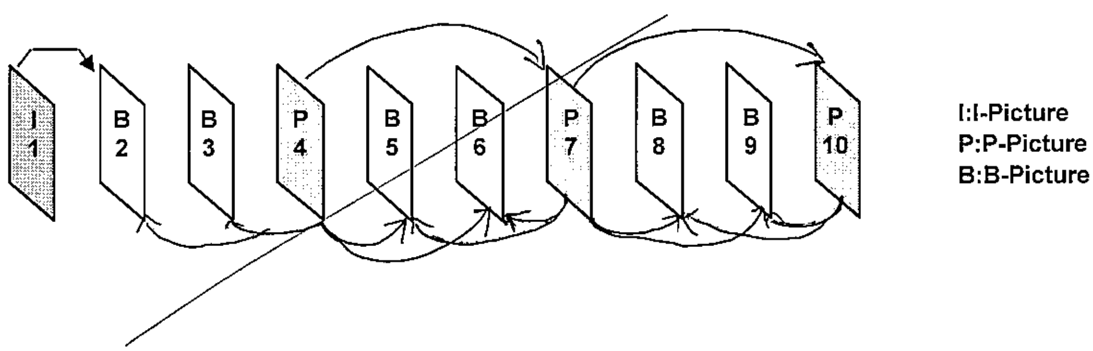
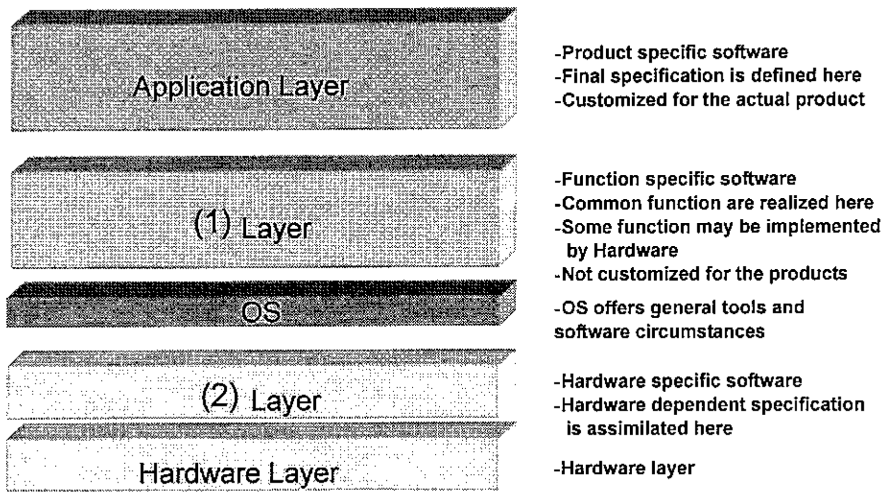


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

- It give application and media frame works the ability to interface with multimedia codecs and supporting components in a unified maner.

16

ID code	2078
Name	Nguyen Van Dai

~~145~~

RVC "System Solution"

Examination

November 24, 2017

82.5

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sampling frequency should be 2 time higher than the signal bandwidth (Nyquist frequency) $f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq f_s/2 \Rightarrow f_m \leq \frac{48 kHz}{2} \Rightarrow f_{max} = 24 KHz.$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$bit rate = (48 * 1000) * 24 * 6 =$ Bit/sec

(c) Calculate the size of 60[min].

Data size = bit rate $* (60 * 60) = (48 * 1000) * 24 * 6 * (60 * 60) =$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias happen with value : 48KHz - 30KHz = 18 KHz.

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

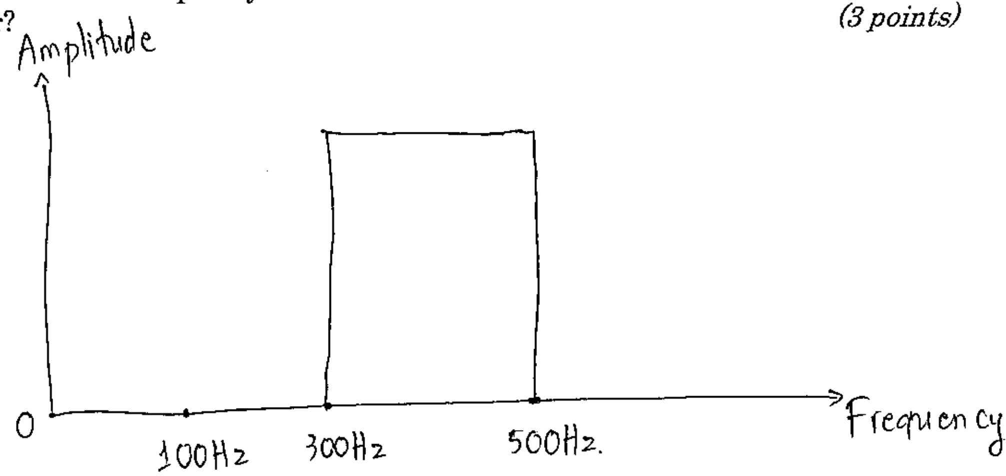
(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

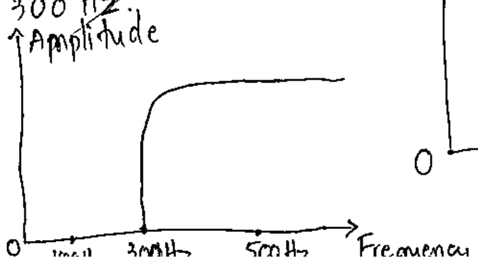
1.5 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- Fast
- Easy
- Less equation.

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

- Using band pass filter to keep it
- We can also use high pass filter with cut off frequency is 300 Hz.





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time - Frequency] transformation.

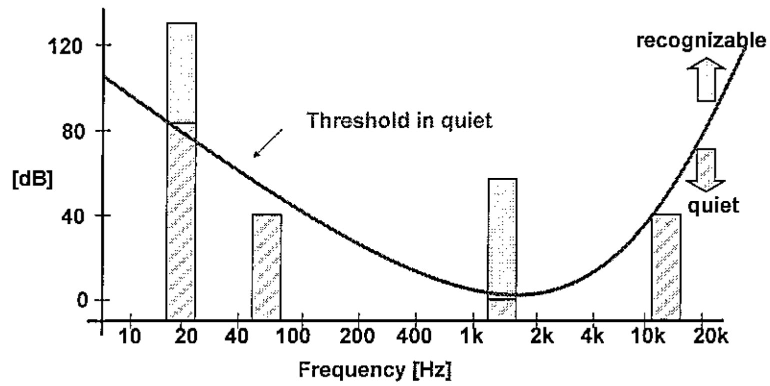
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

3

(5 points)



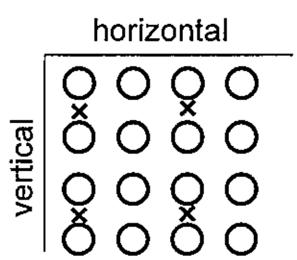
- In Audio Encoding, we can delete data or information that we can't hear (under Threshold in quiet) and keep data at ~~be~~ above threshold in quiet (recognizable area).

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 × 2160 × 8 ×~~
3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] × 3 × $\frac{1}{2}$

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/frame] ×]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 24 × $\frac{1}{2}$ × 30 [frame/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans.
1) DCT — a) Probability theory technique
2) VLC — b) Time Domain technique
3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

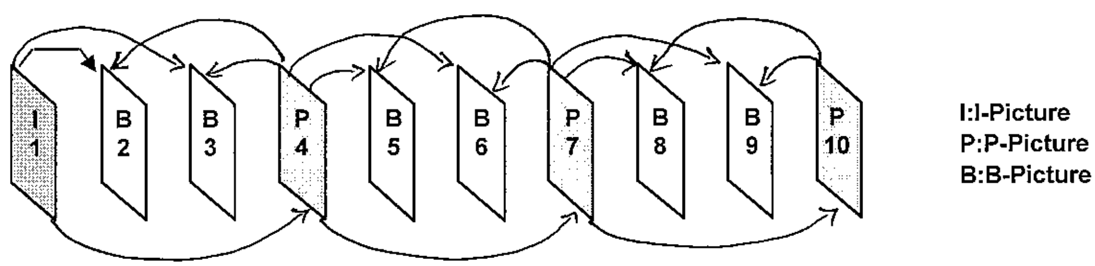
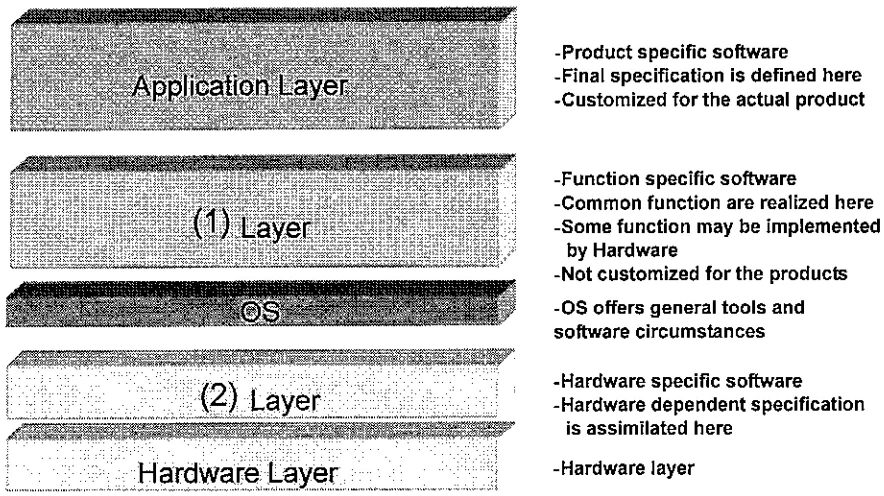


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

3

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2080
Name	Dat Vu

~~35~~

33

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Using $f_s \geq 2 f_m$

3

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) ~~4~~

(b) Signed Truncation ~~-4~~

(c) Rounding -4

~~6~~

4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_M \leq \frac{f_s}{2} = 24\text{ kHz}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~$2^{24} - 1$~~

(c) Calculate the size of 60[min].

~~$60 \cdot 60 \cdot 6 \cdot (2^{24} - 1) \cdot [\ ]$~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing will happen~~

~~Alias~~ = 18 KHz ?

8 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) ~~simple~~ (e) ~~Complex~~

(d) Difficult (f) ~~easy~~

(g) poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1

FFT faster than DFT
also optimize some steps.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

00

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

08

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [DFT] transformation.

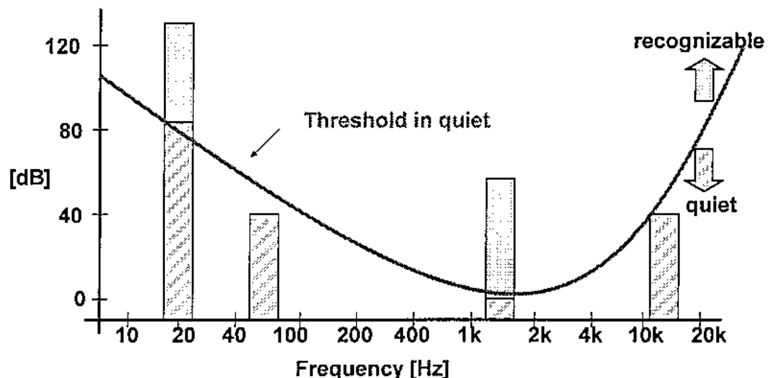
(2) Stereo Coding
Utilize the property of [MS stereo coding (M=L+R, S=L-R)] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

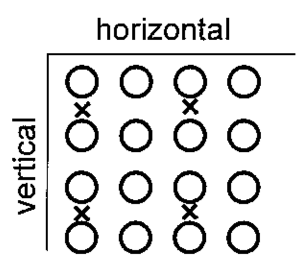
(5 points)



- Remove some Audio frequencys that most of people can't recognize

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[25 times]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT (c)	a) Probability theory technique
	2) VLC (a)	b) Time Domain technique
	3) MC (b)	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

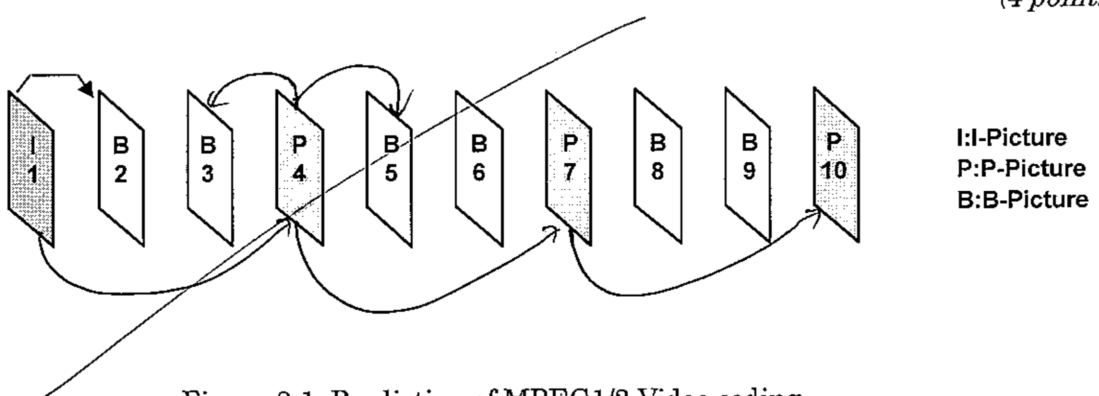
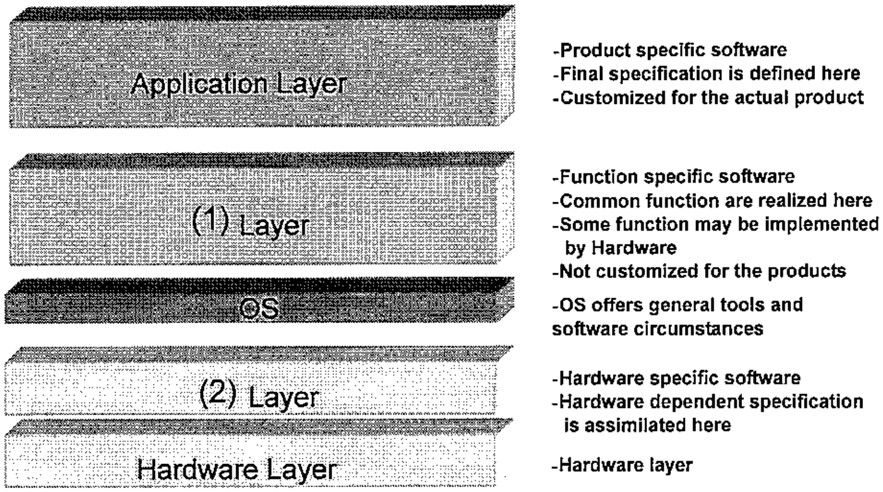


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

For ~~the~~ routines audio, video, still images.

0

19

ID code	2081
Name	Duc Hong Phan

RVC "System Solution"

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November 24, 2017

~~70~~ 26

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$- f_S \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) ~~3.75~~ . −4

(b) Signed Truncation ~~3.25~~ . −3

(c) Rounding −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_S \geq 2 \times f_m \rightarrow f_m \leq \frac{f_s}{2} = \frac{48}{2} = 24\ kHz$.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = $(48 \times 1000) \times 24 \times 6$ = ?

(c) Calculate the size of 60[min].

datasize = bitrate $\times 60 \times 60$. = ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias : 18 kHz~~

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) single (b) Complex.

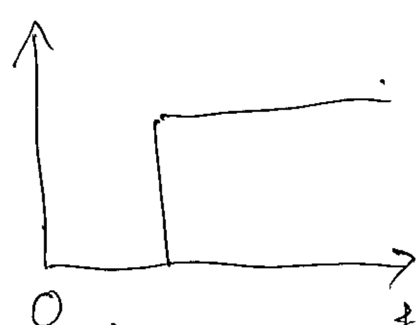
(c) good (e) good.

(d) poor (f) good

(g) poor (h) good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*



Use filter : high pass.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

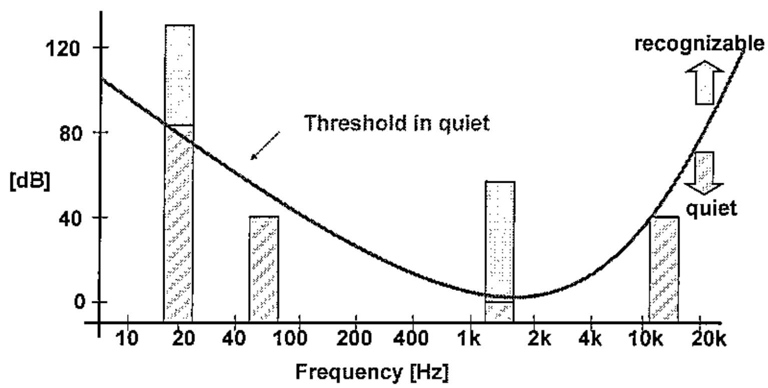
(1) Fourier Transform
Utilize [time - frequency.] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~dt~~ data apperance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



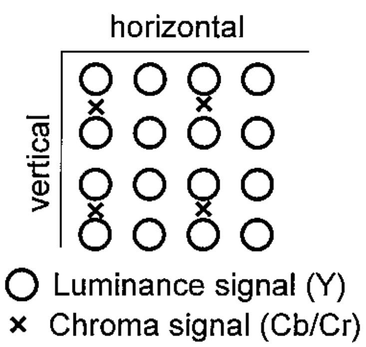
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~8 [bits] x 4.~~]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

3840 [pixels/line] × 2160 [line/frame] × 8 [bits/pixel] × 3 × 1/2]
= 3840 × 2160 × 12 [bit/frames]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

3840 [pixels/line] × 2160 [line/fram] × 12 × 30 [frame/sec]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT C — a) Probability theory technique

2) VLC a — b) Time Domain technique

3) MC b — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

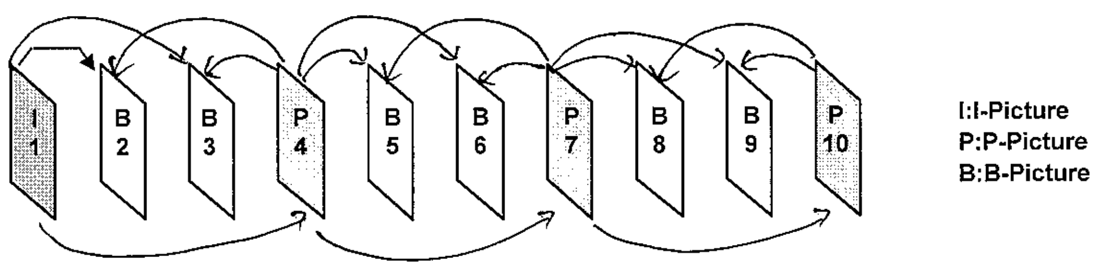
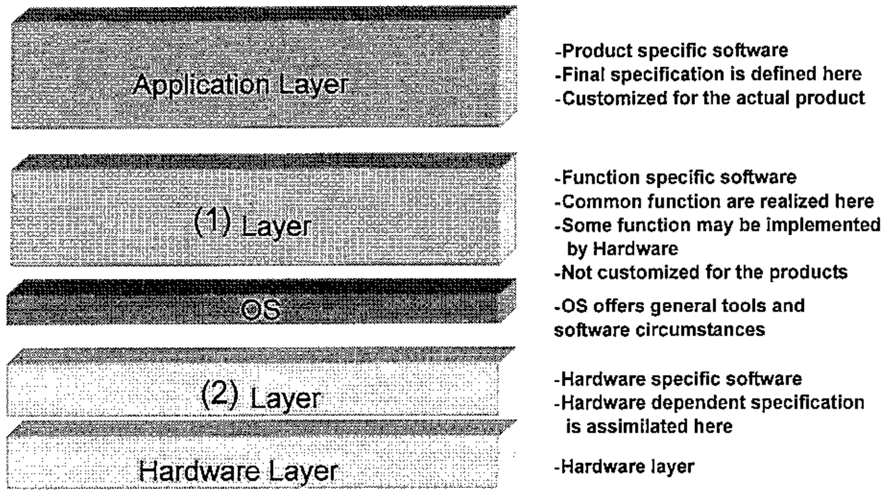


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

25 + 3

ID code	2082
Name	Hau Sy Le

~~72~~

RVC "System Solution" **Examination** November 24, 2017

80

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Use sampling frequency ~~higher~~ ~~or~~ equal or higher than 2 times of the maximum frequency of original signal:

$f_s \geq 2 f_{max}$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) ~~0~~ ~~4~~ ~~4~~

(b) Signed Truncation −3

(c) Rounding ~~+4~~ −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$\frac{48\ KHz}{2} = 24KHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48000 . 24 . 6 bps

(c) Calculate the size of 60[min].

48000 . 24 . 6 . 60 . 60 bits

(d) Suppose an analog signal which has 30kHz component. What will happen to the digitalized signal sampled by 48kHz?

Aliasing will occurs.

Alias signal frequency: $f_a = 48KHz - 30kHz = 18KHz$.

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) ~~Easy~~ Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

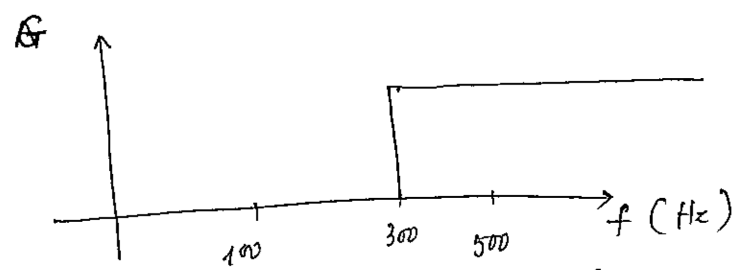
1

FFT has the calculation time much faster than DFT.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

We use high-pass filter to do this. with $f_c = 300$ Hz



We also can use bandpass filter with $f_L = 300$ Hz, $f_H = 500$ Hz but it is not necessary in this case.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

5

(1) Fourier Transform
Utilize [frequency domain] transformation.

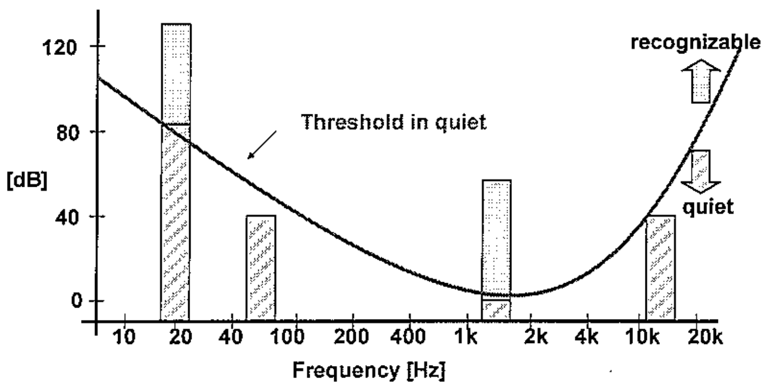
(2) Stereo Coding
Utilize the property of [differential] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ocurrence 1].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

5



The Psych-acoustic model shows the responsibility of human ears to different signal frequency. Signals hae the magnitude below the "threshold in quite" cannot be regconized / heard by human ears.

This Psych-aucostic model is used to encode the audio data. Signals which hae the magnitude below the threshotd will be removed to reduce the data size.

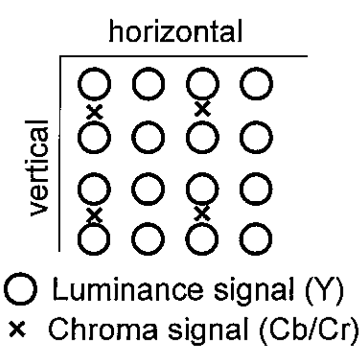
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] x 2160[lines/frame] x $\frac{1}{2}$ x 8 bits [bits/frame]
]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [8294400 [pixels/frame] x 8 bits + 8294400 [pixels/frame] x $\frac{1}{2}$ x 8 bits

= 12 x 8294400 bits / frame]

4) Calculate total data rate of UHD/4K Video data above

Ans: [12 x 8294400 [bits / frame] x 30 [frame / s]

= 360 x 8294400 bits / s]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

12 Ans:[360 x 8294400 [bits / s] / 100 x 10^6 [bits / s]]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

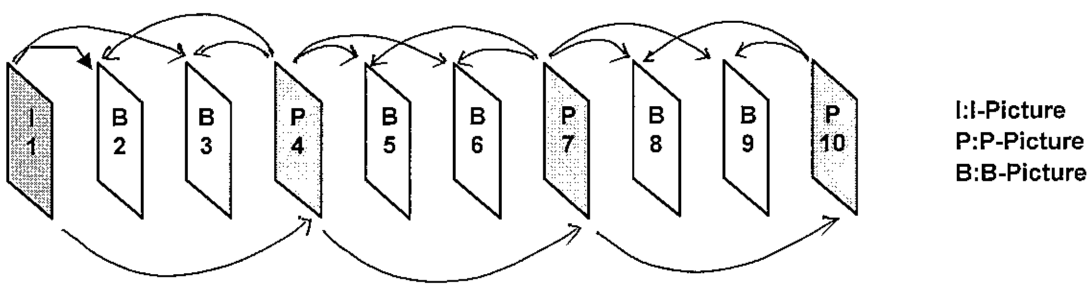
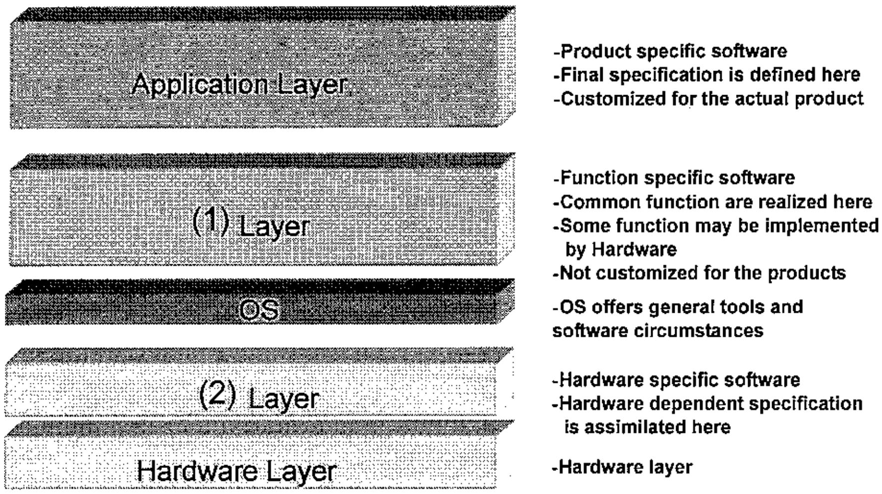


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

15

ID code	2083
Name	Nguyễn Ngọc Hòa

~~50~~

52

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Digitalized signal sampled frequency is bigger than 2 times analog signal frequency

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) −4

(b) Signed Truncation −3

(c) Rounding −4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m = \frac{f_s}{2} = \frac{48}{2} = 24$ kHz ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = (48 × 1000) × 24 × 6 [X]

(c) Calculate the size of 60[min].

data size = bit rate * (60 * 60) [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~A lias : 18 kHz~~ ⚠

12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple

(b) complex

(c) good

(e) good

(d) poor

(f) good

(g) ~~good~~

(h) ~~poor~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

5

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time frequency] transformation.

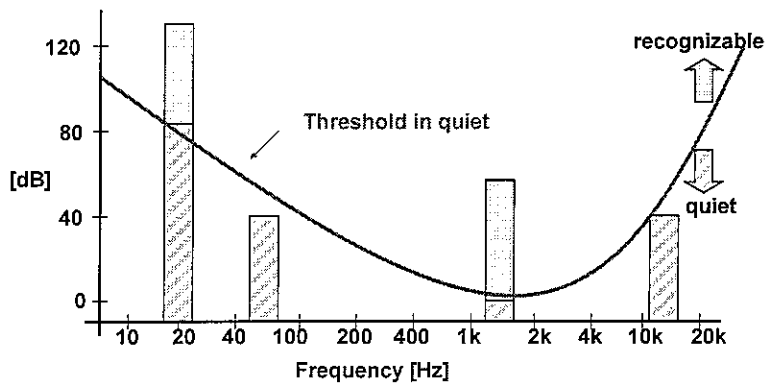
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance].

2.2 Following figure shows a Psych-acoustic model.

0 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

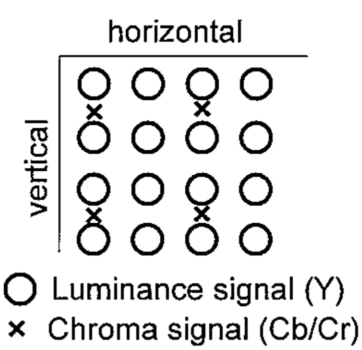


3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] * 2160 [lines/frame] * 8 [bits/pixel] * 3 / 12]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] * 2160 [lines/frame] * 8 [bits/pixel] * $\frac{3}{2}$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [~~3840~~ * 3840 [pixels/line] * 2160 [lines/frame] * ~~8~~ 12 * 30 [frame/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT a) Probability theory technique

2) VLC b) Time Domain technique

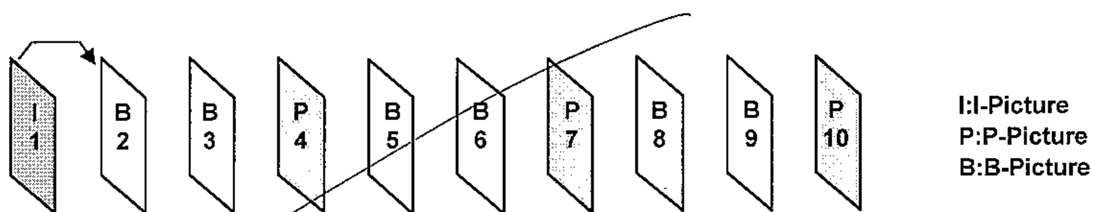
2

3) MC c) Frequency domain technique

3.3 Prediction method (MPEG)

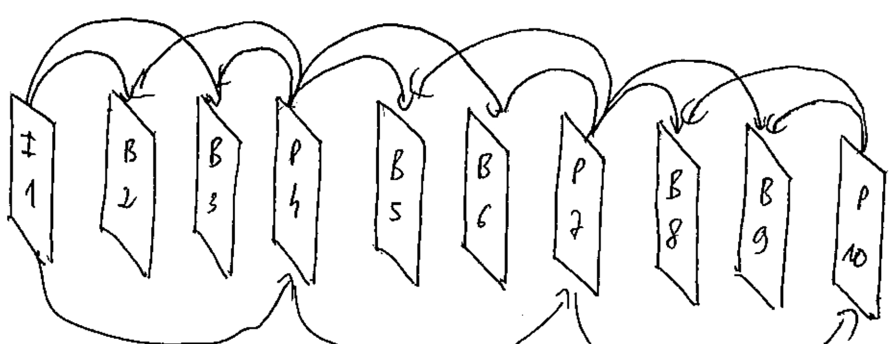
(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)



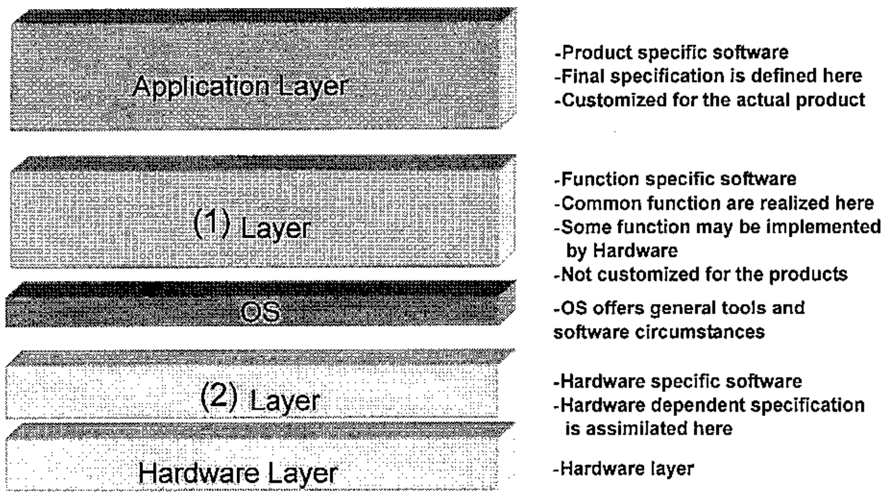
4

Figure 2.1. Prediction of MPEG1/2 Video coding



4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API   b) Middleware 3   c) RTL   d) Driver

(2) a) API   b) Middleware   c) RTL   d) Driver 3

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

30

ID code	HW 2084
Name	Lê Anh Hoàng

~~82~~
84

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 To prevent "Aliasing", the sampling frequency must be 2-times equal or bigger than ~~tw~~ the frequency bandwidth: $f_s \geq 2 \times f_m$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) [-3.75] → [-4]

(b) Signed Truncation [-3.75] → [-3]

(c) Rounding : [-3.75] → [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48kHz}{2} = 24kHz$ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate : $(48 \times 1000) \times 24 \times 6$ (bit/sec) ✗

(c) Calculate the size of 60[min].

data size: $(48 \times 1000) \times 24 \times 6 \times 60 \times 60$ (bit) ✗

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

=> ~~This causes Alias 18kHz~~ △

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

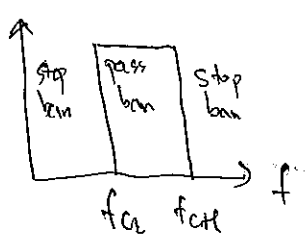
(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

We should use the band pass filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

15

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time - frequency] transformation.

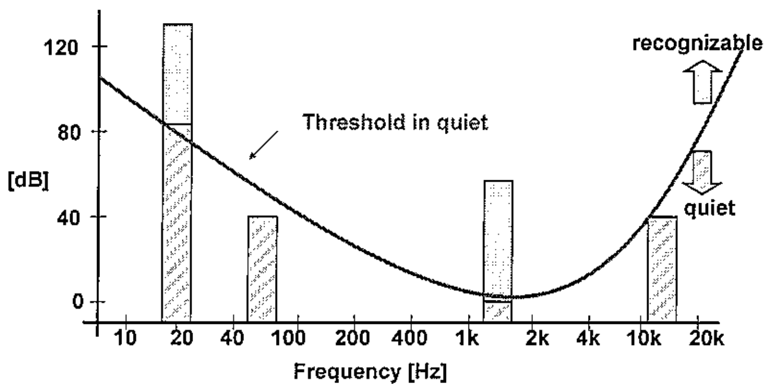
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data eppearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

(5 points)



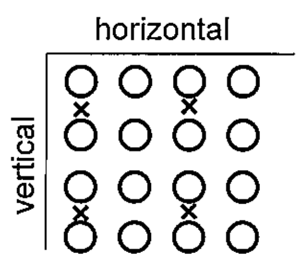
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] × 2160[lines/frame] × $\frac{1}{2}$ /

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2}$ (bits / frame)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 24 \times \frac{1}{2} \times 30$ (bps)]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$[3840 \times 2160 \times 24 \times \frac{1}{2} \times 30] / [100 \text{ Mbps} \times 10^6]$]

12

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

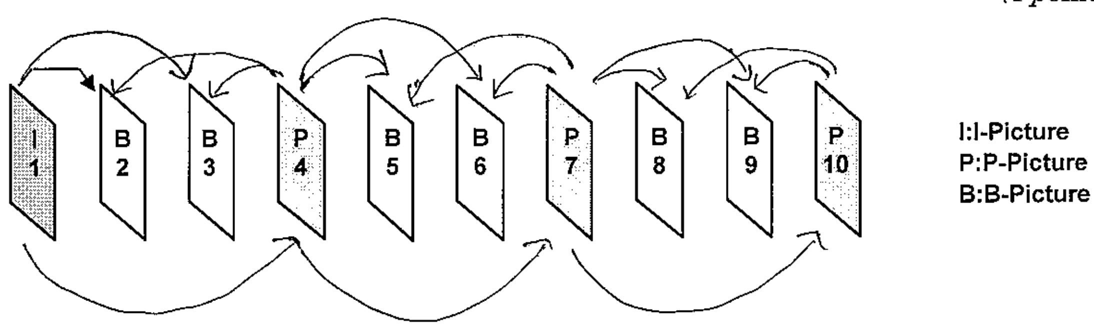
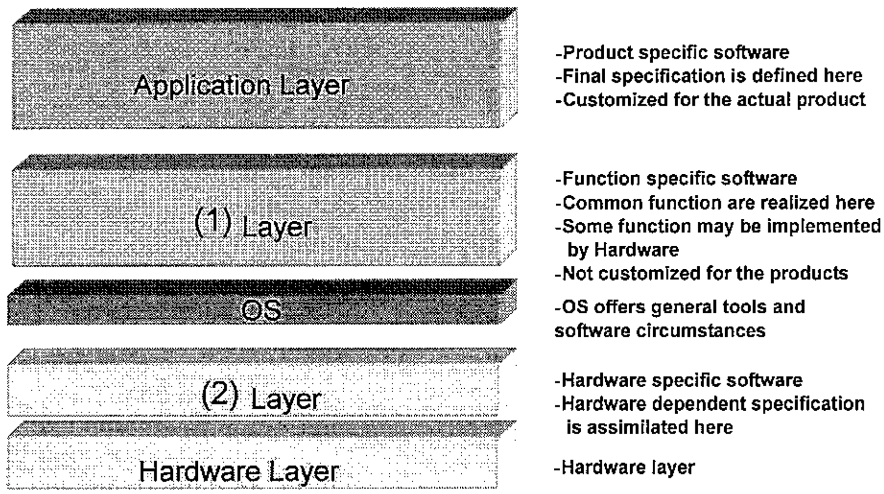


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMaxIL serves as a low-level interface for audio video and imaging codes used in ~~framework~~ embedded device. It gives application framework the ability to interface with multimedia codes and supporting components in a unified manners.

24

ID code	2085
Name	Nguyen Van Hoang

~~79.5~~

88.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sampling frequency should be 2 times higher than the signal bandwidth.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) [-4]

(b) Signed Truncation [-3]

(c) Rounding [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} \leqslant \frac{f_s}{2} \rightarrow f_{max} \leqslant \frac{48}{2} = 24 (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = ~~24~~ (24*1000)*24*6 [bit/sec]

(c) Calculate the size of 60[min].

datasize = 24000*24*6*60*60 [bit]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing error will occur with frequency $f_a = 48 - 30 = 18 (kHz)$

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

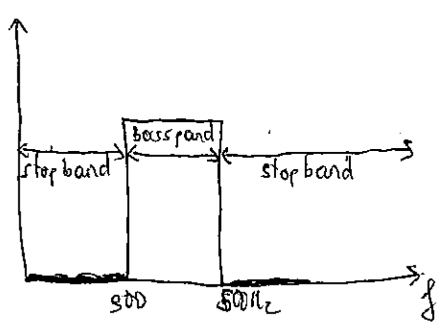
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

The calculation algorithm of FFT is faster than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

We should use Band Pass Filter to keep the components whose frequency from 300Hz to 500Hz



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

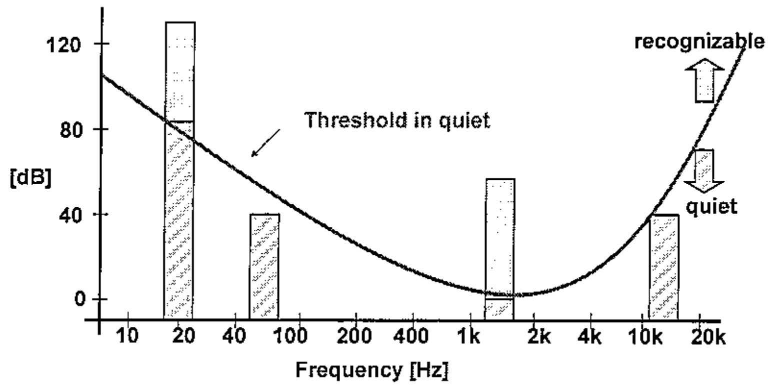
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

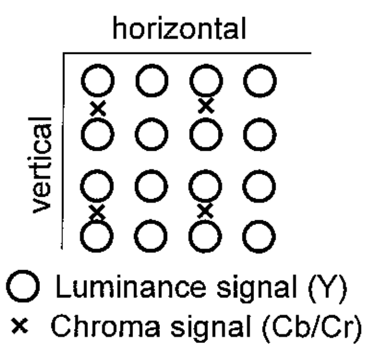
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] x 2160 [lines/frame] x 8[bit]] [bit/frame]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times \frac{2}{3}$ [bit/frame]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 8 \times \frac{2}{3} \times 30$ ~~[bit/frame]~~ [bips]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$3840 \times 2160 \times 100 \times 30$ [Mbit/s]]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

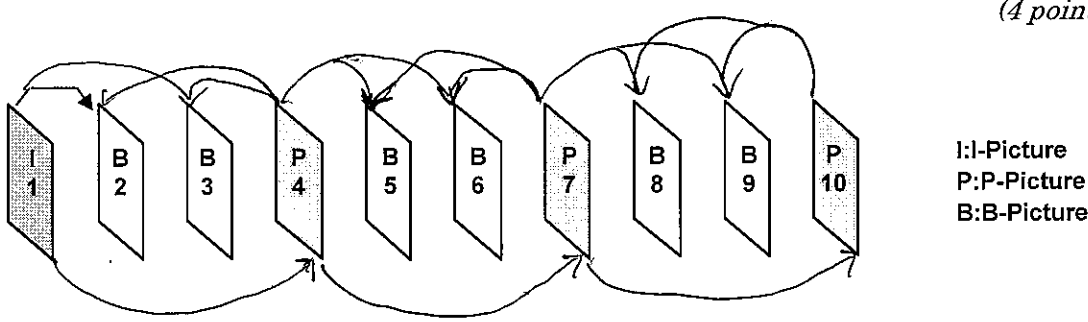
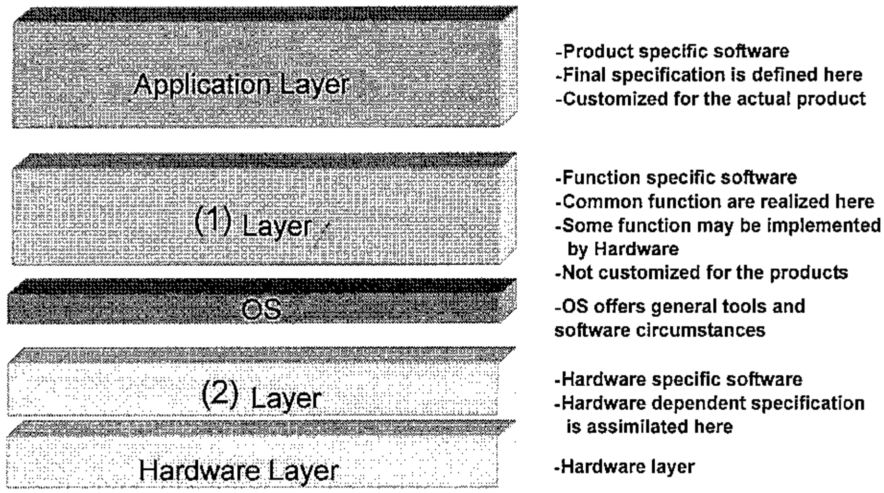


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2 It gives application & media frameworks the ability to interface with multimedia codecs & supporting components in a unified manner.

25 + 3

ID code	2086
Name	VO LE MINH HUNG

~~89~~

98

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sample frequency : $f_s \geq 2 f_m$ with f_m: Maximum frequency of signal

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq \frac{f_s}{2} \rightarrow f_m \leq \frac{48}{2} \rightarrow f_m \leq 24 (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 . 24 . 1000 . 6 (bits/s)

(c) Calculate the size of 60[min].

48 . 24 . 1000 . 6 . 60 . 60 (bits)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

→ Alias signal : $f_a = f_s - f_m = 48 - 30 = 18$ kHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

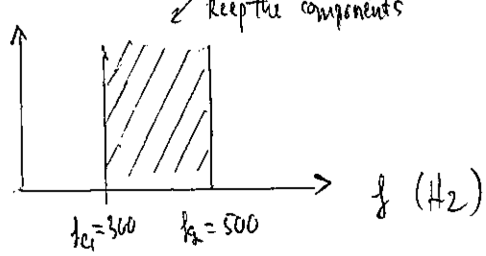
2 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

Reduce ~~the~~ calculation :

	DFT	FFT
Multi	N^2	$N(\log_2 N - 1)/2$
Add	$N(N-1)$	$N \log_2 N$

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

Use band Pass filter will keep the components who frequency from 300Hz to 500Hz
& Keep the components



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

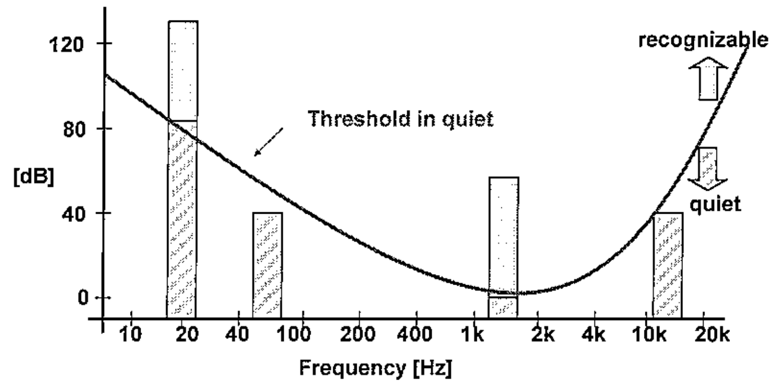
(1) Fourier Transform
Utilize [Time - ~~Poukiere~~ Frequency] transformation. MDCT

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



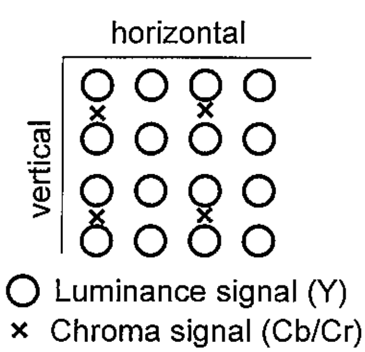
- Meaning : the hearing sensation that corresponds the sound → Hearing range and hearing threshold are exist.

- Purpose : We can delete the ~~infor~~ information that we can't hear.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$3840 \cdot 2160 \cdot 8 \cdot \frac{1}{2}$ ~~[pixels/frame]~~ [bits/frame]]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \cdot 2160 \cdot 8 \cdot \frac{3}{2}$ (bits/frame)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \cdot 2160 \cdot 8 \cdot \frac{3}{2} \cdot 30$ [bps]]

12

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans: [$\frac{3840 \cdot 2160 \cdot 8 \cdot \frac{3}{2} \cdot 30}{100 \cdot 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

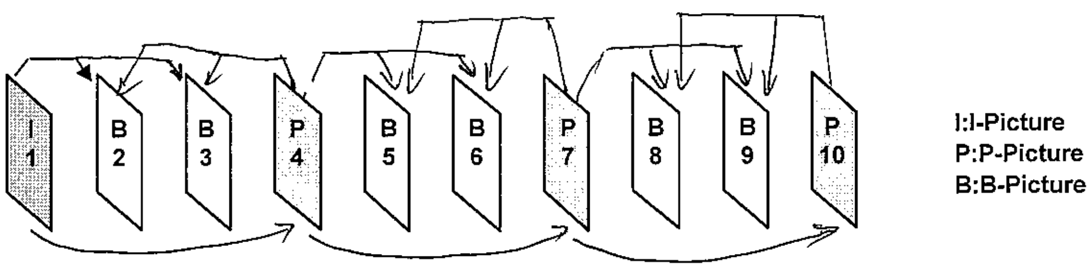
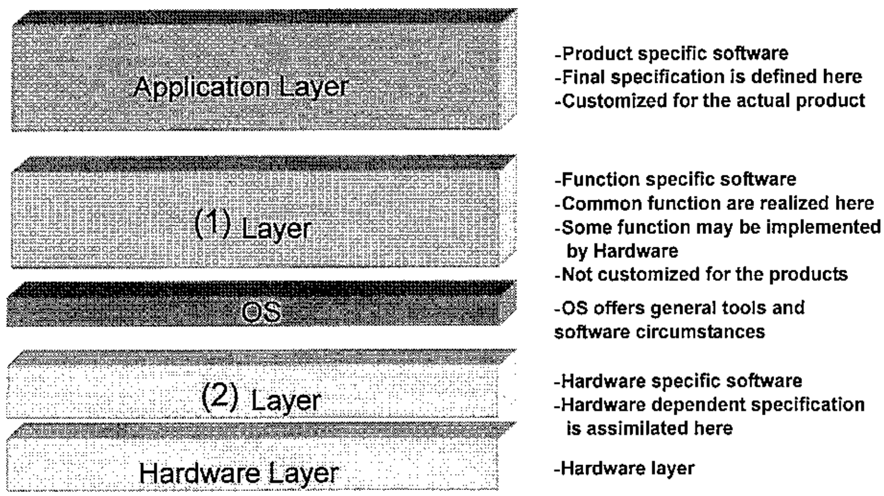


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

ID code	(BH001-2) 2087
Name	Vo Thi Ngoc Huyen

14

~~60.5~~

68,5

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

If the sampling frequency is not higher than Nyquist frequency, aliasing error occurs.

~~Thefore~~ Therefore: sampling frequency ≥ Nyquist frequency

$f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) [-3]

(b) Signed Truncation [-3]

(c) Rounding [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m \leq \frac{f_s}{2} \Leftrightarrow f_m \leq \frac{48\,kHz}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48*1000) * 24 * 6

(c) Calculate the size of 60[min].

data size = bitrate * (60*60)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 8kHz~~

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5

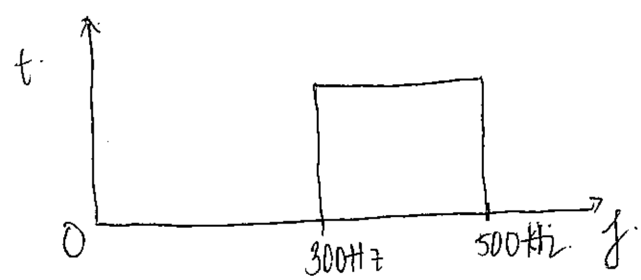
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT is Fast calculation algorithm of DFT, for $N = 2^m$ case

FFT has less multiplication and addition than DFT.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3



We use band pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - frequency] transformation.

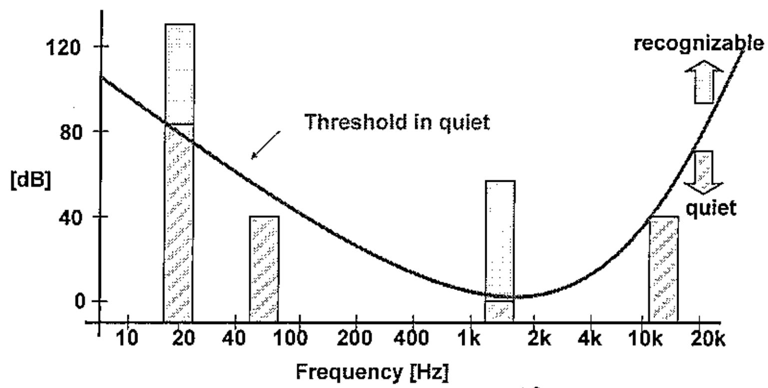
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

5

(5 points)



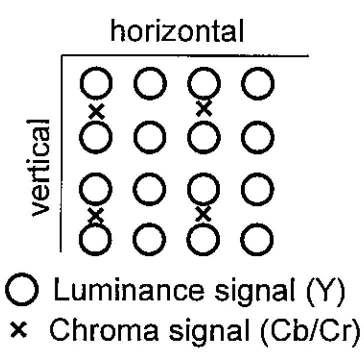
Meaning : The hearing sensation that corresponds to sound level is the loundness of the sound. Hearing range and hearing threshold are exist

Purpose : We can delete the information that we can't hear.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

3840 [pixel/line] * 2160 [lines/frame] * 8 [bit/pixel] *2

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3480 [pixel/line] * 2160 [line/frame] * 8 [bit/pixel] * $\frac{3}{2}$
= 3480 * 2160 * 24 [bits/frames]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3480 [pixel/line] * 2160 [line/frame] * 30 [fram/sec] * 8 [bit/frame]
= 3480 * 2160 * 30 * 8 [bps]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

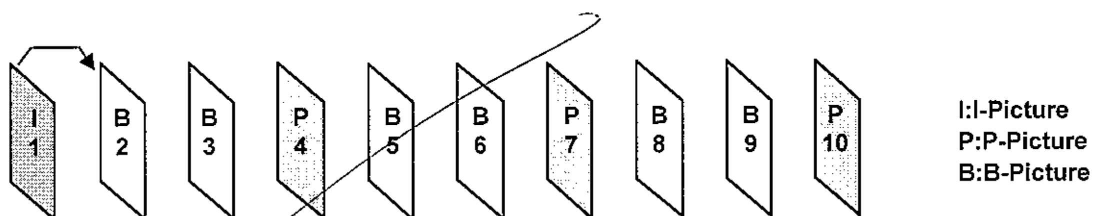
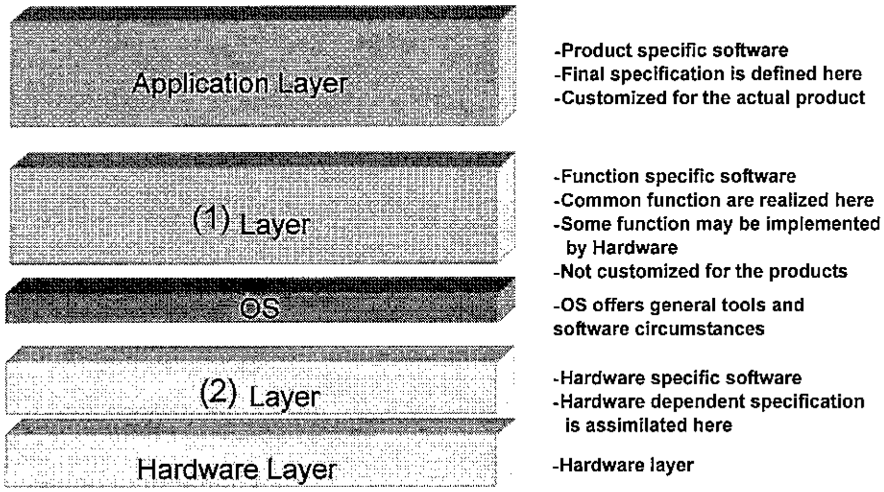


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Open max IL serve as a low level interface for audio video ~~&~~ and imaging code used in embedded devices.
It gives application and method frame work the ability to interface with multimedia codes and supporting components in a unified maners.

2

27

ID code	2088
Name	Nguyen Van Khoa

~~37~~

43

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

~~Cover the signal~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation $-\cancel{4}$

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~10~~ 6

(a) Calculate the maximum frequency CD can re-produce.

$$f_{max} = f_s/2 = \frac{48kHz}{2}$$ ✗ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$$bitrate = bit \times channel \times \cancel{f} T = \cancel{24 \times 6 \times \frac{1}{f}} = \frac{24 \times 6}{f}$$ ✗

(c) Calculate the size of 60[min].

$$size = bitrate \times time = bitrate \times 60^2$$ [✗]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

The ~~signal will be lose its data~~ ✗

6

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Complex)	(b) (Simple)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Difficult) : for repeating copy & signal transfer	(e) (Poor) : for original signal (f) (Easy) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Complex (b) Simple

(c) Good (e) ~~Poor~~

(d) ~~Difficult~~ (f) ~~Easy~~ Easy

(g) ~~Good~~ (h) Poor

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1

Faster

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

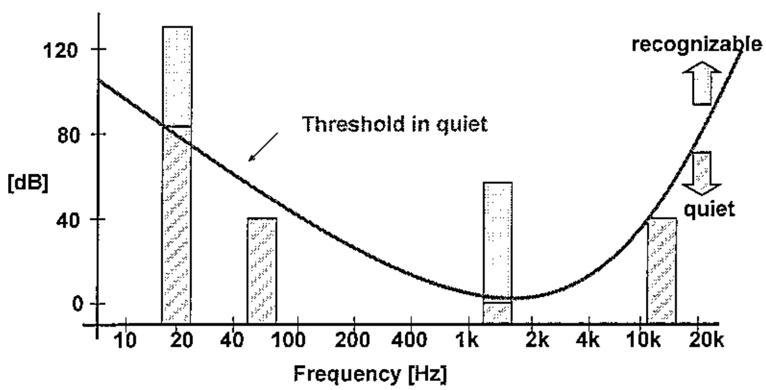
(1) Fourier Transform
Utilize [signal] transformation.

(2) Stereo Coding
Utilize the property of [losses] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [transferring].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



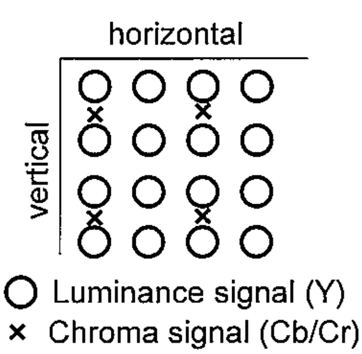
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{2}{12}$ (bit/frame)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840\,[p/\text{line}] \times 2160\,[\text{line}/\text{frame}] \times 8\text{ bits} \cancel{\times \text{Frame rate} \times \text{time}} \times \frac{1}{2} \times 3$]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$\frac{\text{Total data volume}}{\text{Time}}$ or $\text{Data of 1 frame} \times \text{Frame rate} = 3840 \times 2160 \times 8 \times 30 \times 3 \times \frac{1}{2}$]

9

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$(4) / 100.10^6$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

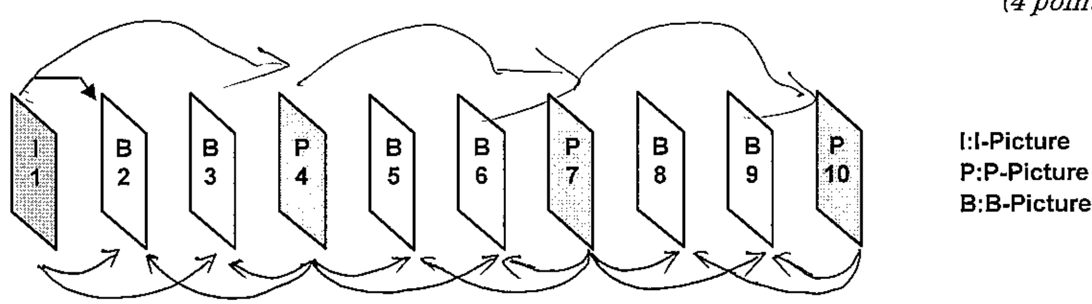
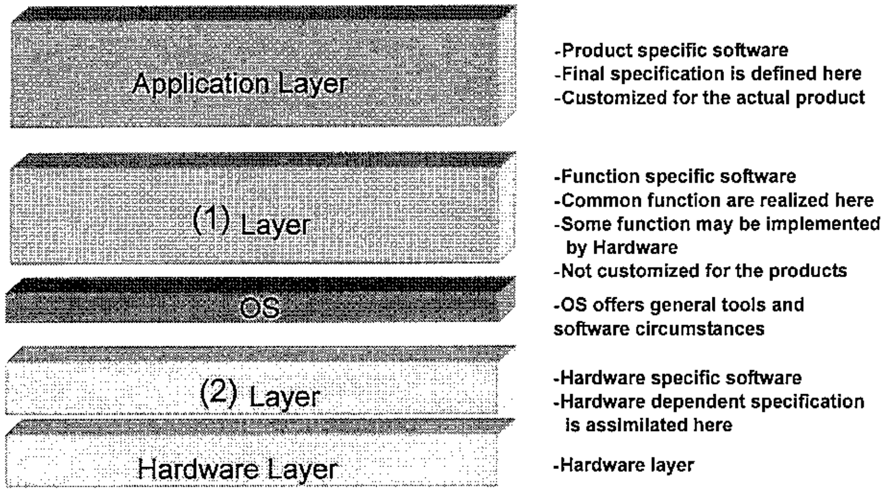


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL ~~d) Driver~~

(2) ~~a) API~~ b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Openmax is a royalty-free, cross-platform set of C-language

2 - Useful for audio, video, and still images

- It gives applications and media frameworks the ability to ~~inte~~ interface with multimedia codecs and supporting component in a unified manner.

12

ID code	2089
Name	Le Quang Lam

RVC "System Solution"

Examination

November 24, 2017

~~59.5~~

61.5

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency $\geq$ Nyquist frequency

$f_s \geq 2 \times f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq \frac{f_s}{2} \Rightarrow f_m = \frac{48\text{kHz}}{2} = 24\text{kHz}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48 \times 1000 \times 24 \times 6$ (bit/sec)

(c) Calculate the size of 60[min].

[?]

(bit rate) $\times 60 \times 60$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias 18kHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5 FFT is fast calculation algorithm of DFT.
FFT has less multiplication and addition than DFT.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

00

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
15
(5 points for each: total 15 points)

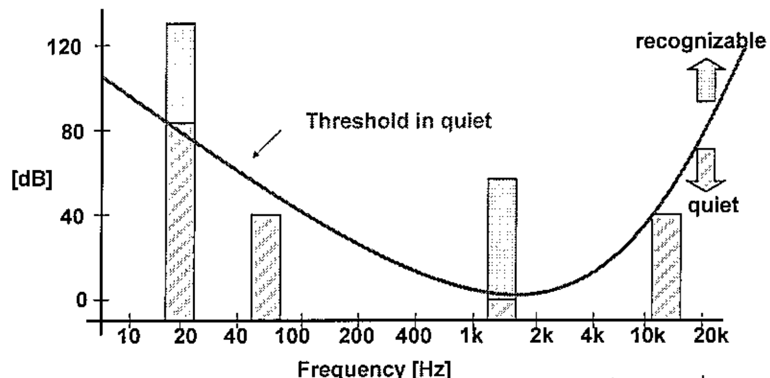
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)

4



The hearing sensation that correspond to sound level and the loudness of sound.

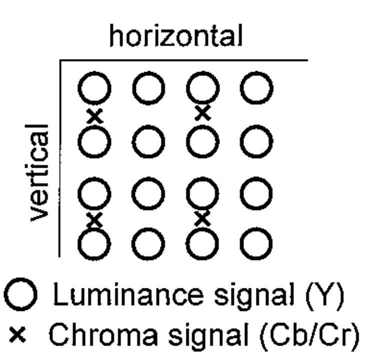
Hearing range and hearing threshold are exist

Purpose : we can delete information that we can't hear

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

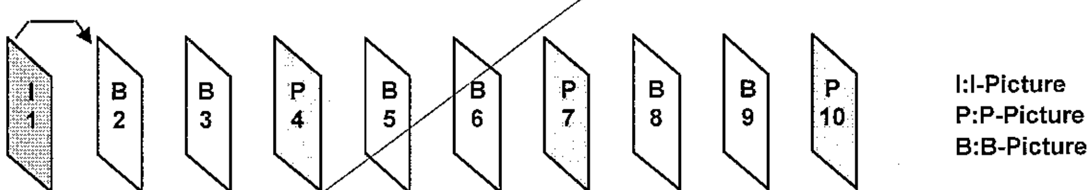
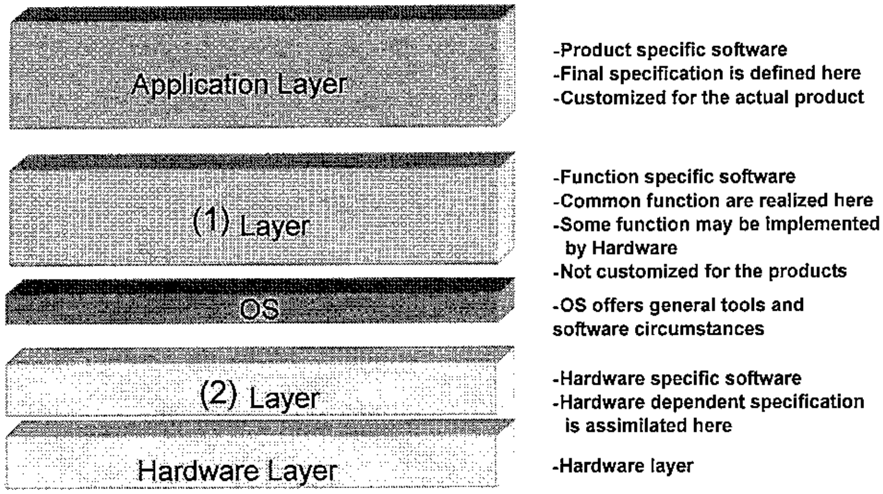


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

6

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

open Max is royalty-free cross-platform set of C language programming interfaces that provide abstraction for routines especially useful for audio, video, and still images.

0

18

ID code	HW 2090
Name	Trần Thanh Lâm

~~32~~ 34

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

0) 1.1 How to prevent "Aliasing"? *(3 points)*

- sampling : discrete on time domain.
- quantization : make steps of ~~quan~~ amplitude.
- coding : representing in digit number.

0) 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

6 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 . f_m \Rightarrow f_m \leq \frac{f_s}{2} = \frac{48}{2} = 24kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = ~~48.24.2.1000.~~

(c) Calculate the size of 60[min].

datasize = bit rate . 60 . 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

6 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple
(b) ~~simple~~
(c) good
(e) good
(d) ~~difficult~~
(f) ~~easy~~
(g) ~~complex~~
(h) ~~complex.~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

n *(5 points for each: total 15 points)*

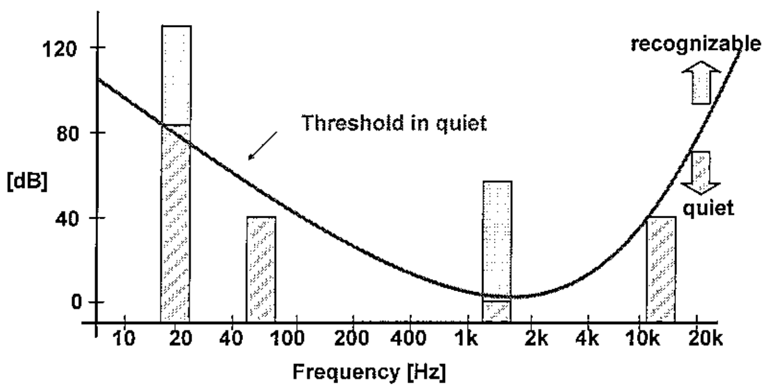
(1) Fourier Transform
Utilize [frequency] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

4 *(5 points)*



Meaning is to filter ~~what~~ which frequency that people can hear and which is can't hear. So, they'll eliminate which frequency that people can't hear for reduce data size.

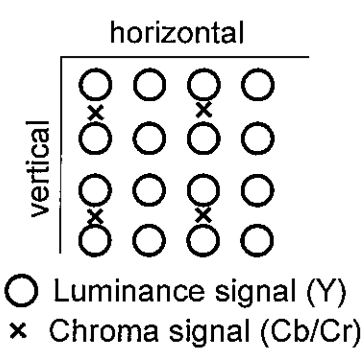
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above

Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

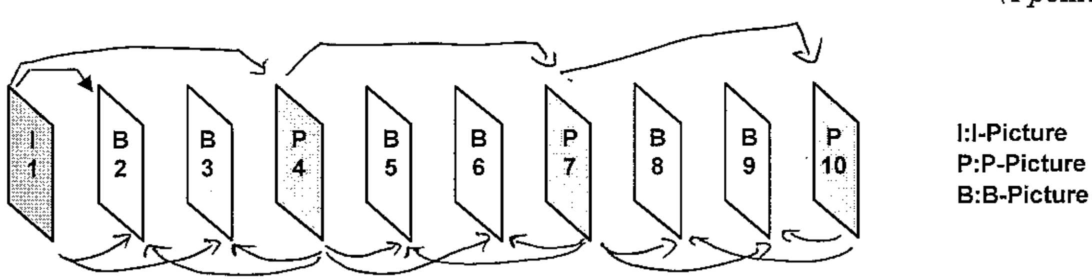
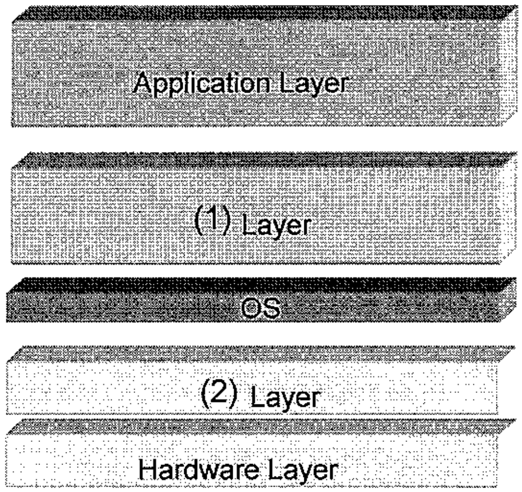


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



-Product specific software
-Final specification is defined here
-Customized for the actual product

-Function specific software
-Common function are realized here
-Some function may be implemented by Hardware
-Not customized for the products

-OS offers general tools and software circumstances

-Hardware specific software
-Hardware dependent specification is assimilated here

-Hardware layer

Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Open max is a royalty-free, cross-platform set of C-language programming interface that provide abstraction for routines especially useful for audio, video and still image.
- It gives applications and media frame works the ability to interface with multimedia codecs and supporting component in ~~a~~ unified manner.

16

ID code	2091
Name	Vo Khac Long

55

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 let's call : + maximum freqency of ~~sy~~ signal : f_m
+ sampling freqency : f_s

Aliasing : $f_s < 2f_m$

to prevent: we reduce f_m or improve f_s

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f_{m_{max}} = f_s/2 = 48khz/2 = 24\ khz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = 48000 × 24 × 6 (bit/sec)

(c) Calculate the size of 60[min].

size = ~~60 × 48000 × 24 × 6 (bits)~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Cause aliasing : ~~$f_a = 18\ khz$~~ ?

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

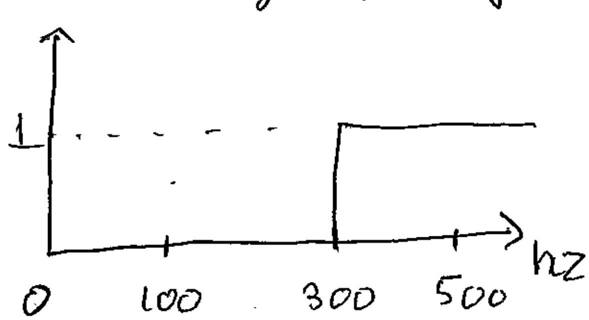
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 FFT is faster than DFT,
Easy to use.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

02

We use high pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

08

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [frequency] transformation.

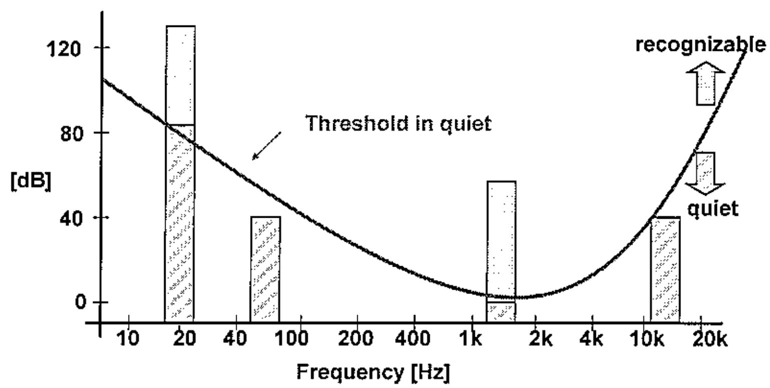
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [Theory technique].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)



We can remove the signal which we can not recognize => reduce space store.

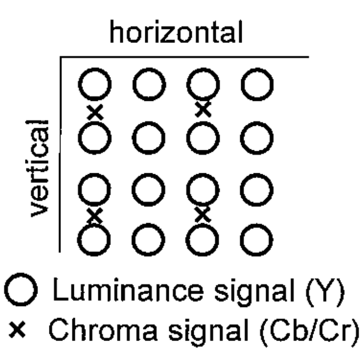
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

~~4 [pixels/line] x 4 [lines/frame]~~

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [1920 [pixels/line] x 1080 [lines/frame] x 8 [bits/pixels] x 30 [frames/sec]]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] +
+ 2[channel] × 1920 [pixels/line] × 1080 [lines/frame] × 8 [bits/pixel]]

4) Calculate total data rate of UHD/4K Video data above
Ans: (3840 [pixel/line] × 2160 [lines/frame] × 8 [bits/pixel] +
+ 2 [channel] × 1920 [pixels/line] × 1080 [lines/frame] × 8 [bits/pixel])
× 30 [frame/sec]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans: (3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] +
+ 2 [channel] × 1920 [pixels/line] × 1080 [lines/frame] × 8 [bits/pixel])]
× 30 [frames/sec] / 10^6 [bit/sec] × 100

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

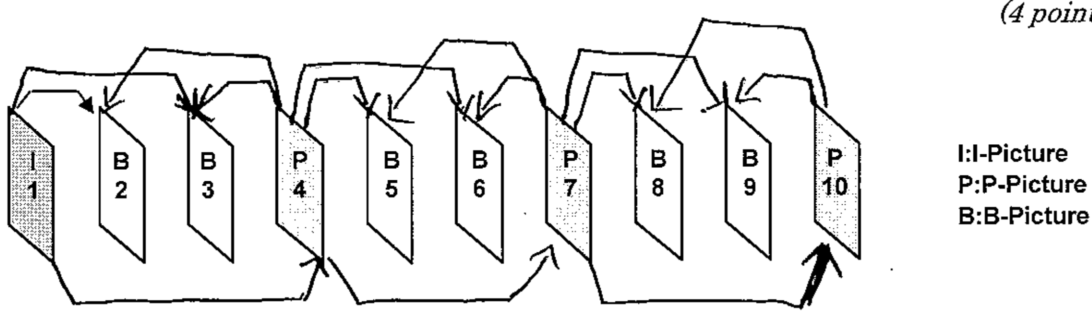
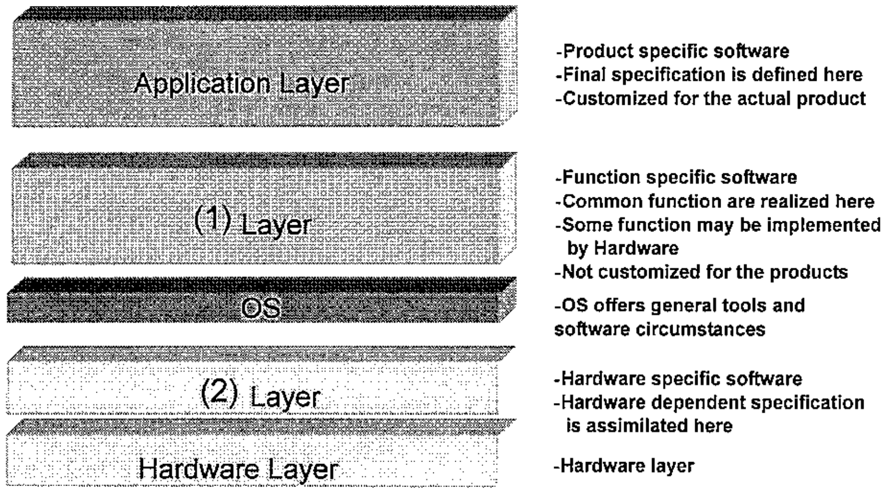


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2092
Name	Nguyen Thi Ly Ly

RVC "System Solution"

Examination

November 24, 2017

63

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Use $F_s \geq 2F_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) [- 4]

(b) Signed Truncation [-3]

(c) Rounding [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$$F_m = \frac{F_s}{2} = \frac{48}{2} = 24 \text{ kHz}.$$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$b_r = 48.1000.24.6 = [X]$

(c) Calculate the size of 60[min].

$b_r.(60.60) = 48.1000.24.6.60.60 = [X]$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18kHz~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Not good) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Not good) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

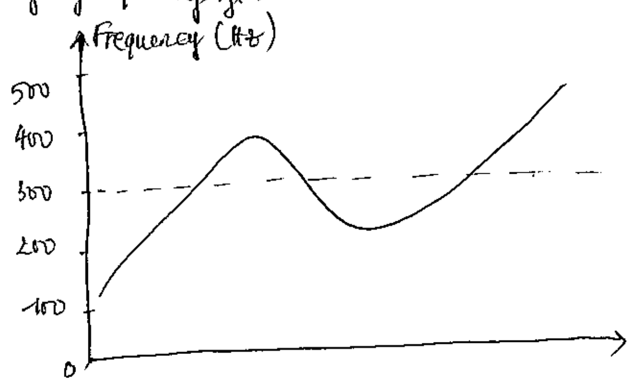
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

Use high frequency filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

15

(1) Fourier Transform
Utilize [Time – Frequency] transformation.

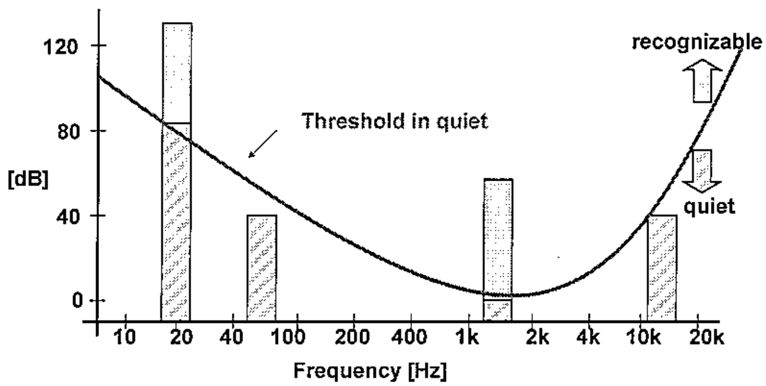
(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

(5 points)



It means, with each frequency (Hz); we need to apply a range of [dB] in Audio Encoding for comfortable. We can use Psych-acoustic to adjustment the voice.

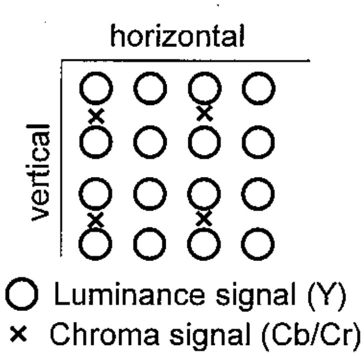
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

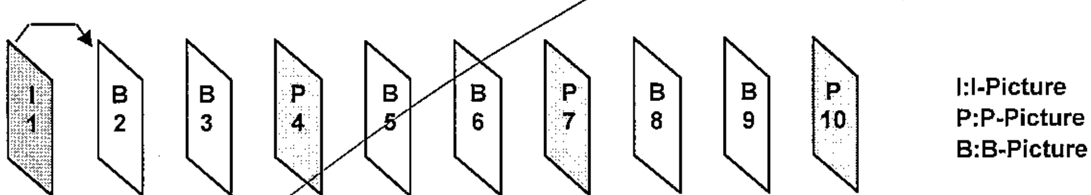
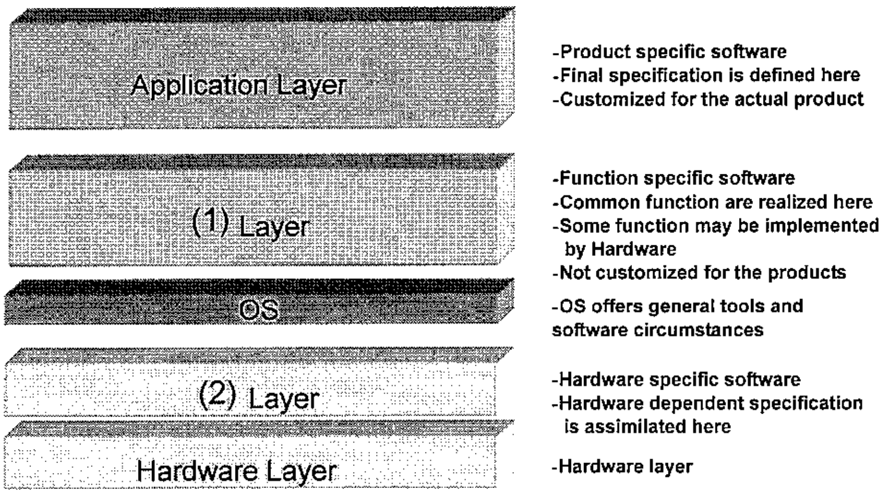


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

14

ID code	2093
Name	PHUNG THI MAN

RVC "System Solution"

Examination

November 24, 2017

48

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

1 The sampling frequency is higher than Nyquist frequency, the aliasing does not occur, so we need to increase the number of samples per second until it's higher Nyquist frequency

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

0

(a) Calculate the maximum frequency CD can re-produce.

~~48 x 1000 x 6 x 2~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~48 x 1000 x 6 x 24 x 2~~

(c) Calculate the size of 60[min].

~~48 x 1000 x 6 x 24 x 60 x 60 x 2~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

The aliasing error occurs.

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) Good

(d) Poor

(f) Good

(g) Poor

(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

~~The transformation is faster~~

1

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

00

2. Audio Coding

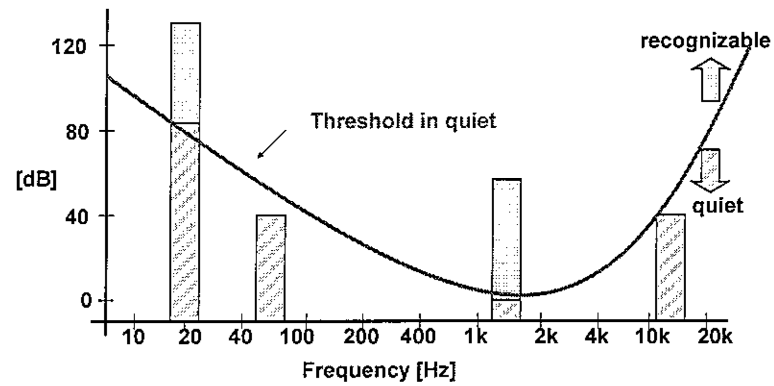
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
10 *(5 points for each: total 15 points)*

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

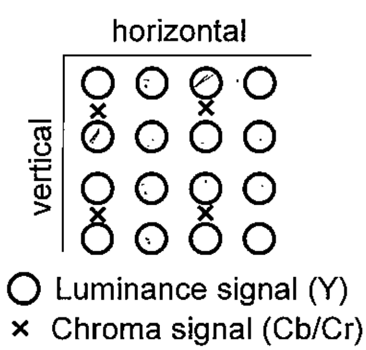
(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~data experience~~].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [= 3840 (pixels/line) x 2160 (lines/frame) x $\frac{3}{2}$ ~~(RGB)~~ ~~x 30 (frames/second)~~
x 8 (bits/RGB) x 30 (frames/second)]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

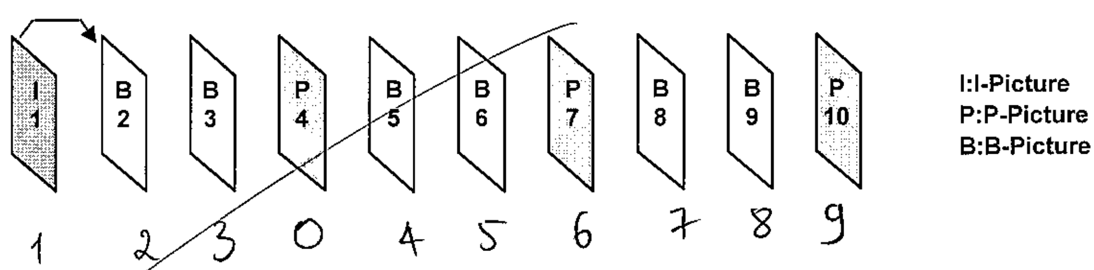
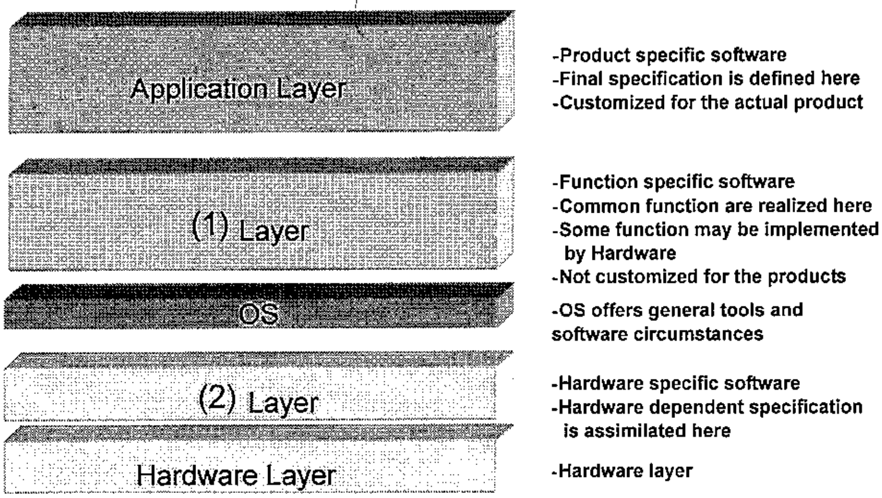


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Giving application and media frame weeks the ability to interface with multi-media codecs & supporting components in a unified manner.

2

16

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~~34~~

42

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

Apply expression $f_s \geq 2f_m$, we can prevent Aliasing.

f_s: frequency sampling

f_m: frequency max

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) : ~~-3~~

(b) Signed Truncation : ~~3~~

(c) Rounding : -4.

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2f_m \Rightarrow f_m \leq f_s/2 \Rightarrow f_m = f_s/2 = \frac{48\,KHz}{2} = 24\,KHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (48.1000) \cdot 24 \cdot 6$ [bit/sec]

(c) Calculate the size of 60[min].

Data size $=$ bitrate $\cdot (60.60) = 48000.24.6.60.60$ [bit]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Suppose: $f_m = 30KHz \Rightarrow f_s \geq 2f_m = 60\,KHz. \Rightarrow f_s$ minimum must be 60KHz

but $f_s' = 48\,KHz$

6 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) (.) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Reasonable~~ Simple

(b) Complex

(c) ~~Reasonable~~

(d) ~~Difficult~~ .

(e) ~~Expensive~~ .

(f) ~~easy~~

(g) Poor.

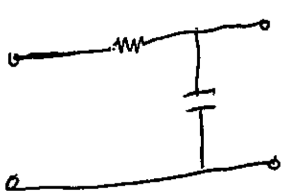
(h) Good.

10 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

Charge

8 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

~~we should use Band width filter~~.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

00

(1) Fourier Transform
Utilize [ ] transformation.

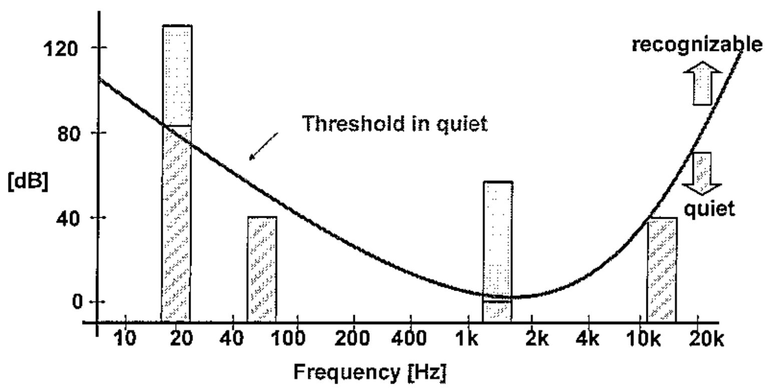
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)



~~Okay~~ ~~idea~~ It decribe the area (frequency, power) that human ears can hear. ~~At the each frequency~~ At frequency, the ratio power [dB] upper side of the line => human can hear.

3. Video Coding

3.1 Picture format

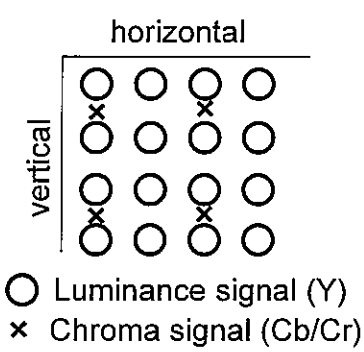
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]

Color format: (4:2:0), 8 bits for each

Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

$8{,}294{,}400 \times 8 \times 3 \times 1/2 \times 30$

2) Calculate chrominance data volume. (Cr and Cb total)

Ans: [

$8{,}294{,}400 \times 8 \times 3 \times 30 \times 1/2$

]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

8294400 × 8 × 3 × 30]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[~200time => 100 Mbps/200 = 0.5 Mbps.]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

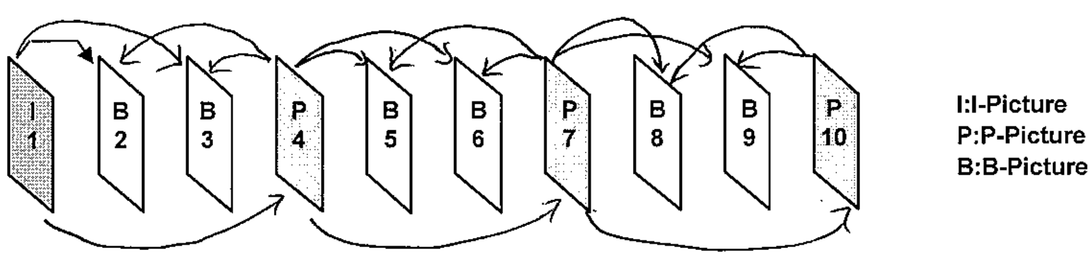
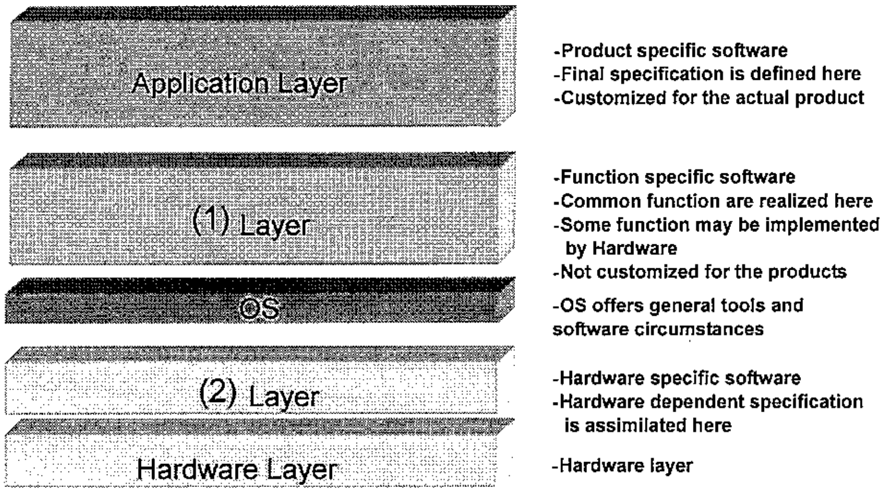


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

25

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~~83.5~~

89.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

- Use ~~frequency~~ sample frequency (f_s) larger 2-times of signal frequency (f_t)
  $f(s) \geq 2 \cdot f(t)$ (Hz)
- Use low pass filter to cut off the bandwith of signal to proper with sample frequency : $f_c \leq f_s/2$ (Hz)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) −4

(b) Signed Truncation −3

(c) Rounding −4

~~16~~ 12

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = f_{sample} / 2 = 24$ KHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = 6 (channels) × 48 (KHz) × 24 (bit) (bit/s)

(c) Calculate the size of 60[min].

Size of 60 min = bit rate (bit/s) × 60 (s) × 60 (min) (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Appear aliasing frequency : 18 KHz~~ 4

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

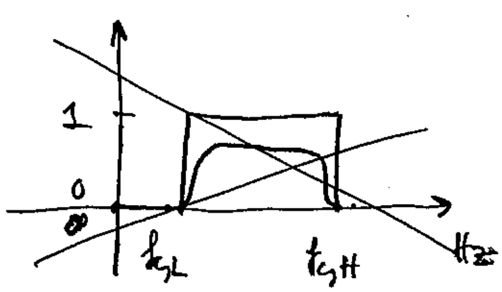
1.5 ~~FFT~~ FFT is tranform faster than DFT.

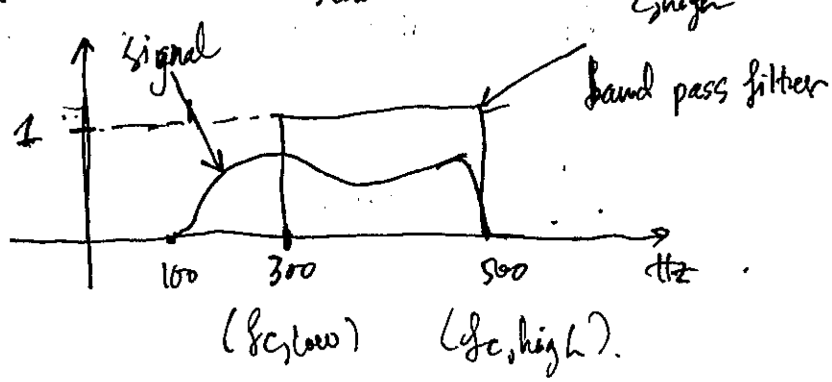
The number of cacalation in ~~DFT~~ FFT is smaller in DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

I will use the band pass filter with $f_{c,low} = 300\,Hz$, $f_{c,high} = 500\,Hz$





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

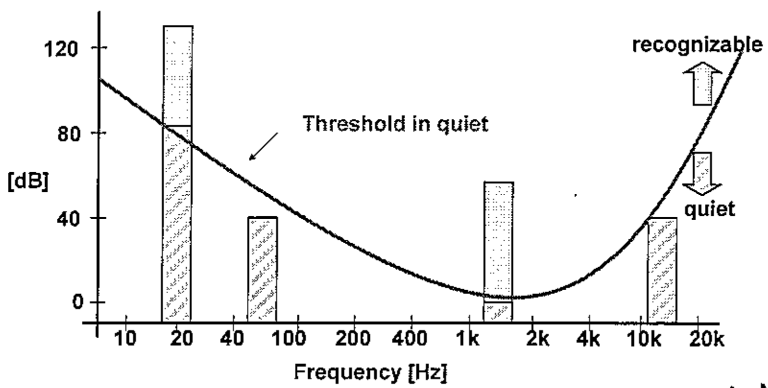
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [collelation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data ~~apparence~~ appreance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

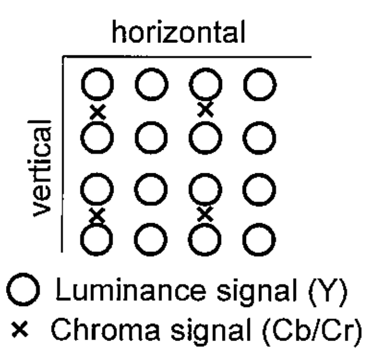


– ~~The line~~ Threshold in quiet is show up the ability of human in voice.
+ The voice below threshold, → human can not hear the voice
+ the voice upper threshold → human can hear the voice.
– In this technique the data of signal that below threshold in quiet will be remove to reduce the total data.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 × 2160 (pixels/frame) × 30 (frame/s) × 8 (bit) × 2 (Cr and Cb) ~~/4 (bit)~~]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 × 2160 (pixel/frame) ~~× 30 frame~~ × 12 (bit/pixel)
(bit/frame)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 × 2160 (pixel/frame) × 12 (bit/pixel) × 30 (frame/s) (bit/s)]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

6 Ans: [3840 × 2160 (pixel/frame) × 12 (bit/pixel) × 30 (frame/s) / 100 (Mbps)
≃ 30 (time) .

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT	a) Probability theory technique
6	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

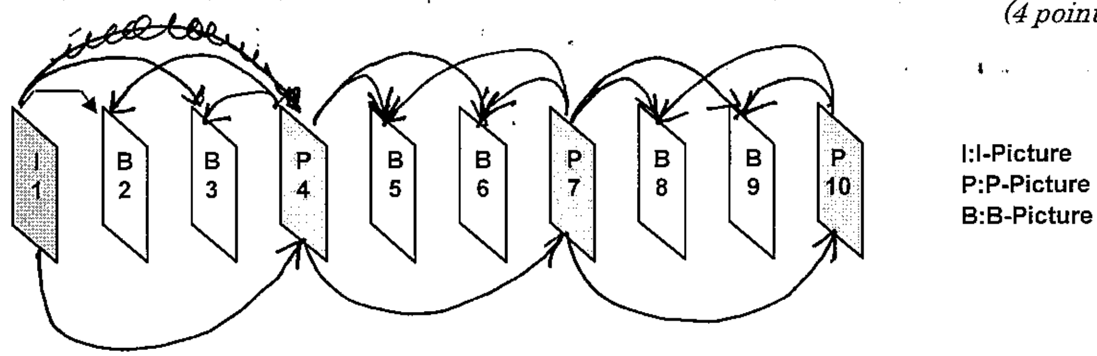
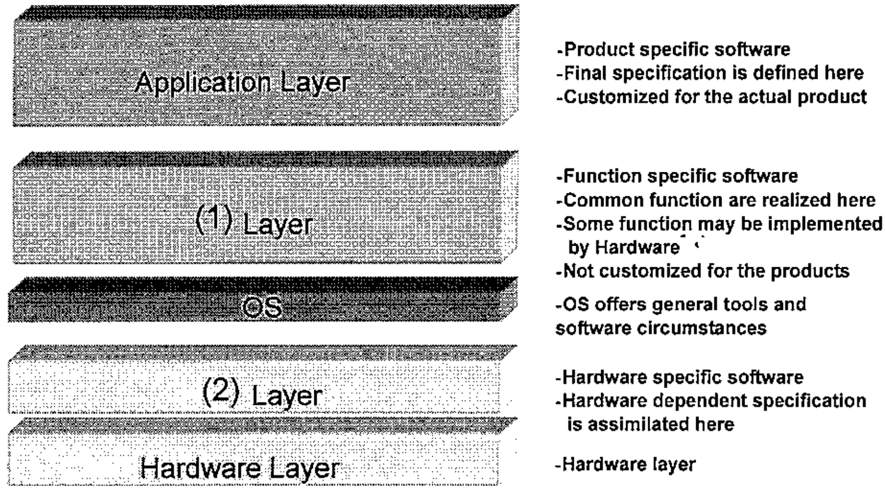


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6.

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

21

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~~64~~

74

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

sampling frequency must be larger or equal 2 times than the signal bandwidth

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~08~~ 10

(a) Calculate the maximum frequency CD can re-produce.

formula $48 \cdot 10^3 / 2$ [X]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48 \cdot 10^3 \times 24 \times 6$ [X]

(c) Calculate the size of 60[min].

Bitrate $\times 60 \times 60$ [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

this signal is aliased. The frequency is $(48 - 30)$ kHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex

(c) good (e) good

(d) poor (f) good

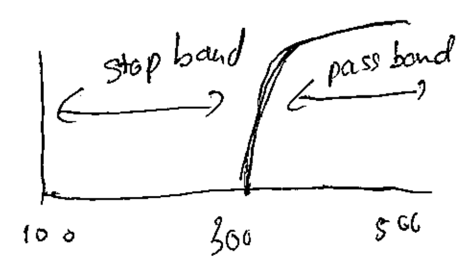
(g) poor (h) good

8 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

less ~~comparation~~ comparation

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

use high pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

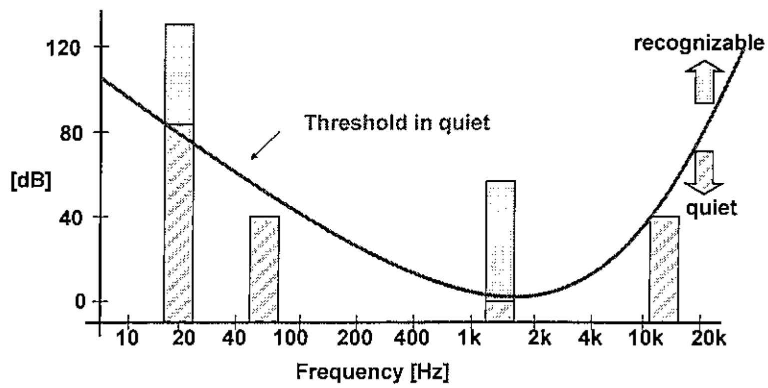
(1) Fourier Transform
Utilize [~~non-cyclic~~ signal time-frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~occurrence~~ data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



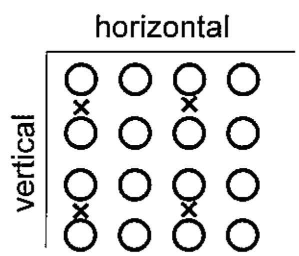
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 \times 2160 \times 8 \times 3 \times 1/2$ unit ?]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 \times 2160 \times 30 \times 12$ unit ?]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

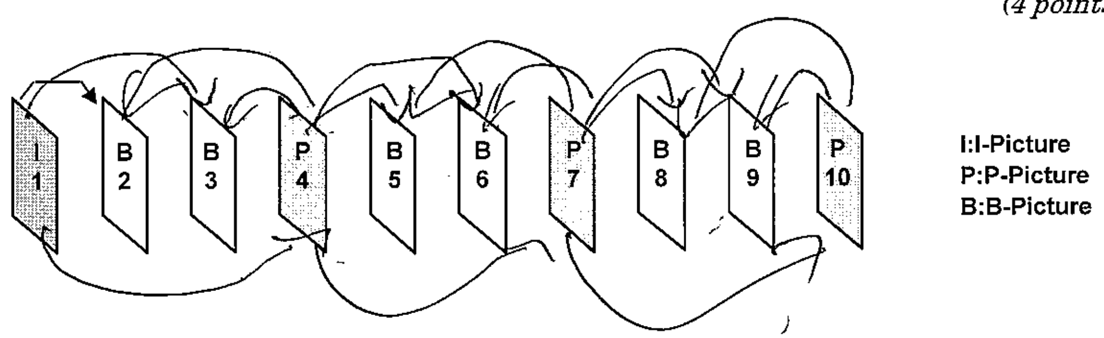
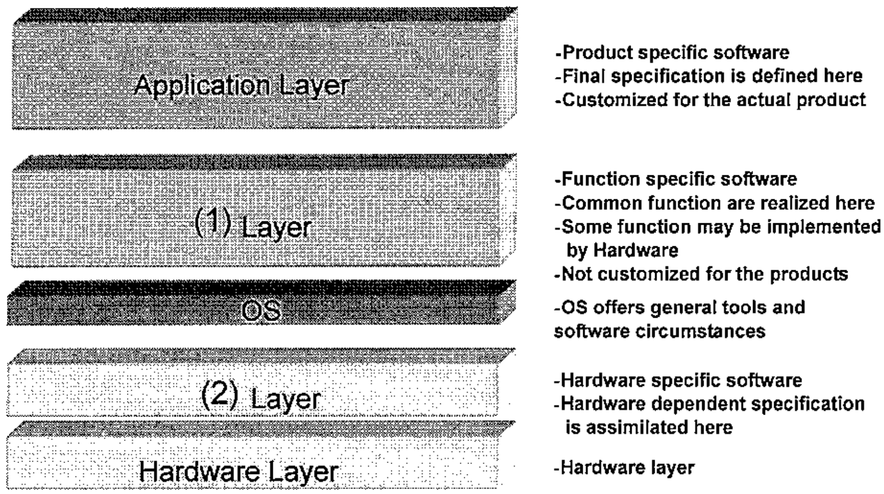


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

Integration Layer : Media components can be integrated into flexible media graphs for advanced streaming media processing

OpenMAX IL ~~scr~~ severs as a low-level interface for audio, video, imaging codecs and supporting components in a unified manner

17+3

ID code	2098
Name	Quy Le

~~785~~

80.5

RVC "System Solution" **Examination** November ~~24, 2~~017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sample frequency is greater than 2 times maximum frequency

$f_s \geq 2 \cdot f_{max}$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

$-3{,}75 \rightarrow -4$

(b) Signed Truncation

$-3{,}75 \rightarrow -3$

(c) Rounding

$-3{,}75 \rightarrow -4$

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_{max} \Rightarrow f_{max} \leq f_s/2 \leq 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $(48 \cdot 1000) \cdot 24 \cdot 6$ [X]

(c) Calculate the size of 60[min]. [X]

datasize = bitrate $\cdot$ $(60 \cdot 60)$

(d) Suppose an analog signal which has 30kHz component. What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~ !

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

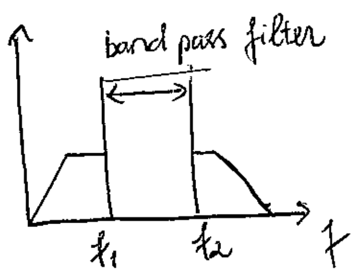
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- FFT is fast calculation algorithm of DFT, for $N = 2^m$ cases
- FFT has less multiplication and addition than DFT

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

- We should use the ~~bass band~~ band pass filter

•



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

15

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

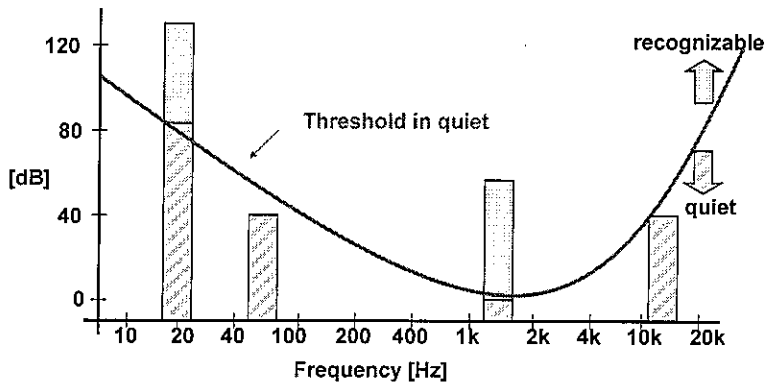
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

5

(5 points)



- Meaning : the hearing sensation that corresponds to sound level is the loudness of the sound → Hearing range and hearing threshold are exist

- Purpose : we can delete the information that we can't hear

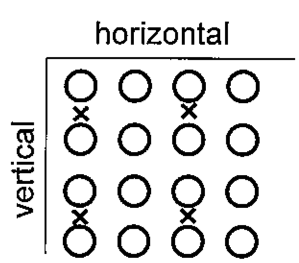
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] ×3 × 1/2
]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] $\times \frac{3}{2}$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 12 [bits/frame] × 30 [frames/sec]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans: [(3840 [pixels/line] × 2160 [lines/frame] × 12 [bits/~~frame~~] × 30 [frames/sec]) / (100 · 10^6 [bps])]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.		
	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

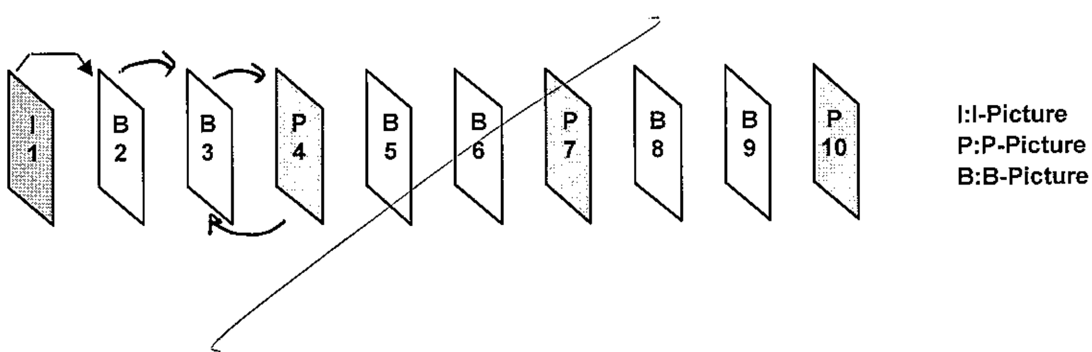
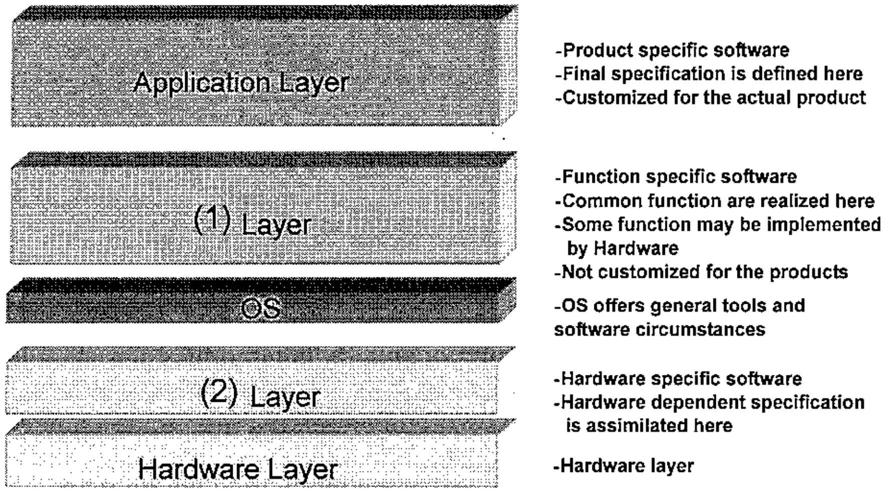


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- OpenMAX IL serves as a low-level interface for audio, video and imaging codecs used in embedded devices
- It gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner

2

8

ID code	2100
Name	Nguyen Duc Tai

RVC "System Solution" **Examination** November 24, 2017

~~69~~ 73

1. Digital Signal Processing

3

1.1 How to prevent "Aliasing"? *(3 points)*

To prevent "Aliasing". We use sampling frequency : $f_s \geq 2f_m$.
ex: $x(t) = \sin(2\pi f.t) = \sin(2\pi.200t)$. $\Rightarrow f_m = 200Hz$.
we should use sampling frequency : $f_s \geq 2f_m \Leftrightarrow f_s \geq 400 Hz$.
$\Rightarrow$ preven "Aliasing" ✓

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) : -4

(b) Signed Truncation : -3.

(c) Rounding : -4.

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq f_s/2 \Leftrightarrow f_m \leq 24$ KHz. ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $(48.1000).24.6$ [bit/sec] ? ✓

(c) Calculate the size of 60[min].

Datasize = bitrate $\cdot (60.60)$ (bit) ? ✓

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~we have $\begin{cases} f_m = 30kHz \\ f_s = 48kHz. \end{cases}$~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

2

FFT	DFT.
+ 2 multiplication	+ 16 multiplication
+ 8 addition	+ 12 addition.

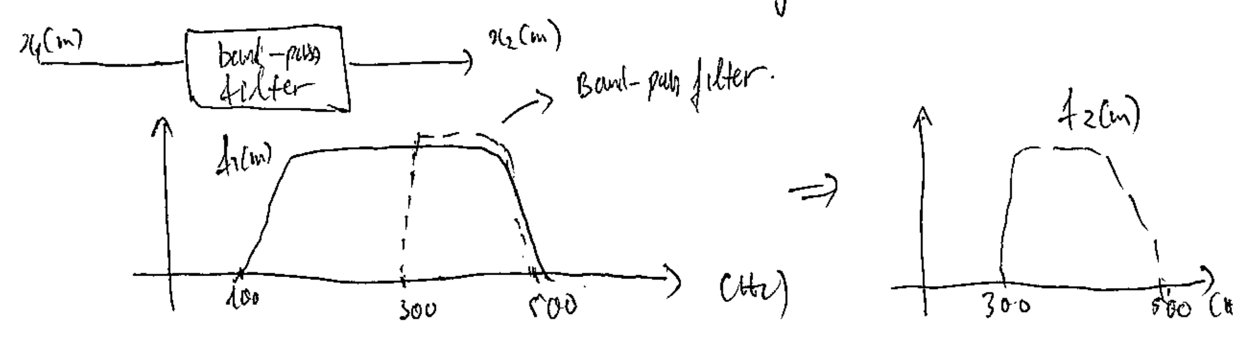
⇒ FFT more simple than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

f_{in} = [100 : 500] (Hz)
filter keep [300 : 500] (Hz) } ⇒ we use band-pass filter (Bộ lọc thông dải).

⊛ figure:



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

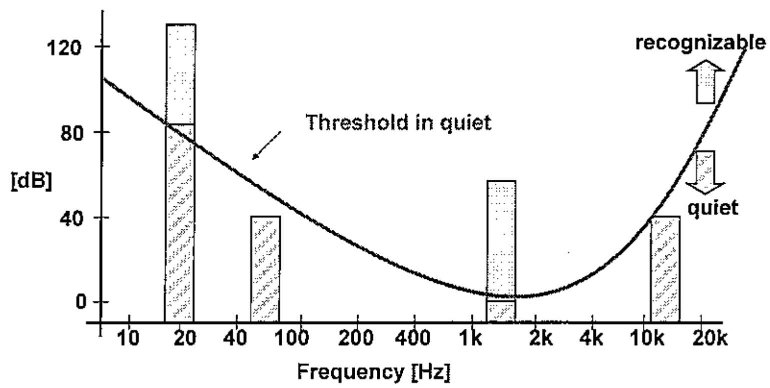
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

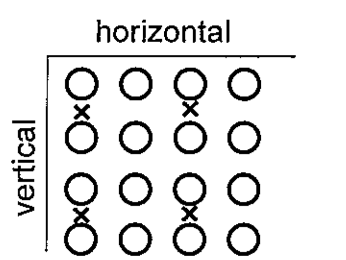


+ The meaning and purpose of this Psych-acoustic model is analyze the range of sound that human can ~~hear~~. recognizable. Though it, we can make many device relative audio for human requirement.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

datarate = 3840 . 2160 . 24 . 30 . [bit/s].]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

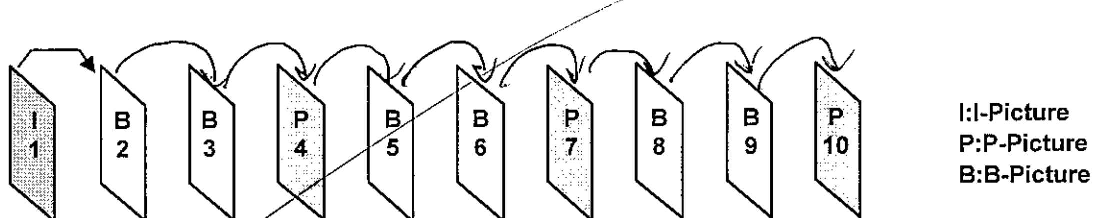
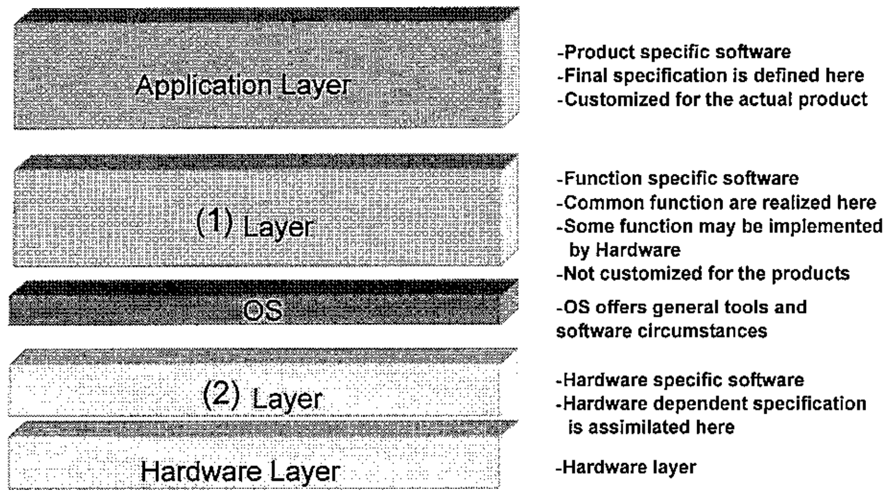


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

1.6

ID code	2101
Name	Nguyen Khac Thanh Tam

~~72~~ 86

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Make sampling frequency (fs) more than 2 times of band width (fm)

$f_s \geq 2 \times f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

-4

(b) Signed Truncation

-3

(c) Rounding

-4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 \times f_m \rightarrow f_m \leq \frac{f_s}{2} = \frac{48.1000}{2} = 24.10^3 (Hz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate $= 24 \times 48 \times 10^3 \times 6$ [x]

(c) Calculate the size of 60[min].

Data size $= 24 \times 48 \times 10^3 \times 6 \times 60 \times 60$ [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$2 \times 30.10^3 > 48$ mean $2 \times f_m > f_s$

$\rightarrow$ Occurs Aliasing

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) poor (f) Good

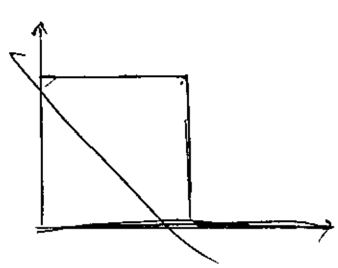
(g) Poor (h) Good

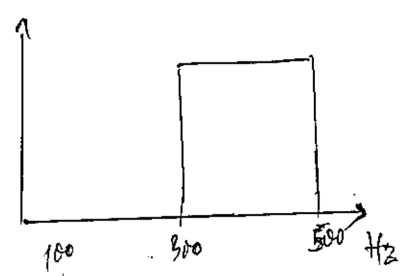
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0 fast ~~fase~~ fourier Transform Discrete Fourier Transform.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0 We should use High pass filter





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

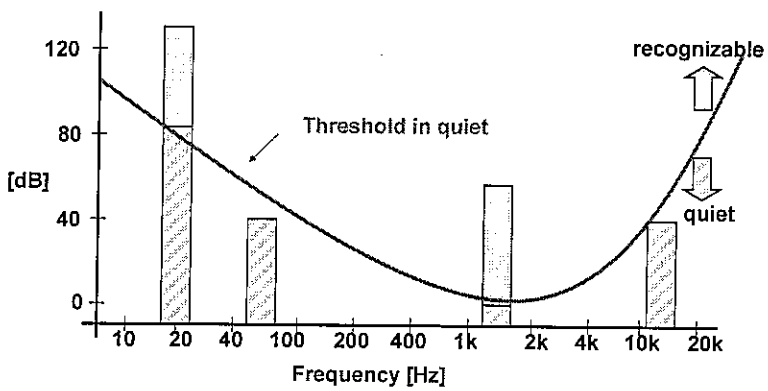
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation ~~between Audio data~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

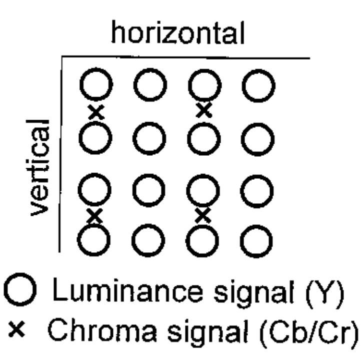


This Psych-acoustic mean: below the line Threshold in quiet. human can't hear and we can remove data from ~~it~~ to compressing data.
Example in 20Hz frequency ~~we~~ human can hear sound above 80dB. The data below 80dB we can remove. and some data human can't recognize we can remove such as in 60Hz below 40dB

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) 8

3840 × 2160 × $\frac{8}{2}$

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above

Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.
1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

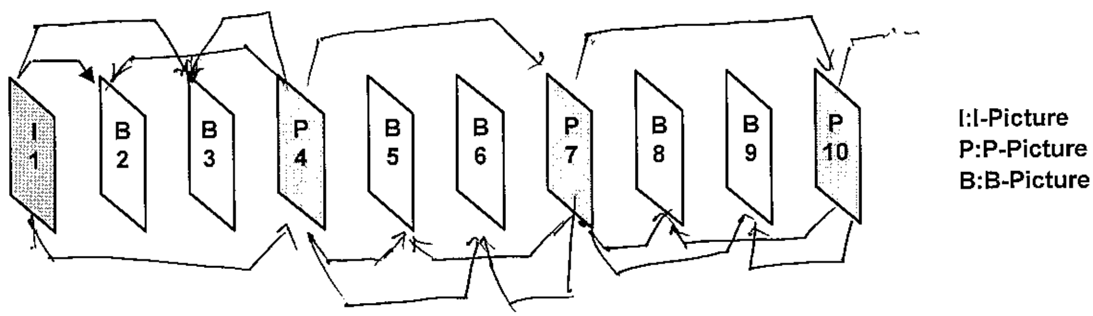
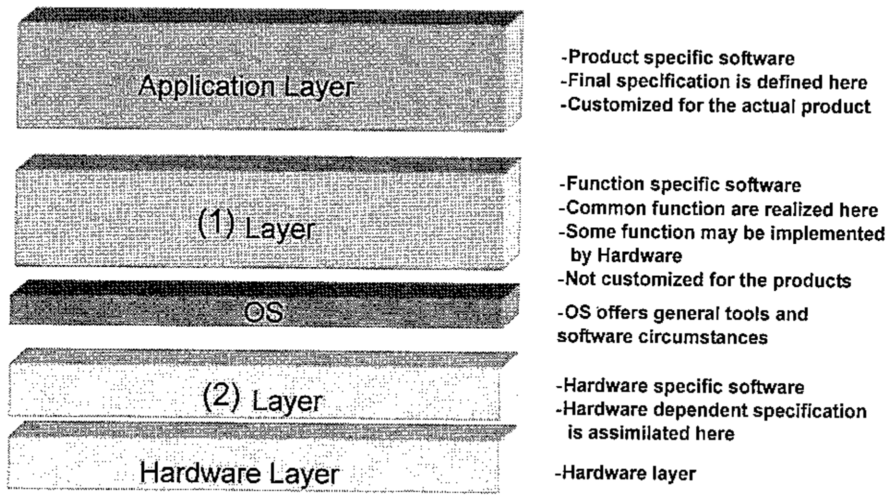


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMax IL is Middel ware layer. function specific software

0

~~Ulld~~ 17

ID code	2102
Name	Nguyen Hai Tan

79

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

3

1.1 How to prevent "Aliasing"? *(3 points)*

- If sampling frequency is not higher Nyquist frequency ($f_s < 2f_m$), aliasing signal appears.
- To prevent aliasing, we must ensure sampling frequency is higher than Nyquist frequency.
- Example to calculate aliasing signal:

$x(t) = \sin(2\pi t * 333)$, $f_m = 333Hz$, $f_s = 500Hz$

$\Rightarrow$ Aliasing signal appears.

Aliasing signal has $f_a = 500 - 333 = 167$ Hz.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation - 3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.

10

(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_m \Rightarrow f_m \leq f_s/2 \Rightarrow f_m \leq \frac{48.10^3}{2} \Rightarrow \cancel{f}_m \leq 24$ [kHz]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = $(48*10^3) * 24 * 2 = 2304.10^3$ [bits/sec] 0

(c) Calculate the size of 60[min].

data size = bit rate * (60 * 60) = $2304*10^3 * (60*60) = 82944.10^5$ [bit] 2

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~ 0 ?

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) good

(g) Poor (h) Good

3

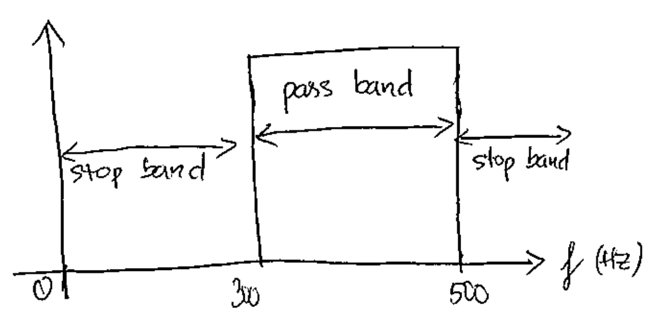
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

	Original (DFT)	FFT
Multiplication (complex)	N^2	$\frac{N(\log_2 N-1)}{2}$
Addition (complex)	$N(N-1)$	$N\log_2 N$

The calculations numbers of FFT is less than DFT.

3

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*



⇒ We should use Band Pass Filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

M

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

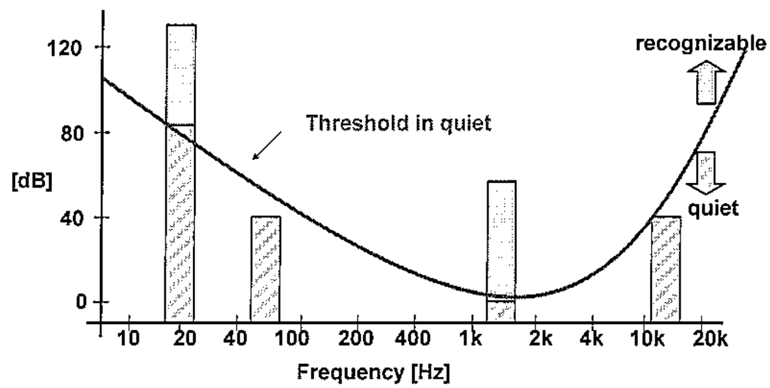
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

3

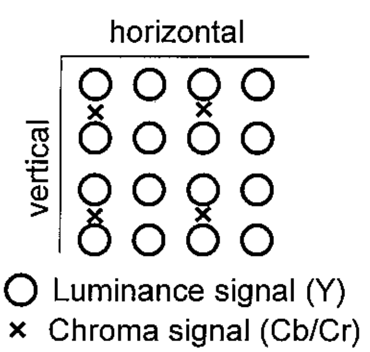
(5 points)



– We ~~can't~~ can delete the information that we can't hear

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] + 2160 [lines/frame] + 8 [bits/pixel] ~~+3÷2~~
= ~~99532800 [bits/frame]~~
66355200 [bits/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [8 294 400 [pixels/frame] * 8 [bits/pixel] * 3 * 1/2
= 99532800 [bits/frame]]

4) Calculate total data rate of UHD/4K Video data above

Ans: [8 294 400 [pixels/frame] * 8 [bits/pixel] * 3 + 1/2 * 30 [frames/sec]
= 295 5984000 [bps]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? ($1 \text{ Mb} = 10^6$ bit)

Ans: [Compression ratio = $\frac{100 \cdot 10^6}{298\ 598\ 4000} \cdot 100 = 3{,}34\ \%$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.

1) DCT — c) Frequency domain technique

2) VLC — a) Probability theory technique

3) MC — b) Time Domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

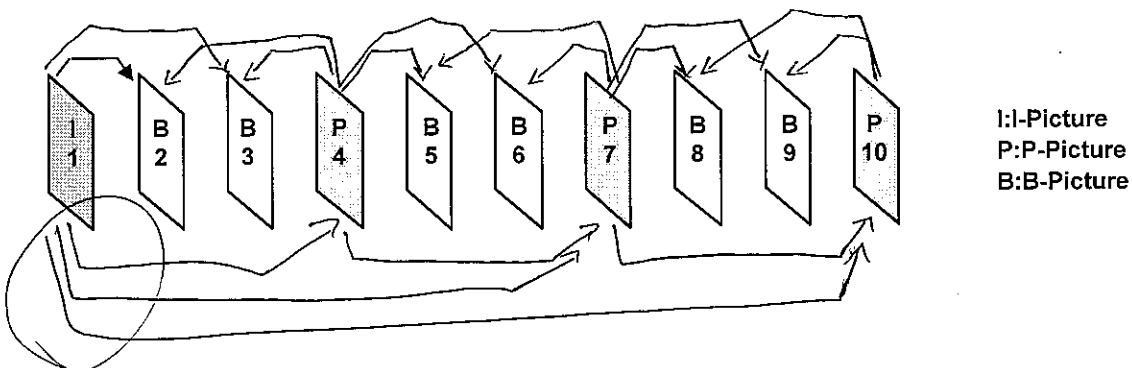
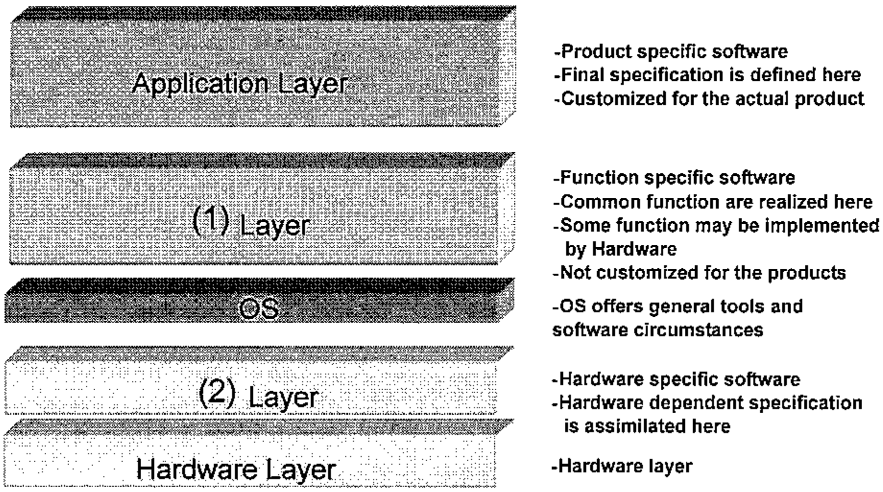


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

- Open MAX IL serves as a low-level interface for audio, video and imaging codecs used in embedded device.
- It gives application and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner.

23

ID code	2104
Name	Huỳnh Quốc Thắng

~~82~~ 86

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency > Nyquist Frequency

$f_s \geq 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) -4.0

(b) Signed Truncation ~~-4.0~~

(c) Rounding -4.0

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = \frac{f_s}{2} = \frac{48kHz}{2} = 24\ KHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate = $24kHz \times 24 \times 6$ = [bit/sec]

(c) Calculate the size of 60[min].

Data size = $60 \times 60 \times 24kHz \times 24 \times 6$ [~~bps~~]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing occurs : $f_a = 18kHz$~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple　　　(b) complex

(c) good　　　(e) good

(d) poor　　　(f) good

(g) poor　　　(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3

+ FFT is fast calculation algorithm of DFT. for $N = 2^n$ cases.
+ FFT has less of multiplication and addition than DFT
+ DFT complex more than FFT.

	DFT	FFT
multi :	N^2	$N(\log_2 N - 1)/2$
add :	$N(N-1)$	$N\log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

+ Using Band Bass Filter to keep the components whose frequency from 300Hz-500H

+ Figure:

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

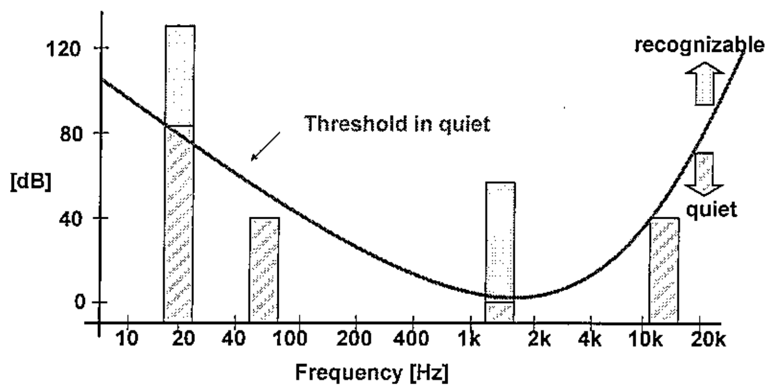
(1) Fourier Transform
Utilize [Time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [property of correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



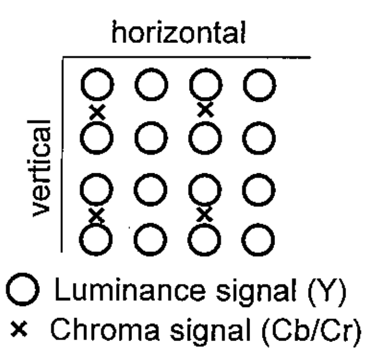
+ Mean: The hearing sensation that corresponds to sound level is the loudless of the sound → hearing range and hearing threshold are exist

+ purpose: We can delete the information that we can't hear.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

3840 x 2160 x 8 x 1 pixels/frames

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} =$ [—] pixels

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} \times 90 =$ [Frames/sec]

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[

9

$\text{Compression ratio} = \dfrac{3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} \times 30}{100\ \text{Mbps}} =$

]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

2

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

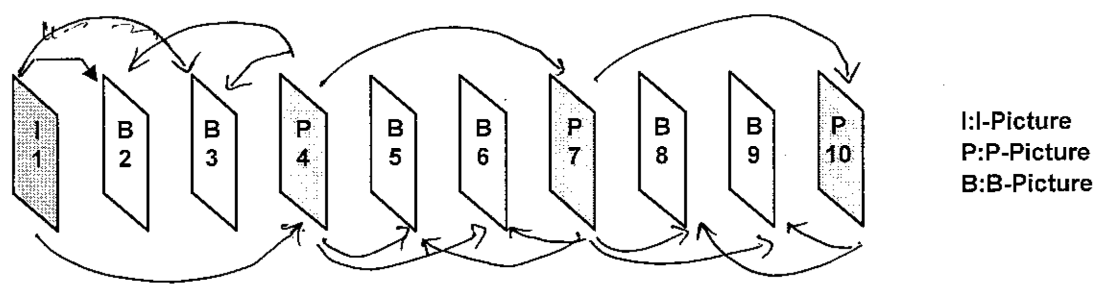
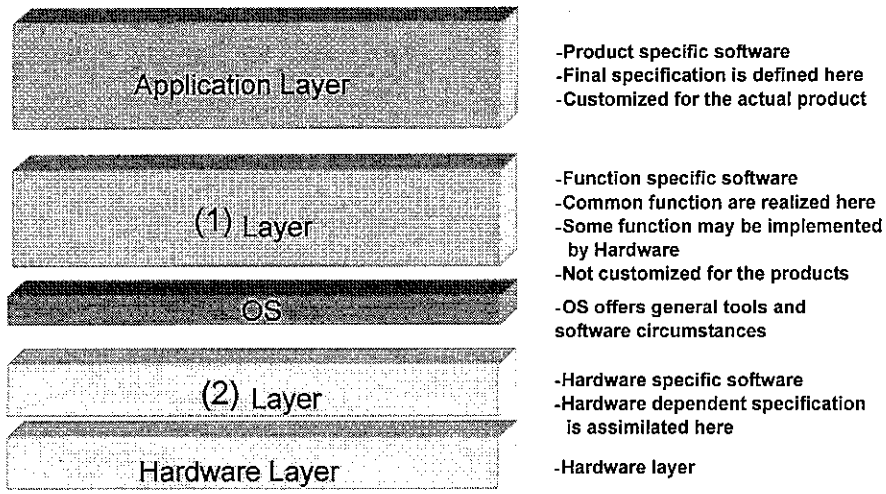


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



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Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

+ OpenMAX IL serves as a low level interface for audio, video, and imaging codecs used in embedded devices. It gives application and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner

12

ID code	2105
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~~40~~

78

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampling frequency must large than Nyquist frequence.

$$f_s \geq 2 f_m$$

While: Nyquist frequency ~~fs~~ $= 2 f_m$.

f_s : sampling frequency

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

~~16~~ 12

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m$

$\rightarrow f_m \leq \frac{f_s}{2} = \frac{48 \cdot 10^3}{2} = 24 \cdot 10^3\ Hz = 24\ KHz$ ~~= 24~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= 48 \cdot 10^3 \cdot 24 \cdot 6$ (bit/sec)

(c) Calculate the size of 60[min].

bitrate . 60 . 60 $= 48 \cdot 10^3 \cdot 24 \cdot 6 \cdot 60 \cdot 60$ (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_s = 48 KHz < 2 f_m = 2 \cdot 30 KHz = 60 KHz$

$\rightarrow$ aliasing signal appear

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) poor (f) Good

(g) poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

3 FFT is faster than DFT.

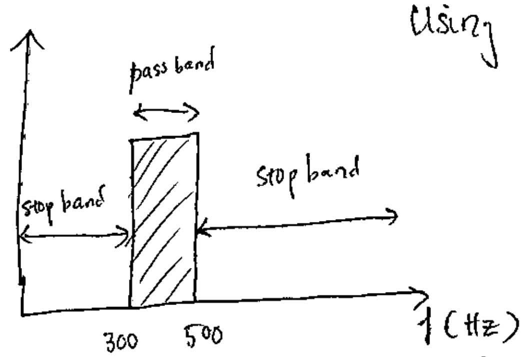
Number of Multiplication & Addition is less than DFT.

	DFT	FTT
Multiplication (complex)	N^2	$\frac{N \cdot (\log_2 N - 1)}{2}$
Addition (complex)	$N(N-1)$	$N \cdot \log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

Using "Band Pass filter"



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

15

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [Correlation ~~cosine~~] between audio data.

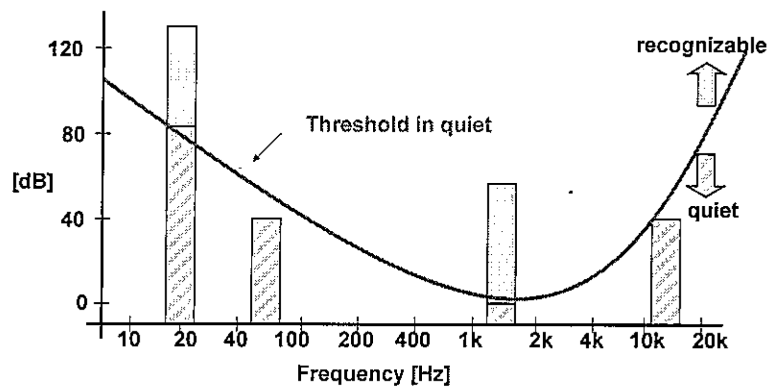
(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appreance].

2.2 Following figure shows a Psych-acoustic model.

5

What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Meaning : This point out that hearing range and hearing ~~that~~ threshold are exit.

purpose: Delete ~~that~~ information that we can't hear.

3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

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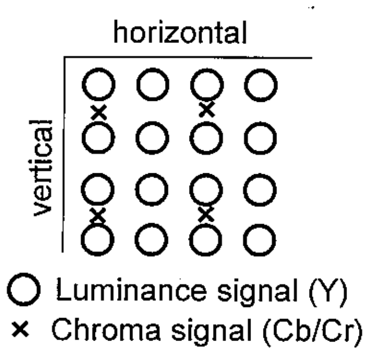

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixel/line] X 2160 [lines/frame] X $\frac{1}{2}$]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$\frac{3840 \times 2160}{2}$ [Pixels/frame] × ~~30 frame/sec~~ 8 [bit]

= 3840 × 2160 × 8 [bit/Frame]]

4) Calculate total data rate of ~~UHD~~/4K Video data above

Ans: [3840 × 2160 × 8 × 3 [bit/frame] × 30 [frame/sec] = 3840 × 2160 × 8 × 3 × 30 [bit/sec]]

0 5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[compression ratio = $\frac{3840 \times 2160 \times 8 \times 3 \times 30}{100 \cdot 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

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2 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

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(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

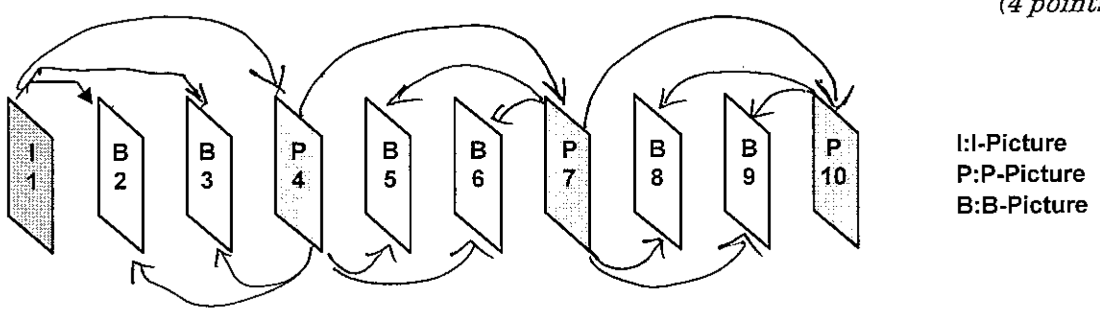

Figure 2.1. Prediction of MPEG1/2 Video coding

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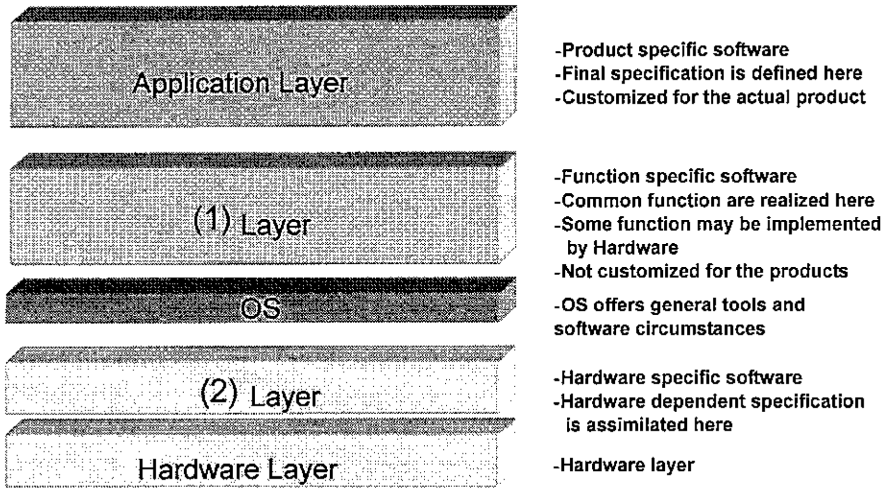

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6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

8

ID code	2106
Name	Đoàn Linh Thiện

~~53~~ 55

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 sampling frequency ≥ Nyquist frequency ($f_s \geq 2f_m$)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) ~~-3~~ ~~-4~~

(b) Signed Truncation ~~1,1 → 2; 0,1 → 1; 0,1 → 1,1 → 2~~ -4

(c) Rounding ~~1,6 → 2; 1,4 → 1; 0,4 → 0; 0,6 → 1~~ -4.

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

02

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 \times f_m \Rightarrow f_m = f_s / 2$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $(48 \times 1000) \times 24 \times 2$

(c) Calculate the size of 60[min].

data size = bitrate × 60 × 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 4,8 kHz~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple   (b) complex

(c) good   (e) good

(d) poor   (f) good

(g) poor   (h) good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.

FFT is fast calculation algorithm of DFT, for $N = 2^m$ cases, FFT has less multiplication and addition than DFT.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1.

Band pass filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time - frequency] transformation.

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Utilize the property of [correlation] between audio data.

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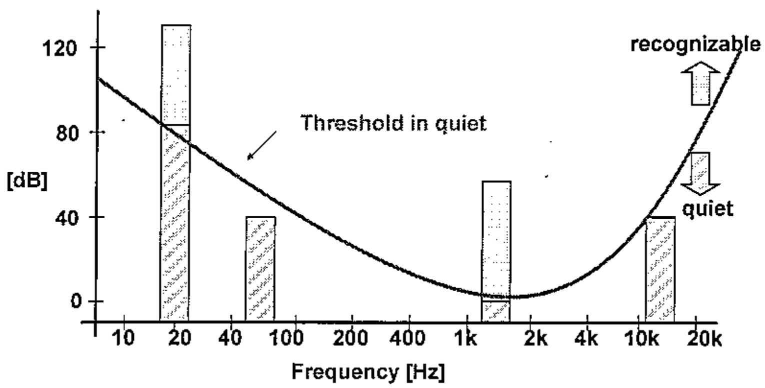
Utilize the probability of [data appearance.].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Meaning: the hearing sensation that corresponds to sound levels is the loudness of the sound → hearing range and hearing threshold are exist.

Purpose: we can delete the information that we can't hear.

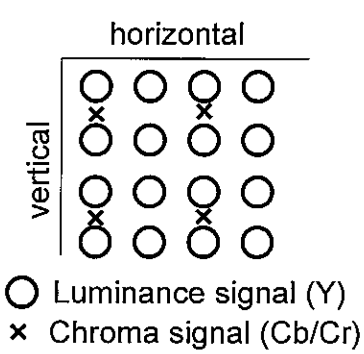
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

3840 x 2160 x 8 (x 3) =]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 × 2160 × 8 × 3 × $\frac{1}{2}$ ... [bits/frame]]

[pixels/line] [lines/frame] [bits/pixel]

4) Calculate total data rate of UHD/4K Video data above

6

Ans: [3840 × 2160 × 12 × 30 ~~[bps]~~ = ... [bps]]

[pixels/line] [lines/frame] [bits/frame] [frame/sec]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[~~3840 × 2160 × 12 × 30 [bps~~]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

0

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

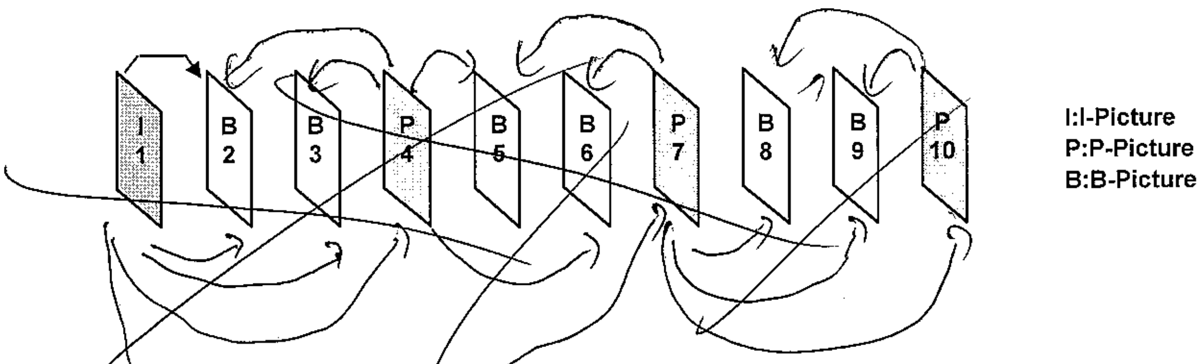
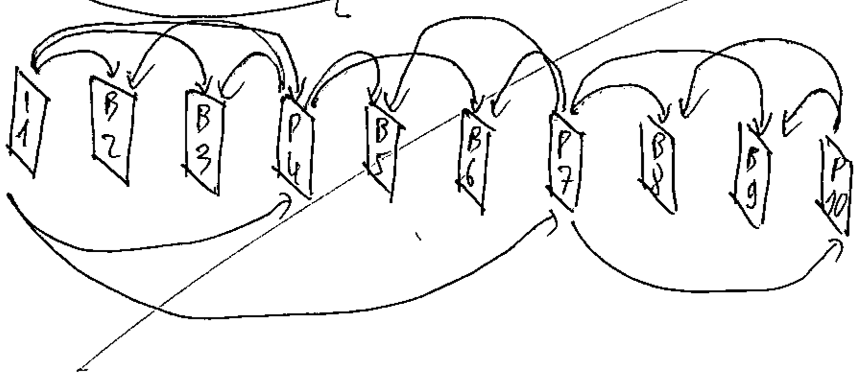


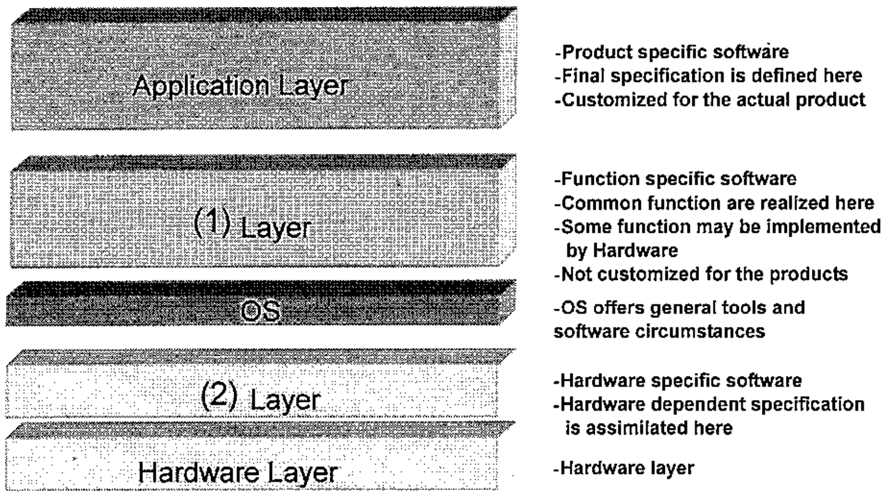
Figure 2.1 Prediction of MPEG1/2 Video coding

0



4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

0

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as a low level interface for audio video & imaging codes used in embedded devices. It gives application & media frame works the ability to interface with multimedia codes & supporting components in a ~~fast~~ unified manners.

2

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Name	Nguyễn Trọng Thư

24

75.5

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Make sampling frequency $\geq$ Nyquist frequency $(f_s \geq 2f_m)$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation $-\cancel{4}$

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

6

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2f_m \Rightarrow f_m = f_s/2 = 48/2 = 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (48 \cdot 1000) \cdot 24$ ✗

(c) Calculate the size of 60[min].

data size $=$ bitrate $\cdot (60 \cdot 60)$ ✗

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~ !

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

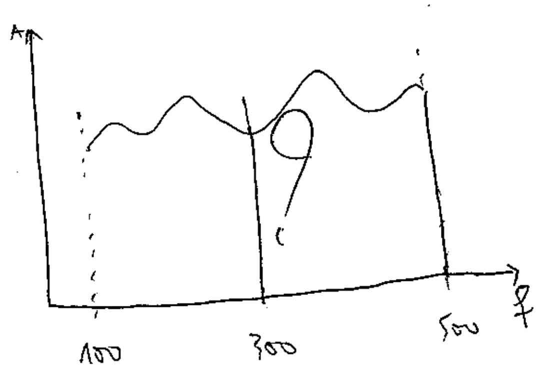
1.5 FFT is Fast calcution algorithm of DFT, for $N = 2^m$ case

, FFT is faster in calcution than DFT (less multiplication, addition ... than DFT)

2

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We should use band pass filter (or high pass filter is good, too)



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

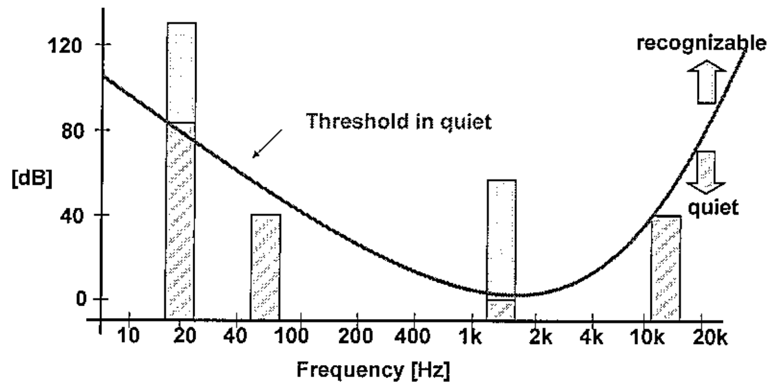
(1) Fourier Transform
Utilize [Time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



The hearing sensation that corresponds to sound levels is the loudness of the sound
⇒ Hearing range and hearing threshold are exist, thus, we can delete the information that we cannot hear

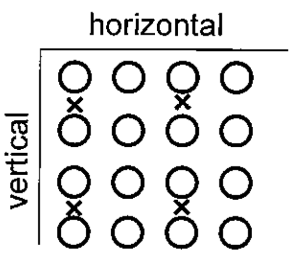
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume (Cr and Cb total)
Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{6}$ [bits/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \times 8 \times 3 \times \frac{1}{2} = 3840 \times 2160 \times 12$ [bit / frame]]

6

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \times 2160 \times 12$ [bit / frame] $\times$ 30 [frame / second]

$\simeq 3840 \times 2160 \times 12 \times 30$ [bps]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$100 \cdot 10^6 / (3840 \times 2160 \times 12 \times 30)$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

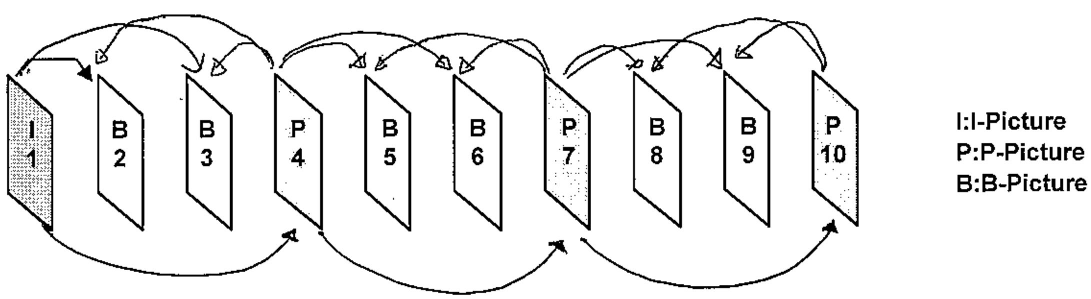
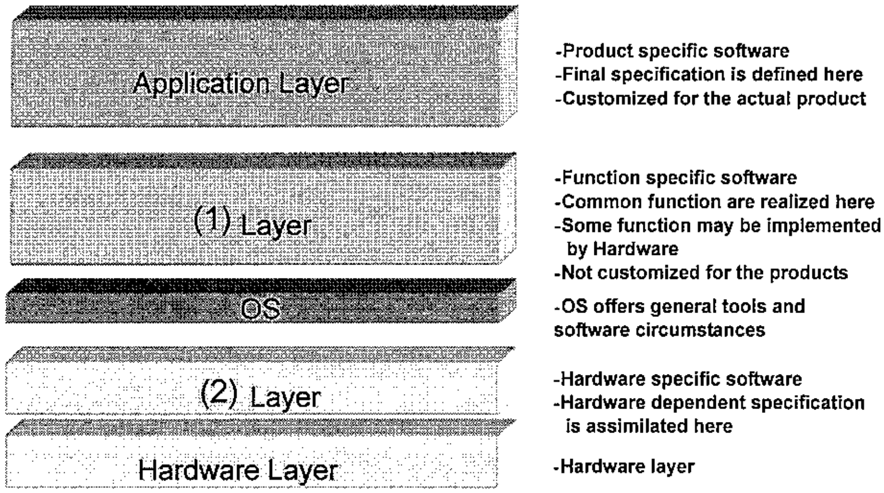


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Open MAX IL serves as a low level interface for audio video & imaging codes used in embedded devices. It gives application & media frame works the ability to interface with multimedia codes & supporting components in a unified manners

2

11

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~~42~~

46

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 to prevent Aliasing f_s should be great or equal two ~~multiple~~ fm.

$f_s \geq 2 * f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) → ~~-3~~

(b) Signed Truncation →

(c) Rounding →

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 2 * f_m \Rightarrow f_m = \frac{f_s}{2} = \frac{48}{2} = 24 \text{ kHz}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate : (48*1000) * 24 * 6 [X]

(c) Calculate the size of 60[min].

data size of 60 min : bitrate * 60 * 60 [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_s < 2 f_m$ → Aliasing will appear

→ alias = 48 - 30 = 18 kHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple
(b) complex
(c) good
(e) good
(d) poor
(f) good
(g) poor
(h) good

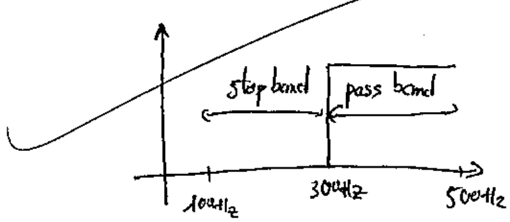
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

2 FFT is more faster than DFT.

	DFT	FFT
addition	$N(N-1)$	$N.\log_2 N$
multiplex	N^2	$\frac{N(\log_2 N-1)}{2}$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0 we should use high pass filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

00

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [ ] transformation.

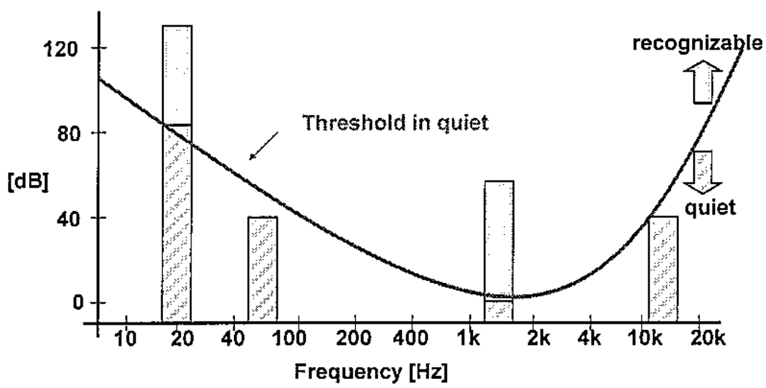
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)



it show the area human can recognized and quiet, ~~and base on it~~ and when you see the figure you can know what point human can hear clearly.

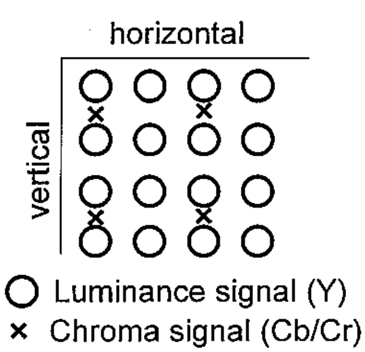
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)

Ans: [$3840 \times 2160 \times \left(\frac{8 \times 2}{2}\right)$ = [pixel/frame]
[pixel/line] [line/frame]
]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixel/lines] × 2160 [lines/frame] *]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 [pixel/lines] × 2160 [lines/frame] × $\left(\frac{8 \times 3}{2}\right)$ × 30 [fram/sec] = bit/sec]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans: [ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT → b) — a) Probability theory technique

2 — 2) VLC → c) — b) Time Domain technique

3) MC → a) — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

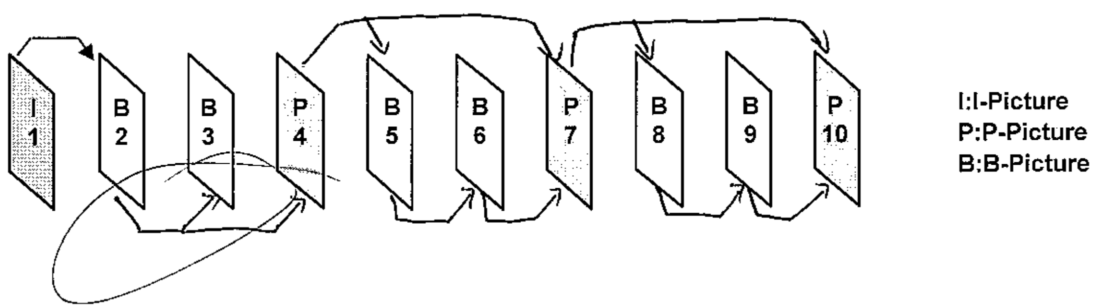
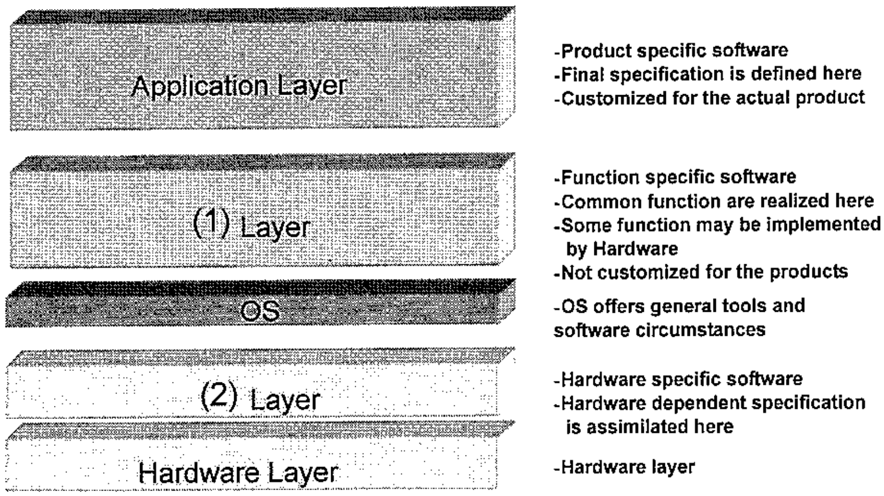


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



6

Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

OpenMax IL is a royalty-free, ~~eer~~ cross-platform, set of C-language programing interfaces that provides abstraction for routine especially usefull for audio, video and still image.

20

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RVC "System Solution" **Examination** November 24, 2017

86.5

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency, f_s, has to be $\geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) (−4)

(b) Signed Truncation (−3)

(c) Rounding (−4)

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$\cancel{f_m \leq \frac{48 kHz}{2}} = 24 (kHz)$ $f_m \leq \frac{f_s}{2} = \frac{48[kHz]}{2} = 24[kHz]$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate (bps) = 24 (bits/sample) · ~~48 (sa~~ $48 \cdot 10^3$ (samples/sec) · 6 (channels)
= ... (bits/sec)

(c) Calculate the size of 60[min].

size = bitrate (bits/sec) · 60 (secs/min) · 60 (mins) = ... (bits)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

since $f_s = 48[kHz]$ is not greater than or equal to $2 \cdot f_m = 2 \cdot 30[kHz]$
$= 60[kHz]$.

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

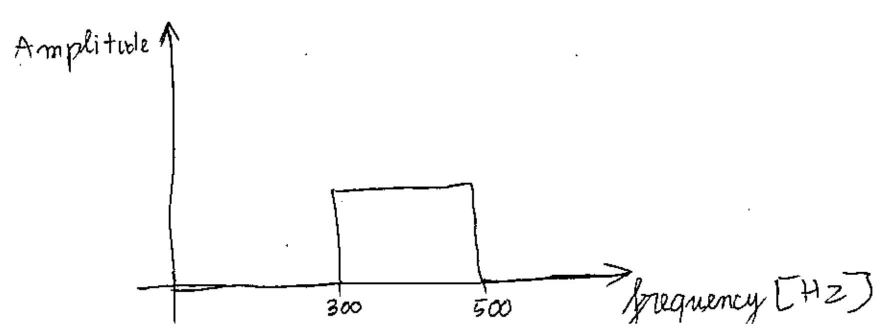
(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

1.5 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

The advantage of FFT in comparison with DFT:
+ Less compuration.
+ Faster execution.

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We should use band pass filter.



2. Audio Coding

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(5 points for each: total 15 points)

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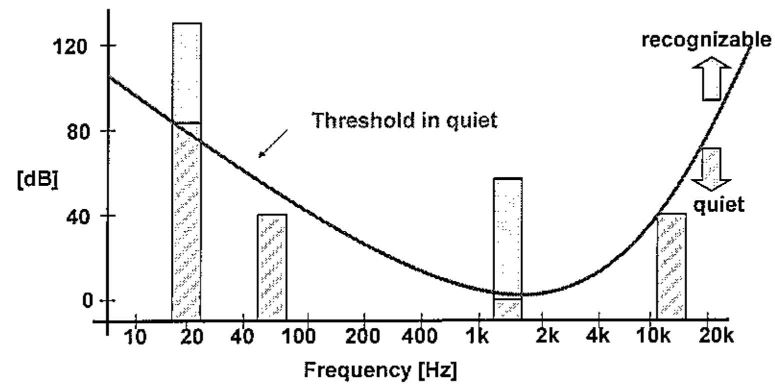
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

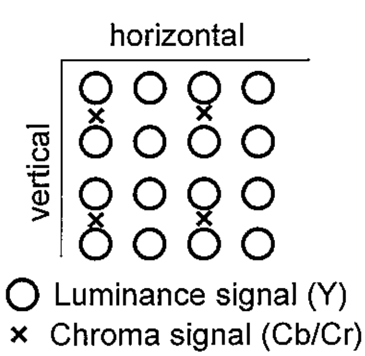
3



It ~~allows~~ helps the audio coding developer determine which signal should be sampled and which signal can be discarded at certain frequency.
Any signal which has the amplitude [dB] below the threshold can be discarded since it is unrecognizable to human ears.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [= (2+0)/8 [bits] · 3840 [pixels/line] · 2160 [lines/frame] ~~· 30 [frame/sec]~~.]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [Total data volume

$= (4+2+0) \cdot 8$ [bits] $\cdot$ 3840 [pixels/line] $\cdot$ 2160 [lines/frame].
]

4) Calculate total data rate of UHD/4K Video data above

Ans: [Total data rate

= Total data volume $\cdot$ 30 [frames/sec].
]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

6 Ans: [Compression ratio.
]

= Total data rate / ~~100~~ 10^8 [bits/sec] = $\cdots$

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT c) — 2) a) Probability theory technique

6 — 2) VLC a) — 3) b) Time Domain technique

3) MC b) — 1) c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

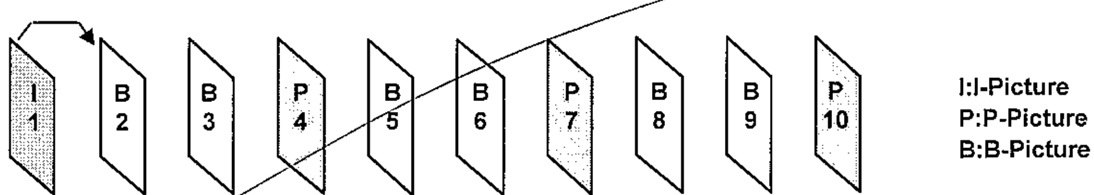
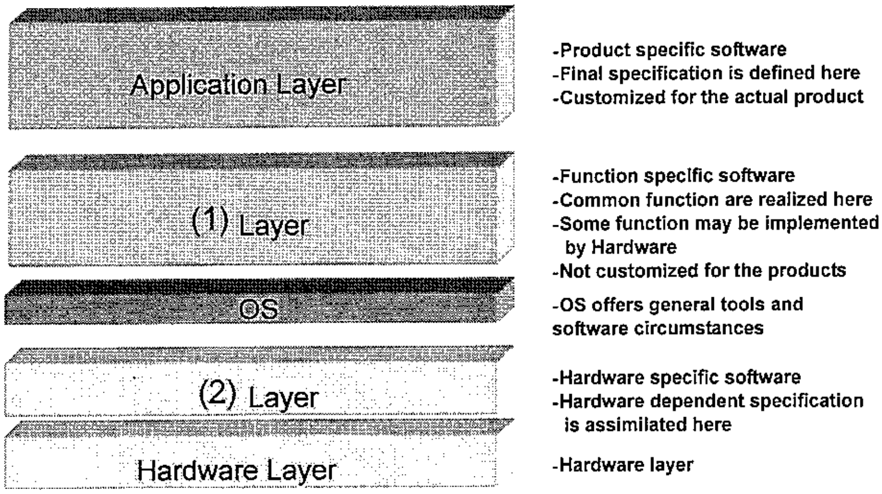


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as a low ~~l~~ level interface for audio, video, and imaging codecs used in embedded devices.

2

It gives applications and media frameworks the ability to interface with multimedia codecs and support components in a unified manner.

14

ID code	HW-2110
Name	Pham Vuong Trieu

~~48.5~~

46.5

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$fs >= 2fm$

because if $fs < 2fm$: alising signal appears.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) − 3

(b) Signed Truncation −4

(c) Rounding −3

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 6

(a) Calculate the maximum frequency CD can re-produce.

$fs >= 2 * fm \rightarrow fm <= fs/2 = 24 KHz.$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = ~~(44,1 48 * 1000) * 24 bit * 8~~ 6

(c) Calculate the size of 60[min].

datasize = bitrate * (60*60). [db.]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

alias ~~18 KHz~~ ?

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple (b) complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1

Faster.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1.5

Band pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

60

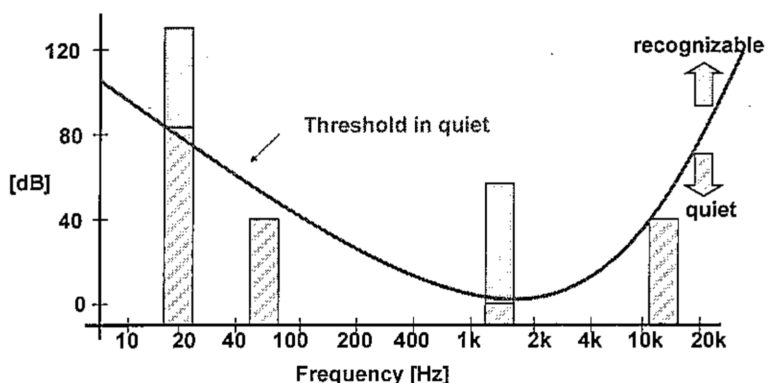
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



- Hearing range and hearing threshold are exist
- we can delete the information that we can't hear.
- The sensitivity of the human being is not constant for the frequency of the signal
- when a big sound exists, there is "masking" effect around that sound.

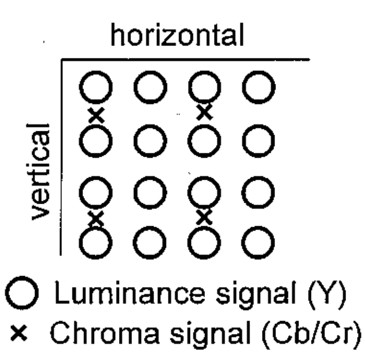
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

3840[pixels/line] x 2160[lines/frame]

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 × 3 × 1/2]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 × 2160 × 12 × 30 [bps]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT b — a) Probability theory technique

0 2) VLC c — b) Time Domain technique

3) MC a — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

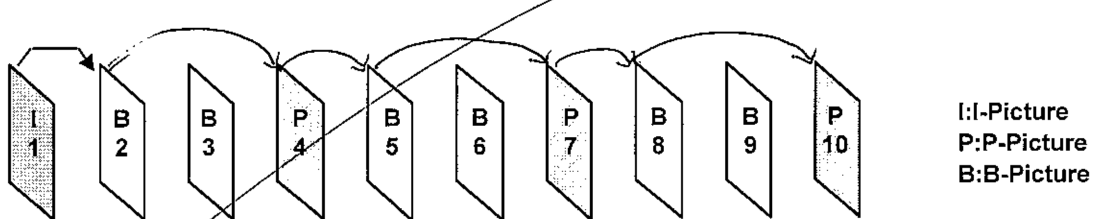
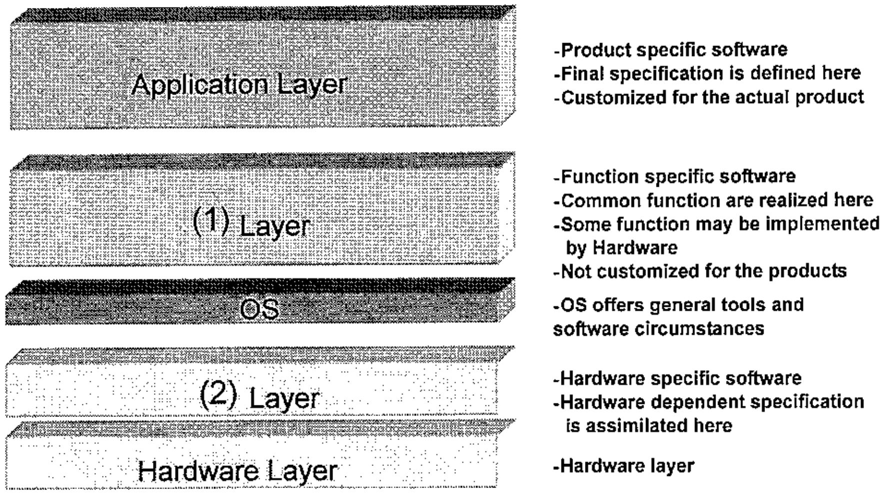


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMax IL serves as a low-level interface for video and imaging codecs used in embedded device.

It gives application and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manners.

13

ID code	2113
Name	Tran Van Tuan

~~58~~ 60

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 increase sampling frequency higher than ~~2 times~~ Nyquist frequency.
$f_s \geq 2 f_m$.

0 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) ~~4~~

(b) Signed Truncation ~~-4~~

(c) Rounding ~~-4~~

~~10~~ 8 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~$f_s \geq 2 f_m \Rightarrow f_m$~~

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq f_s/2$
$\Leftrightarrow f_m \leq 24$ kHz. ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (48 \times 1000) \times 24 \times 6$ [×]

(c) Calculate the size of 60[min].

data size $=$ bitrate $\times (60 \times 60) = (48 \times 1000) \times 24 \times 6 \times (60 \times 60)$ [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias ~~18 KHz.~~ 1

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

16

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) complex

(c) good (e) good

(d) poor (f) good

(g) poor (h) good

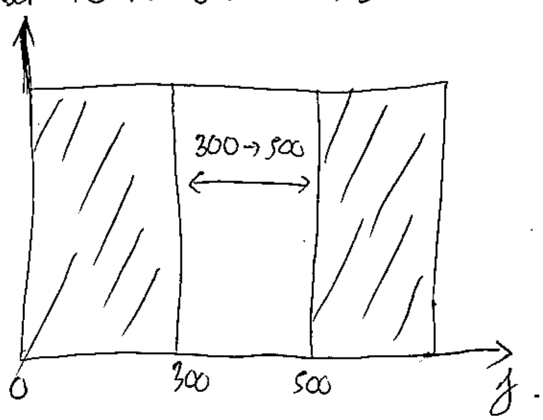
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure ~~of that filter~~? *(3 points)*

0

Use bi-direction filter to remove 0 → 300 Hz and larger than 500Hz.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

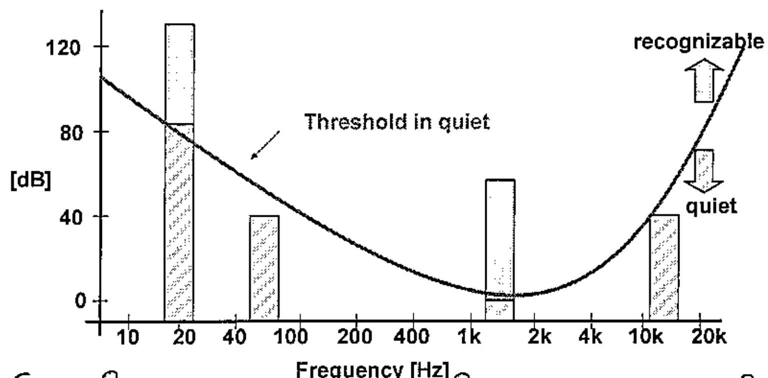
(1) Fourier Transform
Utilize [~~Utilize~~ time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



meaning : the hearing range & hearing threshold of people.

purpose : can delete the information that we can't hear.

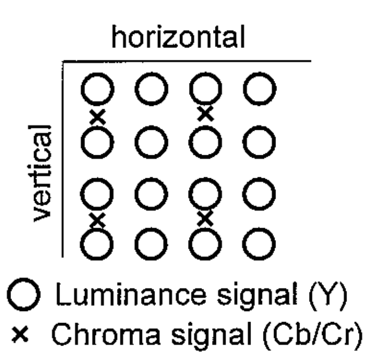
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

3840 × 2160 × 8 × 3 × 1/2 = 8 294 400 × 12

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 × 2160 × 8 × 3 × 1/2

8294400 × ~~18/6~~ 12]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [8294400 ×12 + 8294400 × 12 unit ?

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [(8294400 ×12 + 8294400 × 12) × 30 unit ?

3

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT a) Probability theory technique

2 2) VLC b) Time Domain technique

3) MC c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

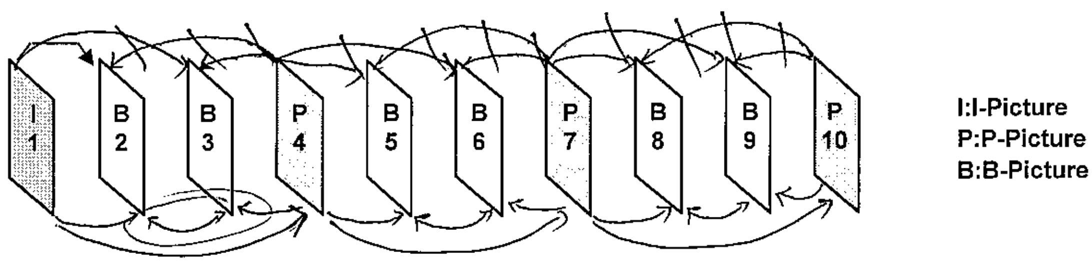
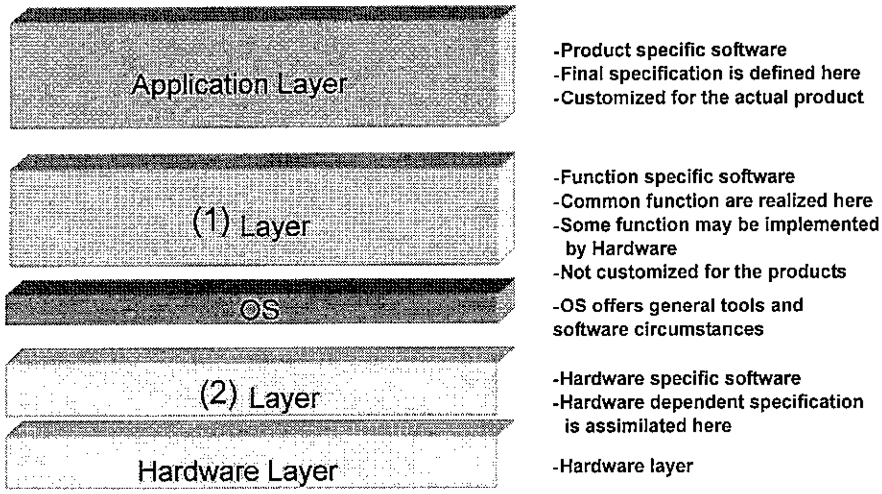


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

It gives ~~a~~ applications and media frameworks, the ability to interface with multimedia codecs and supporting components in a unified manner.

17

ID code	2114
Name	TRIỆU THANH VÂN

~~67~~ 69

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

Sampling frequency must larger than 2 times compared with maximum frequency.

6 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) ~~-3~~

(b) Signed Truncation -3

(c) Rounding -4

~~16~~ 8 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq f_s/2 \Leftrightarrow f_m \leq \frac{48kHz}{2} \Leftrightarrow f_m \leq 24kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48 . 1000) . 24 . 6 $\boxed{X}$

(c) Calculate the size of 60[min].

datasize = bitrate (60 . 60) $\boxed{X}$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~→ Alias 18 kHz~~

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Poor

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0) Suitable for data compress

3 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

band pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

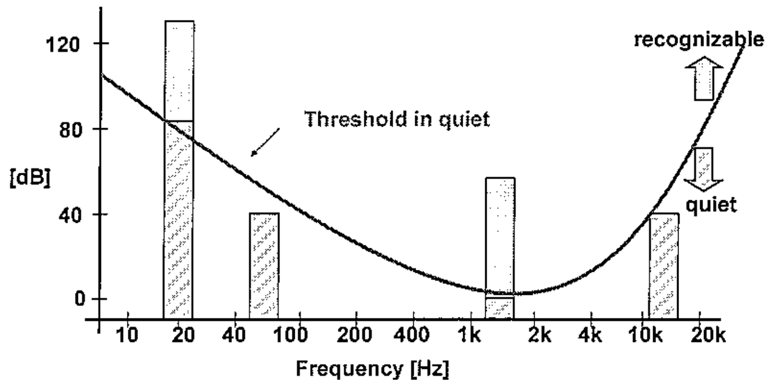
(1) Fourier Transform
Utilize [time - frequency
- Fourier] transformation.

(2) Stereo Coding
Utilize the property of [correlation
- stereo coding] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



can delete information in quiet part

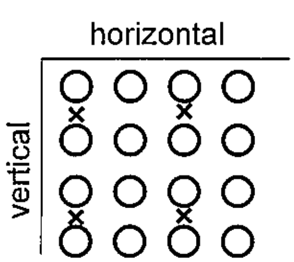
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 × 2 × $\frac{1}{2}$]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 × 3 × $\frac{1}{2}$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160 [lines/frame] × $\frac{24}{2}$ × 30 [frame/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

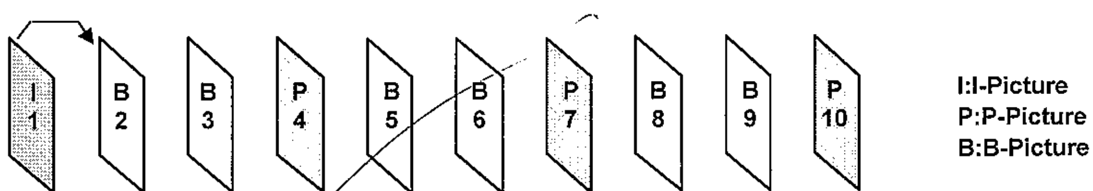
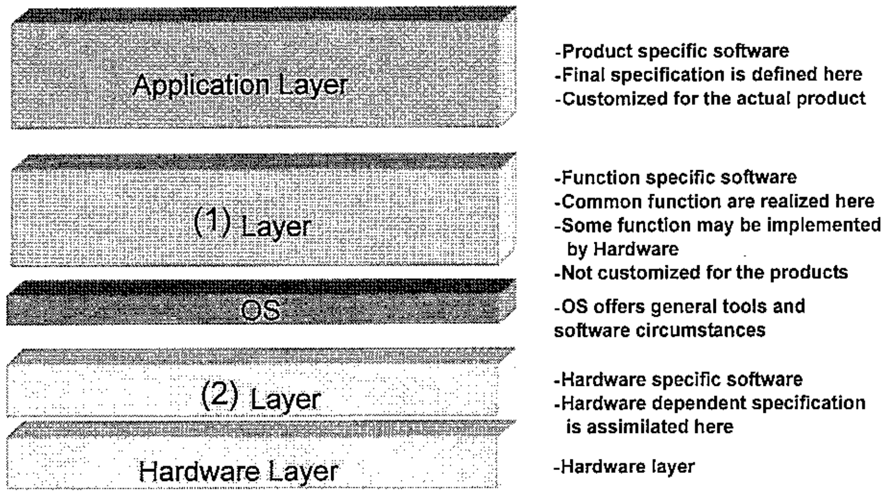


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unified maner.

2

8

ID code	2115
Name	Nguyen Thanh Vien

RVC "System Solution" **Examination** November 24, 2017

~~53~~

55

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 to prevent Aliasing $f_s >= 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) -1

(b) Signed Truncation 0

(c) Rounding 1

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~4~~ 6

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m <= \frac{f_s}{2}$ = [?]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48*1000) * 24 * 6 = [?]

(c) Calculate the size of 60[min].

datasize = bitrate * (60 * 60) = (48 * 1000) * 24 * 6 * (60 * 60) = [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex.

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

2

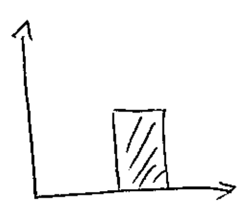
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

	FFT	DFT.
Multiplication	$N\,\underline{(\log_2 N-1)}$.	N^2
Addition	$N\log_2 N$	$N(N-1)$

3

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

– We should use band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

15

(1) Fourier Transform
Utilize [time - frequency] transformation.

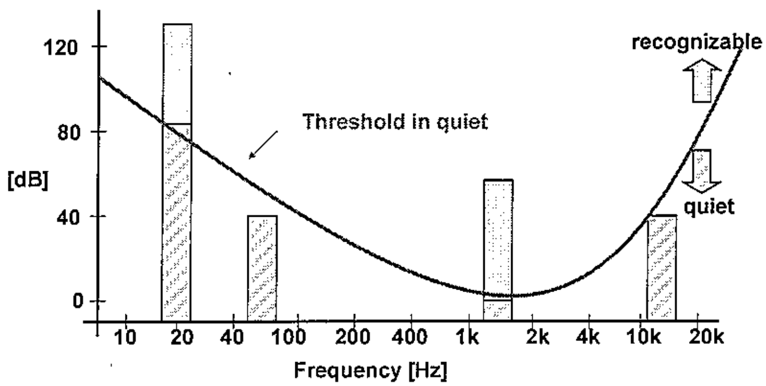
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

2



- Meaning: show the threshold in quite line and when recognizable and quite.

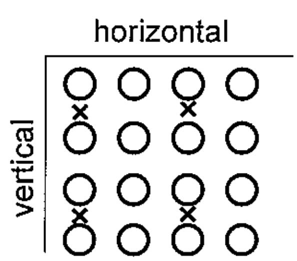
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] * 2160 [line/frame] * 8 * 2 · $\frac{1}{2}$]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	c	a) Probability theory technique
2) VLC	b	b) Time Domain technique
3) MC	a	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

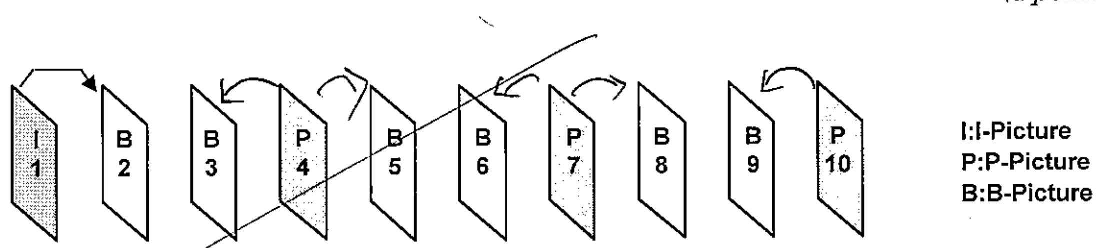
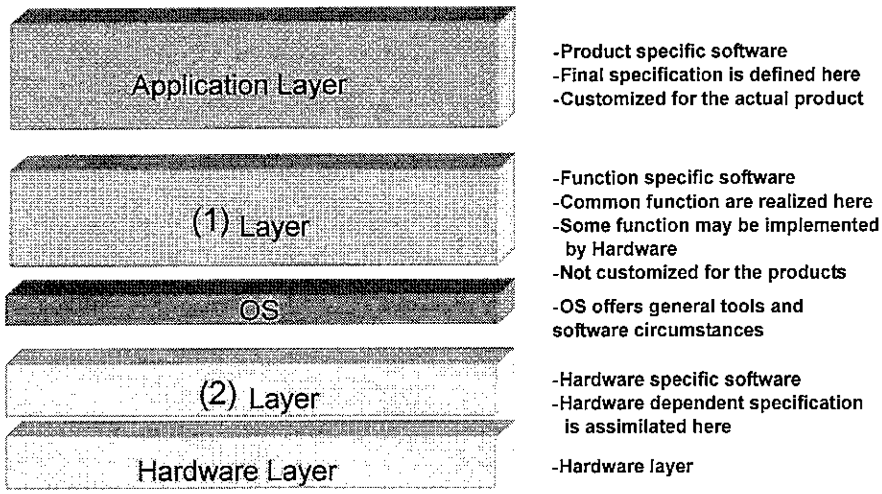


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Open MaxIL server as a low-level Interface for audio video

2 & Imaging codes used In embedded device. It give application

& media frame words the ablity to Interface En with

multimedia codes & supporting component In a Inified manner

8

ID code	2116
Name	Phan Van Viet.

52

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

- $f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

6

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow$ maximum frequency $f_M \leq \frac{f_s}{2} = \frac{48}{2} \Rightarrow f_M = 24kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= (48 \times 1000) \times 24 \times \cancel{2} =$ x

(c) Calculate the size of 60[min].

The size of $=$ bit rate $\times 60 \times 60 =$ [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Aliasing 18kHz~~ !

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

FFT

+ 2 multiplication

+

DFT.

+ 16 multiplication

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time Frequency] transformation.

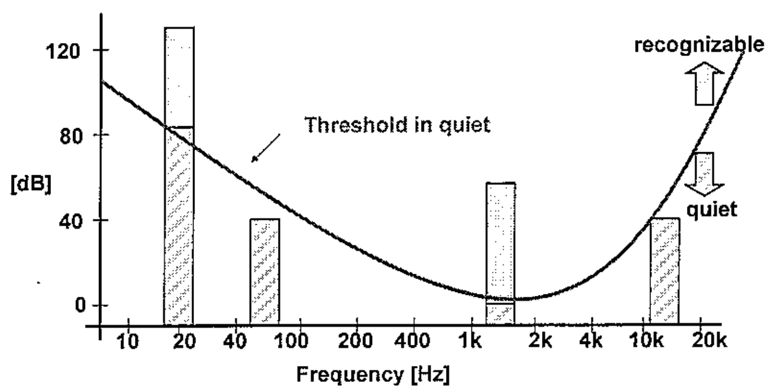
(2) Stereo Coding
Utilize the property of [condition] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

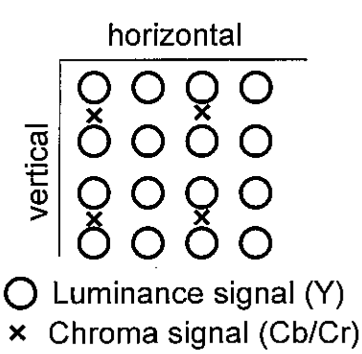
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

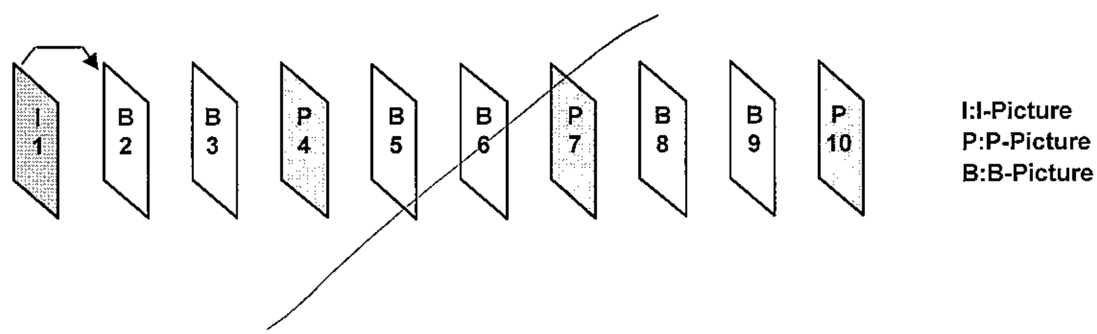
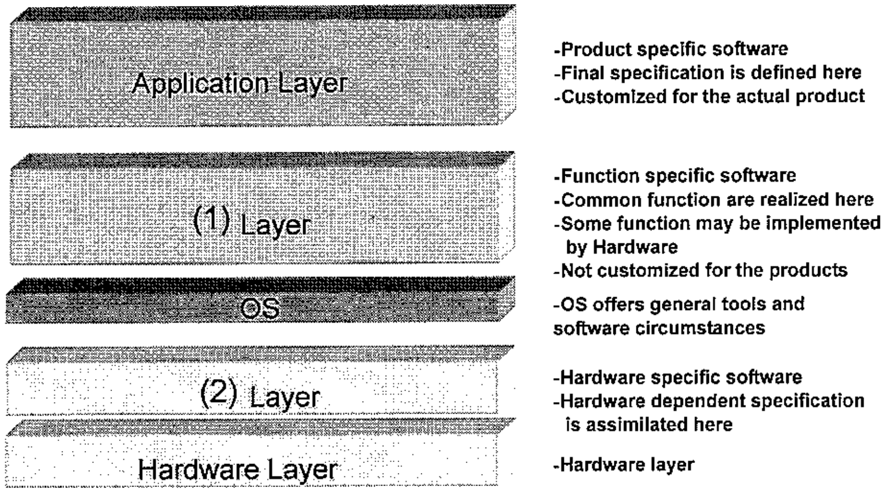


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

13

ID code	2117
Name	Nguyen Le Vinh

~~51.5~~

65.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1

1.1 How to prevent "Aliasing"? *(3 points)*

If $fs < 2fm$ aliasing signal appears

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off)

-4

(b) Signed Truncation

$-\cancel{4}$

(c) Rounding

$-\cancel{3}$

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~

16

(a) Calculate the maximum frequency CD can re-produce.

$fs \geq 2fm \rightarrow fm \leq fs/2$

$\Leftrightarrow fm \leq \frac{48}{2} = 24\ (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$Bitrate = fs * 24 * 6 = 48 * 1000 * 24 * 6\ [bit/sec] = ?$

(c) Calculate the size of 60[min].

$datasize = bitrate * (60 * 60) = 48 * 1000 * 24 * 6 * 60 * 60 = ?$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$Alias = 48 - 30 = 18\ kHz$

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple　　(b) Complex

(c) Good　　(e) good

(d) Poor　　(f) Poor

(g) poor　　(h) good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

00

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1.5

Band pass filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

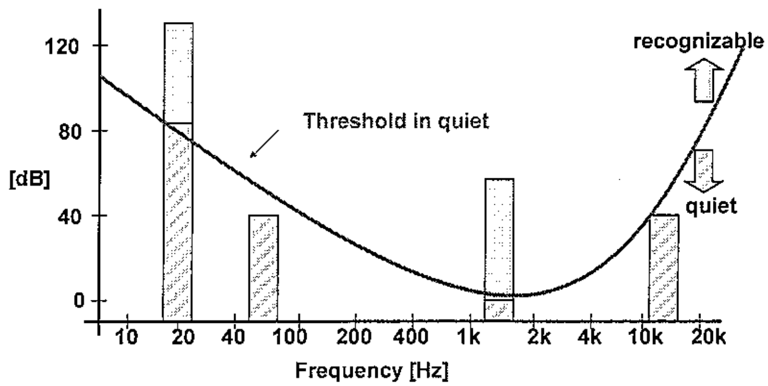
(1) Fourier Transform
Utilize [~~Utilifed the property~~ time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [~~Audio date~~ Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~time frequency~~ ~~(correlation/data appearance~~ data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

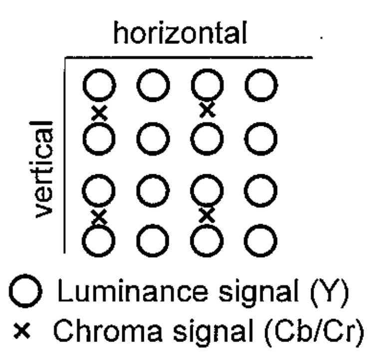
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8[bit] × 3
= 3840 × 2160 × 24 [bits/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 30 [frames/sec]]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160 [lines/frame] × 12[bits/frame] × 30[frames/sec]

= 3840 × 2160 × 12 × 30]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

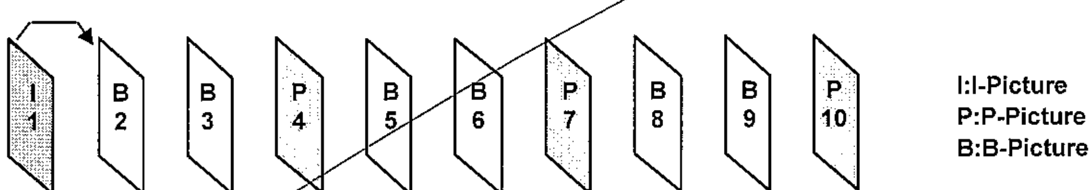
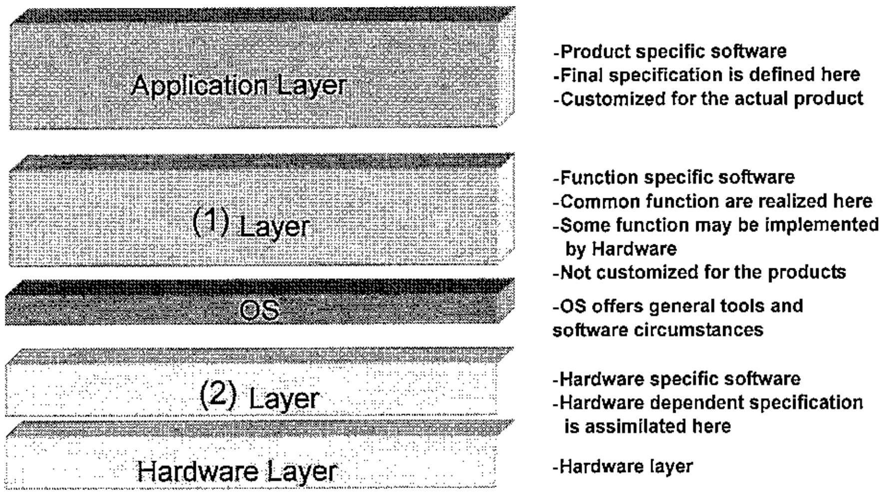


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

6

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

Advantage of openMaxIL

OpenMAX IL server as a low-level interface for audio video & Imazing voles used In embedded device. It give application media from words the ability to interface with multimedia codes & supporting components In a inified manners.

12

ID code	2118
Name	Huỳnh Văn Ý

~~43~~

57

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$f_s \geq 2 f_m$

f_s = Frequency Sampling

f_m = Frequency Nquist (of signal)

6 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding ~~-3.5~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq \frac{f_s}{2} = \frac{48k}{2} = 24\,kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= 48.1000.24.6$ bps

(c) Calculate the size of 60[min].

data size (60 min) = bitrate $\times 60 \times 60 = 48.1000.24.6.60^2$ (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias occurs $f_s < 2f$ 30 $48 < 30.2 \Rightarrow f_s < 2 f_m$~~

1.4 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex
(c) good (e) good
(d) ~~Difficult~~ (f) good
(g) poor (h) good

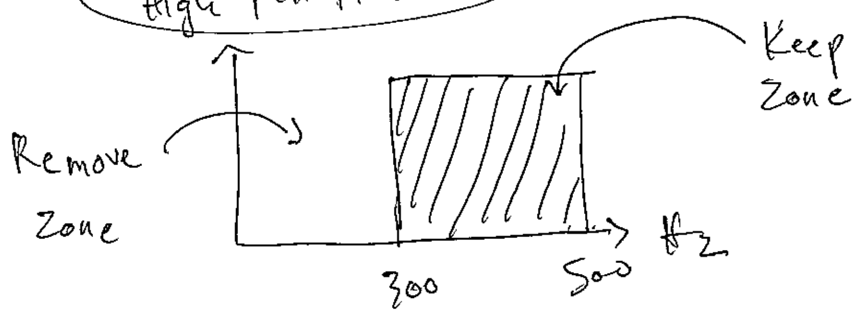
3 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT Use less than calculation DFT

	DFT	FFT
Mul	N^2	$\frac{N(\log_2 N - 1)}{2}$
Add	$N(N-1)$	$N \cdot \log_2 N$

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

High Pass Filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

07

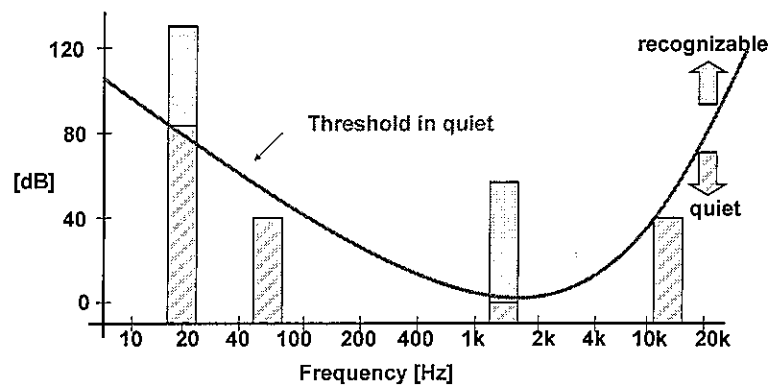
(1) Fourier Transform
Utilize [frequency] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)

1

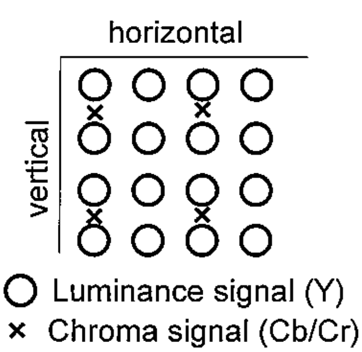


Meaning: It use to ~~cut out~~ remove signal which human ear can not recognize

Purpose: make down size to ~~lossy~~ lossy

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

16 x 3840 x 2160 (bit/frame)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$\frac{24}{2} \times 3840 \times 2160$ (bit/frame)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$\frac{24}{2} \times 3840 \times 2160 \times 30$ (bit/sec)]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$\frac{24}{2} \times 3840 \times 2160 \times 30 / 100 \times 10^6$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

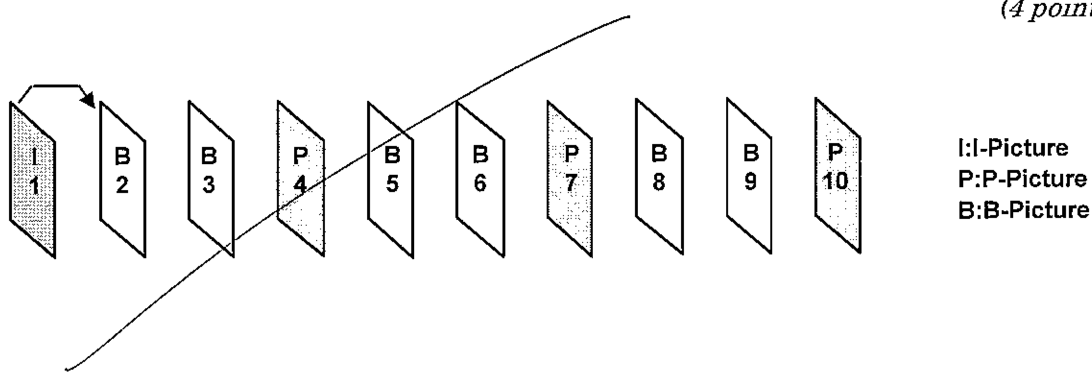
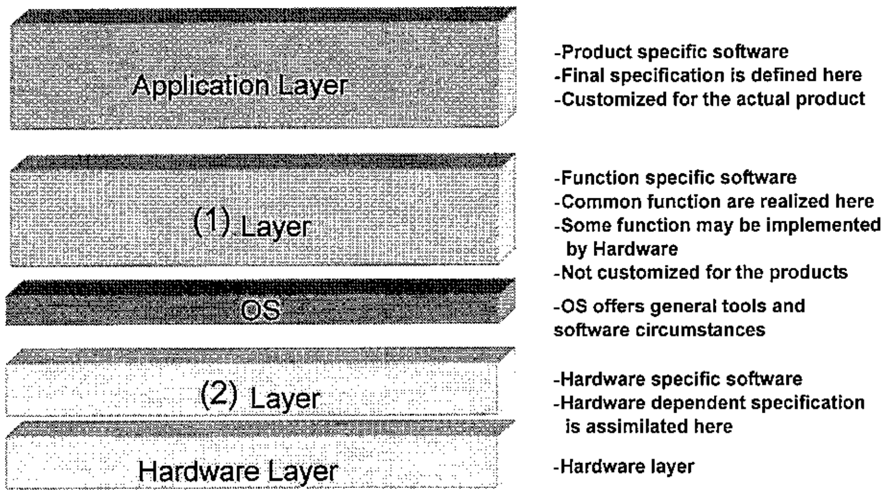


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

That middle layer of OpenMax: implement encoding, decoding of MP3, H264, MPEG... Support for fast develop application

0

19+3

ID code	2119
Name	Binh Vo

~~52~~

RVC "System Solution"

Examination

November 24, 2017

54

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

~~Prev~~ Applying sample frequence at least double ~~sign~~ signal frequence

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) -4

(b) Signed Truncation -~~4~~

(c) Rounding ~~-3~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$\frac{48}{2} = 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

24 . 1000 . 24 . 6 [X]

(c) Calculate the size of 60[min].

60 . 60 . bit rate [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias = 18 kHz~~ ?

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) ~~Good~~ Poor

(d) Poor (f) Good

(g) ~~Go~~ Poor (h) Good

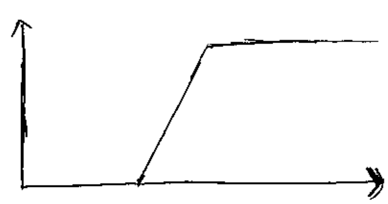
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

~~High-pass filter~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

07

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [ ] transformation.

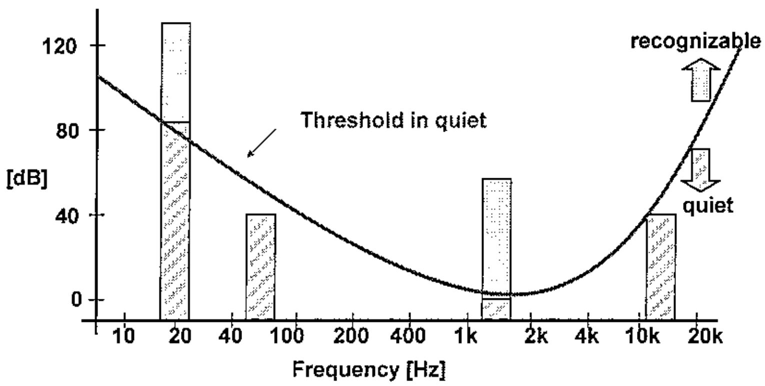
(2) Stereo Coding
Utilize the property of [losing data] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data length].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

4

(5 points)

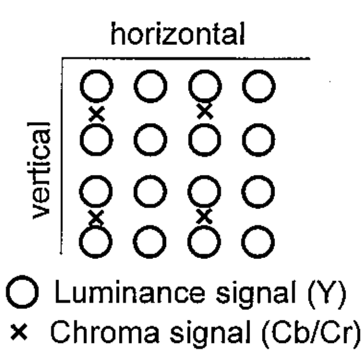


Normally, people can't recognize sound that lower than value of threshold in quiet
So then, in Audio Encoding, we can remove those audio signal to reduce ~~data~~ amount of data that need to be compressed.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [8 294 400 [pixels/frame] x 2 x 8 [bits]]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [8 294 400 [pixel/frame] * x ~~6~~ x 8 [bit]

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [total data volume of 1 UHD/4K Video data [bits] * x 30 [frame/sec]

6

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[~~data rate / (100 · 10^6)~~ data rate ~~[bit/sec]~~ [bps] / (100 · 10^6) [bps]]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

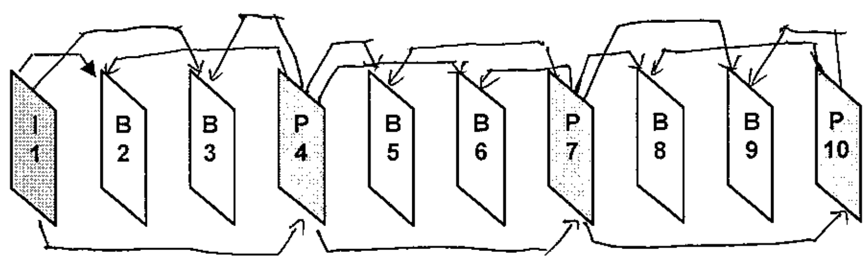
Ans.	1) DCT	a) Probability theory technique
6	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4



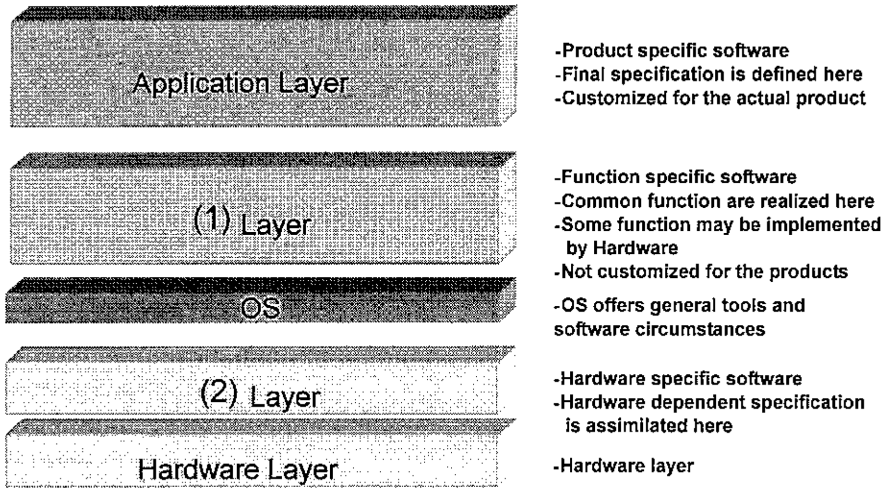
I:I-Picture
P:P-Picture
B:B-Picture

Figure 2.1. Prediction of MPEG1/2 Video coding

100.10^6

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

RGB : 12

15

ID code	2121
Name	Dang Thai Duy

~~42.5~~

54.5

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

~~Increase the sampling frequency.~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~4~~ 16

(a) Calculate the maximum frequency CD can re-produce.

48 / 2 (kHz) = ?

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 000 . 6 . 24 (bit/sec) = ?

(c) Calculate the size of 60[min].

48 000 . 6 . 24 . 60 . 60 / 8 (byte) = ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

There will be an alias frequency of (48 - 30) = 18 kHz

6

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (~~Poor~~ Good) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) ~~Poor~~ Difficult (h) ~~Good~~ ~~Easy~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5 The number of calculation of FFT is lower than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

We use High-pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

5

(1) Fourier Transform
Utilize [The time based tor frequency based] transformation.

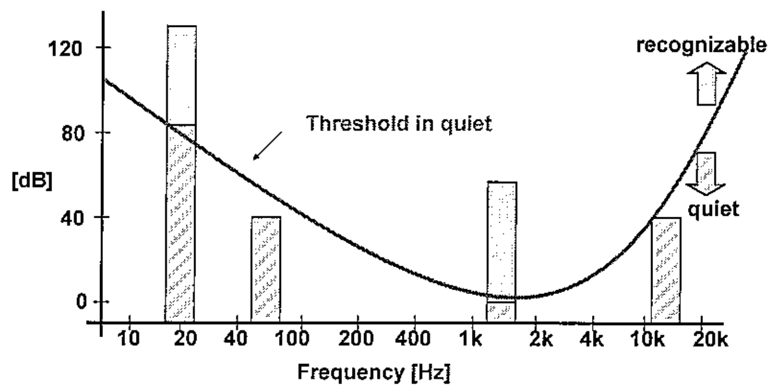
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

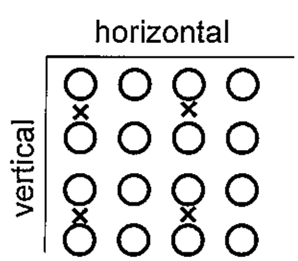
2



This is to remove the frequency that people ears can not hear in the audio data. This method is used to reduce the size of audio data.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (~~Cr~~ and Cb total)
Ans: [3840 [pixel/line] / 2 [Cr ratio] + 2160 [~~pixel~~ line/frame] / 2 [Cb ratio]
= [byte]
ditt ?]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixel/line] × 2160 [line/frame] × 8 [Y data] × 4 [Cr data] × 4 [Cb data] / 8 [bit/byte] = [byte]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [~~3840~~ [data volume] × 8 [bit/byte] × 30 [frame/sec] = [bit/sec]]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT ~~c~~ — a) Probability theory technique

2 2) VLC ~~b~~ — b) Time Domain technique

3) MC ~~a~~ — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

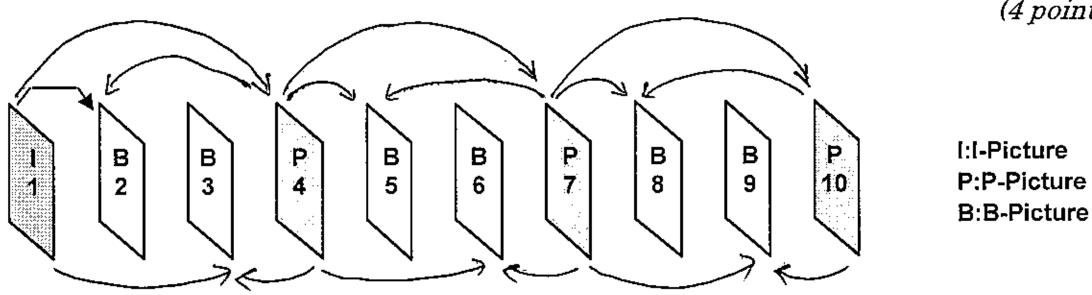
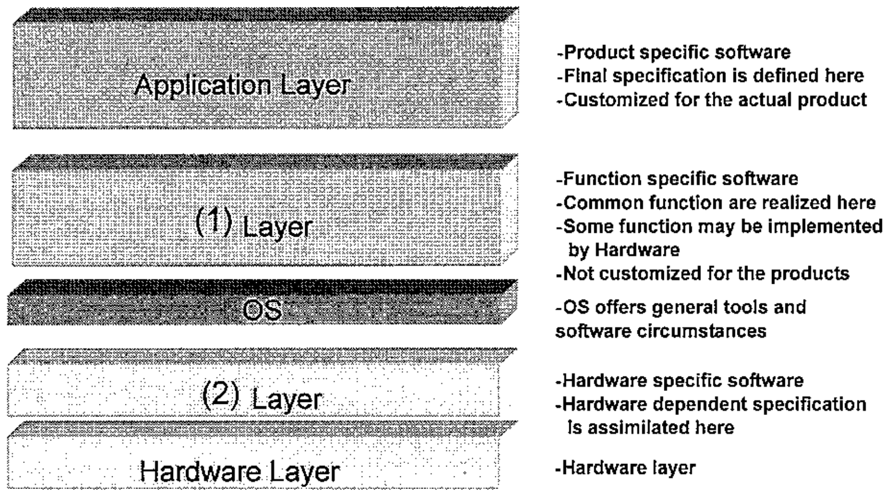


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

13 + 3

ID code	2122
Name	Chau Tri Dat

~~48~~

56

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$f_s \geq 2 f_m$.

The sampling frequency should be 2 times higher than signal bandwith (Nyquist frequency).

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 6

(a) Calculate the maximum frequency ~~CD can~~ re-produce.

~~$f_m = \frac{f_s}{6} = \frac{48}{6} = 8 kHz$.~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48 \times 1000 \times 24 \times 6$ [x]

(c) Calculate the size of 60[min].

$48 \cdot 1000 \times 24 \times 56 \times 60 \times 6$ [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

aliasing: $f_a = 48 - 30$. [x]

14

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (　　　)	(b) (　　　)
Cost	Reasonable	Expensive
Quality	(c) (　　　) : for original signal (d) (　　　) : for repeating copy & signal transfer	(e) (　　　) : for original signal (f) (　　　) : for repeating copy & signal transfer
Stability	(g) (　　　) : for time variant, etc	(h) (　　　) : for time variant, etc
Portability	Difficult	Easy

(a) Simple.　　　　(b) Complex

(c) ~~Poor~~　　　　(e) Good

(d) Poor　　　　(f) Good

(g) Poor.　　　　(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

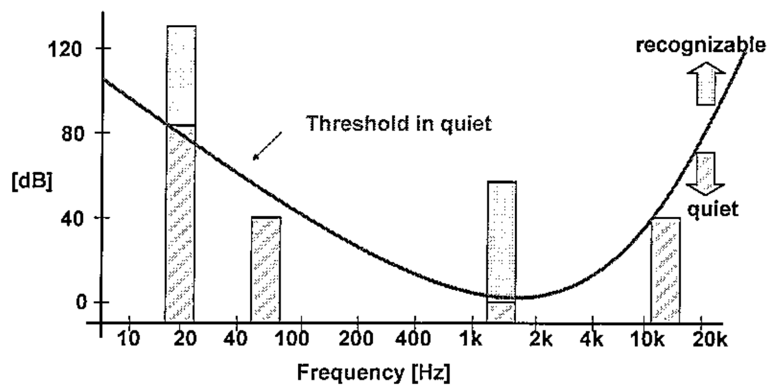
(1) Fourier Transform
Utilize [time frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation , [illegible]] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



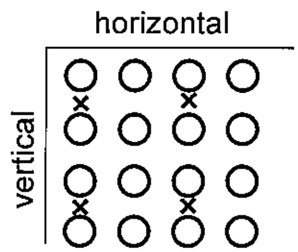
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] x 2160[pixels/frame] x ~~24~~ [bit/frame]
(24 x $\frac{1}{2}$ x
= [bits/frame]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840[pixels/line] × 2160[pixels/frame] × 24 × $\frac{1}{2}$ [bit/frame]]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/line] × 2160[pixels/frame] × 24 × $\frac{1}{2}$ [bit/frame] × 30[frames/s]

= [bits/s]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ~~ratio?~~ (1 Mb = 10^6 bit)

Ans: [(3840 [pixels/line] × 2160[pixels/frame] × 24 × $\frac{1}{2}$ [bit/frame] × 30[frames/s]) : 10^8]

=

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.

1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

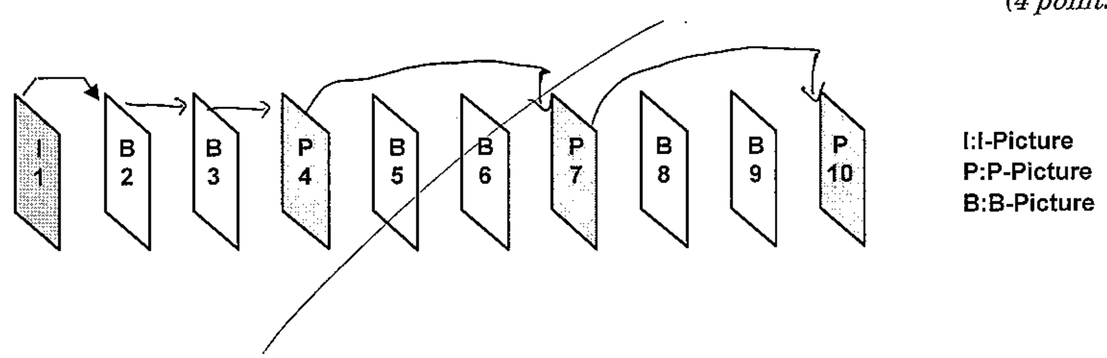
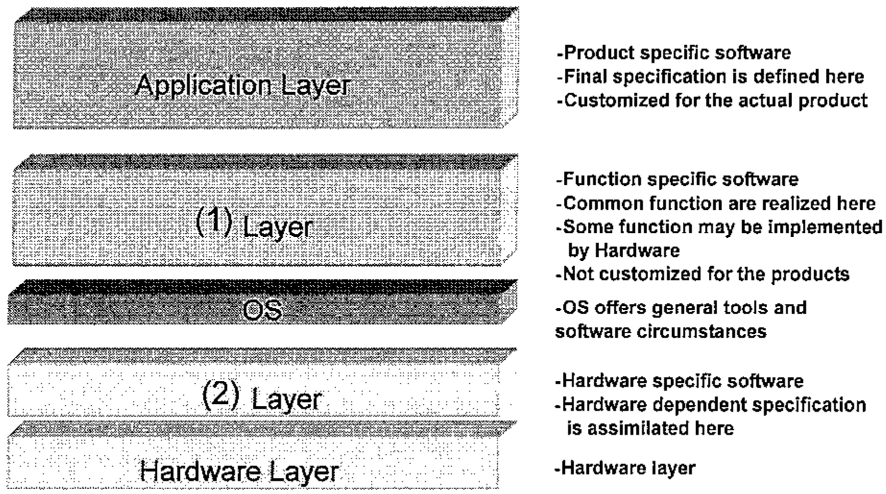


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a)~~ API b) Middleware c) RTL d) Driver

3

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Open Max IL server as low level interface for audio, video, imaging lookes used in embedded devices.

2 It gives ~~a~~ application & media frameworks the ability to interface with multimedia clockes & supperting unsign maners.

3

ID code	2124.
Name	Nguyen Le Minh Duc .

~~10~~

12

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

- ~~Increase resolution.~~
- ~~Reduce sampling time.~~
- ~~Increase compression bitrate.~~

3

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

-3

(c) Rounding

~~-3.~~

~~0~~ 0

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD. (Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

(a) Calculate the maximum frequency CD can re-produce.

~~9600 kHz.~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~6,912 Mbps.~~

(c) Calculate the size of 60[min].

~~6,912 x 60 x 60 = 24883,2 Mb. [Mb]~~

(d) Suppose an analog signal which has 30kHz component. What will happen to the digitalized signal sampled by 48kHz?

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Complex~~ (b) ~~Simple~~.

(c) Good. (e) ~~poor~~.

(d) Difficult. (f) ~~Easy~~.

(g) poor (h) good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

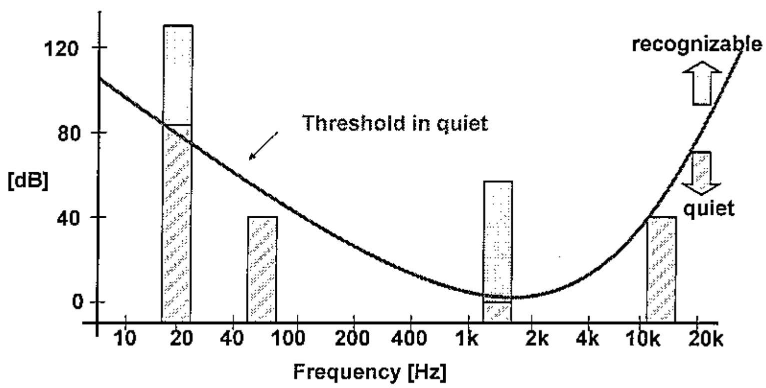
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

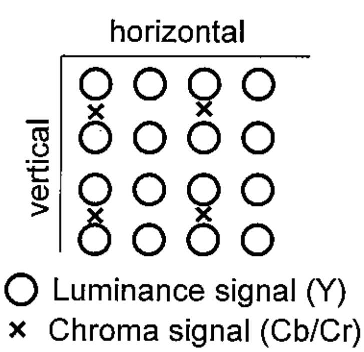
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	a) Probability theory technique
2) VLC	b) Time Domain technique
3) MC	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

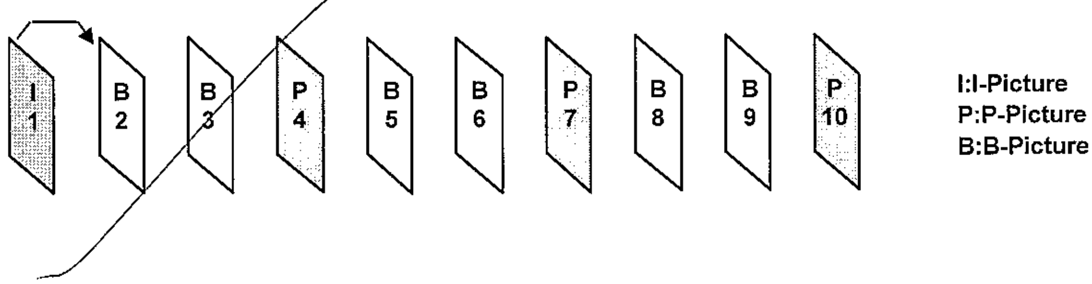
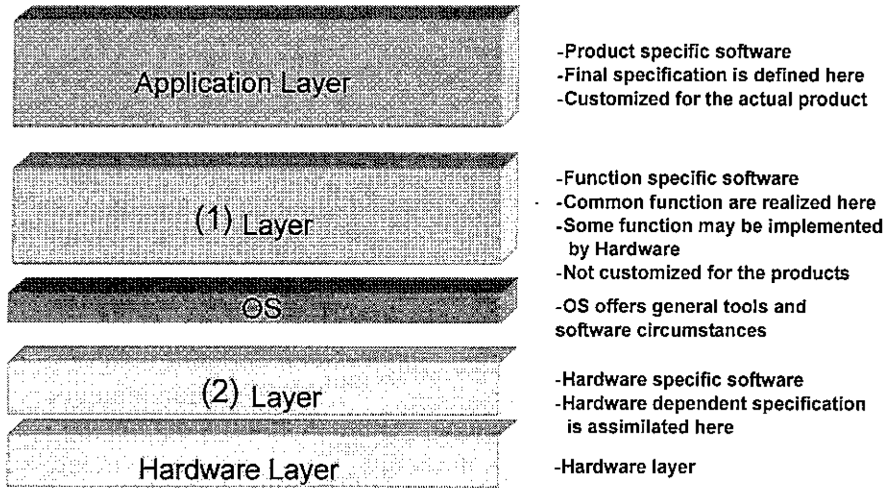


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a) API~~ b) Middleware c) RTL d) Driver

3

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

5

ID code	2125
Name	Tran Anh Duc

~~39~~

49

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sampling frequency should be 2 times higher than the signal brandwith (Nyquist frequency)

6 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -3

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~0~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48 \times 10^3}{2}$ [?]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48 \times 10^3 \times 24 \times 6$ [ ]

(c) Calculate the size of 60[min].

$48 \times 10^3 \times 24 \times 60 \times 60 \times 6$ [ ]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_a = 48kHz - 30kHz$

10 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (complex)	(b) (simple)
Cost	Reasonable	Expensive
Quality	(c) (good) : for original signal (d) (poor) : for repeating copy & signal transfer	(e) (poor) : for original signal (f) (good) : for repeating copy & signal transfer
Stability	(g) (good) : for time variant, etc	(h) (poor) : for time variant, etc
Portability	Difficult	Easy

(a) complex

(b) simple

(c) good

(e) ~~poor~~

(d) poor

(f) good

(g) ~~good~~

(h) ~~poor~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

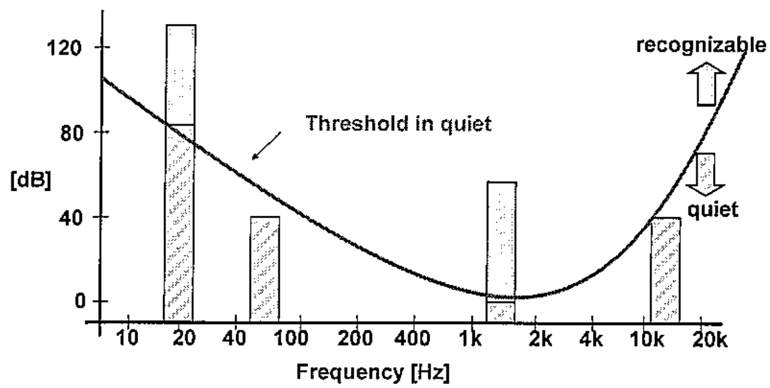
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



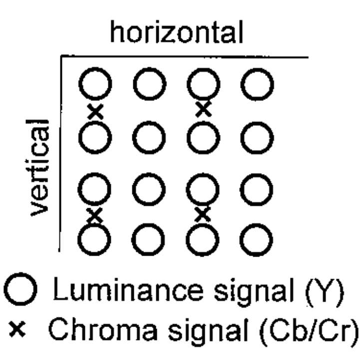
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

~~4×4~~ 3840 × 2160 /2

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [[(3840 × 2160)/4) × 8]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 x 2160 x 8]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 x 2160 x 8 x30]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT b a) Probability theory technique

2) VLC a b) Time Domain technique

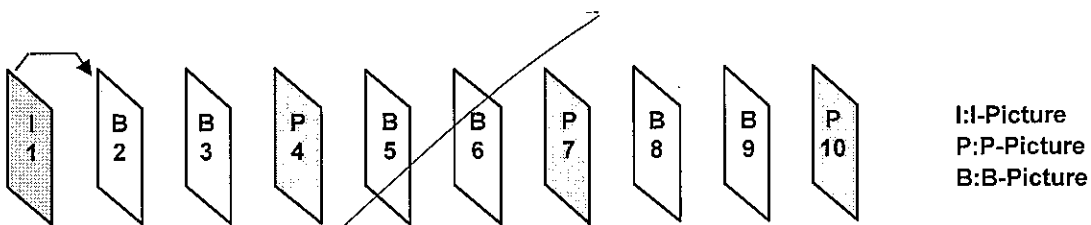
2

3) MC c c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

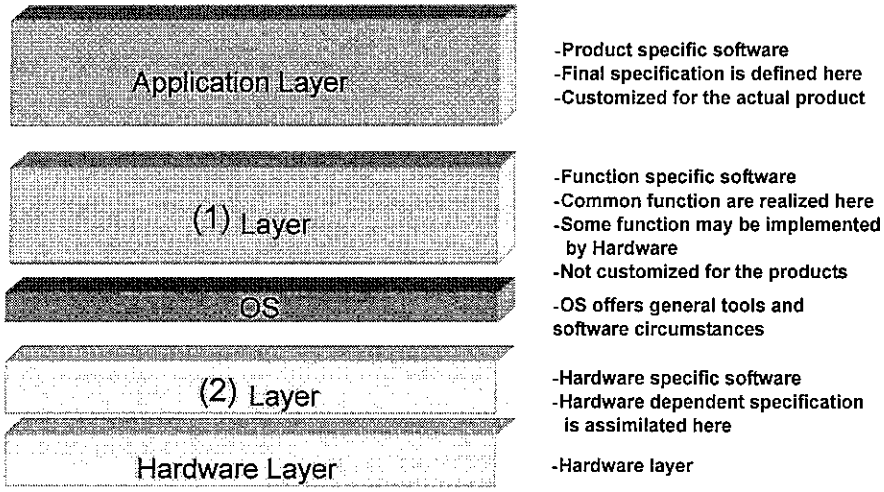


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

3

ID code	2126
Name	Vo Tri Duc

~~15~~ 19

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 We should use the signal sample as value:

~~fs~~ ~~fs~~ $f_s \geq 2f$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) : -3

(b) Signed Truncation : -4

(c) Rounding :

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$= f_s/2 = 48\,kHz/2 = 24\,kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$= \cancel{24\,kHz}$ or $24\,bit \times 24\,kHz \times 6$ [x]

(c) Calculate the size of 60[min].

[x]

$= bitrate \times 60 \times 60 = 24 \times 24 \times 6 \times 60 \times 60$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

→ ~~Aliasing~~ x

4 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) ~~Simple~~

(e) ~~Complex~~

(d) ~~Difficult~~ ~~Easy~~

(f) ~~Easy~~ ~~Difficult~~

(g) Poor ~~Good~~

(h) ~~Good~~ Poor

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

→ High-pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

00

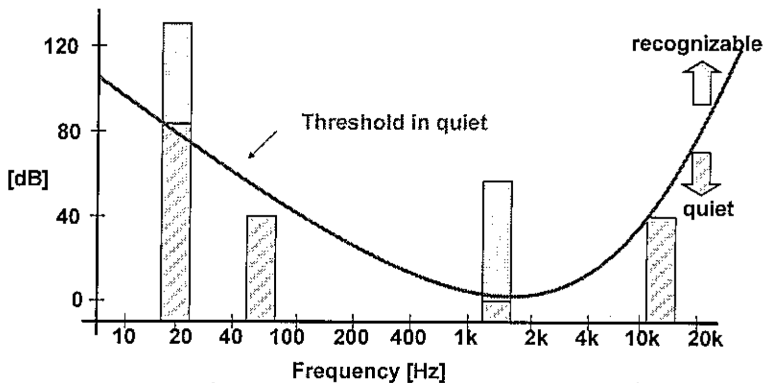
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
1 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

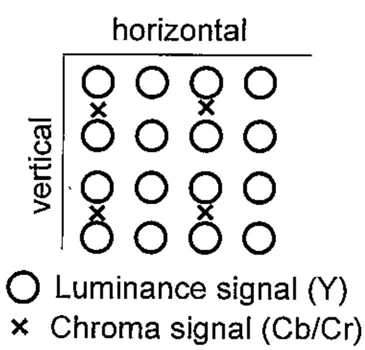


Pull down the "threshhold in quiet" from ~~200Hz~~ on 200Hz ~~to~~ 20kHz, so human can recognize sound easily.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])
= 38

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

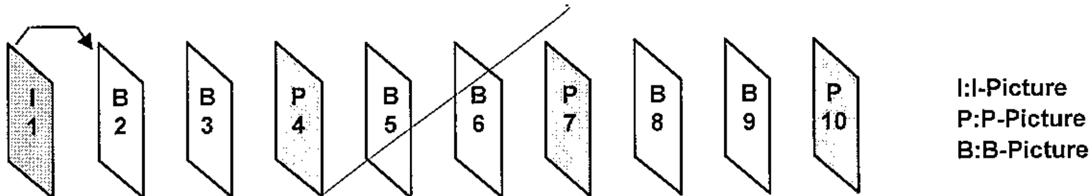
3) MC — c) Frequency domain technique

0

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

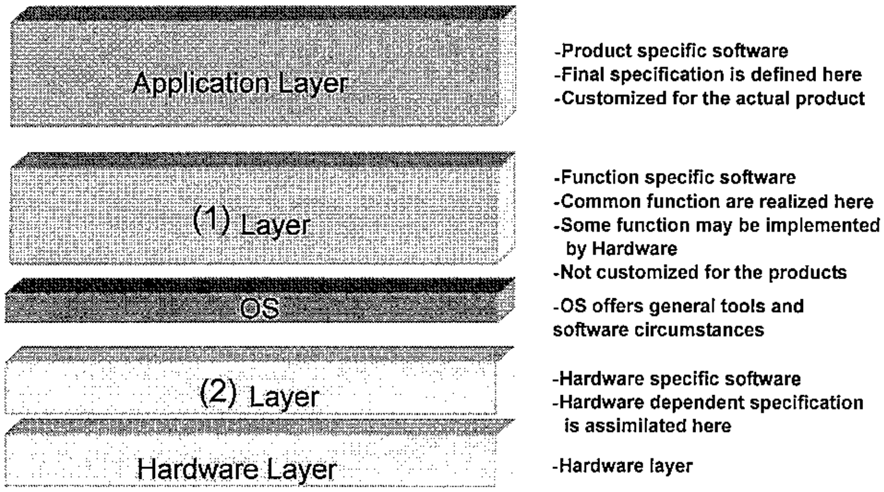


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a) API~~ b) Middleware c) RTL d) Driver

3

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

ID code	2128
Name	Văn Quang Thanh Thảo

15

64

81

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

To prevent "Aliasing" you must follow up below equation.:

$f_s \geq 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

8

12

(a) Calculate the maximum frequency CD can re-produce.

$f_m = f_s/2 = \frac{48\,kHz}{2} = 24(kHz)$ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate $= (48 \times 1000) * 24 * 6 =$ [X]

(c) Calculate the size of 60[min].

data size $=$ bit rate $* (60 \times 60)$ [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

→ Alias $= 48\,kHz - 30\,kHz = 18\,kHz$ ✓

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (~~Complex~~)	(b) (~~Simple~~)
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) Complex
(c) ~~Complex~~
(e) Good
(d) poor
(f) Good.
(g) poor
(h) Good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

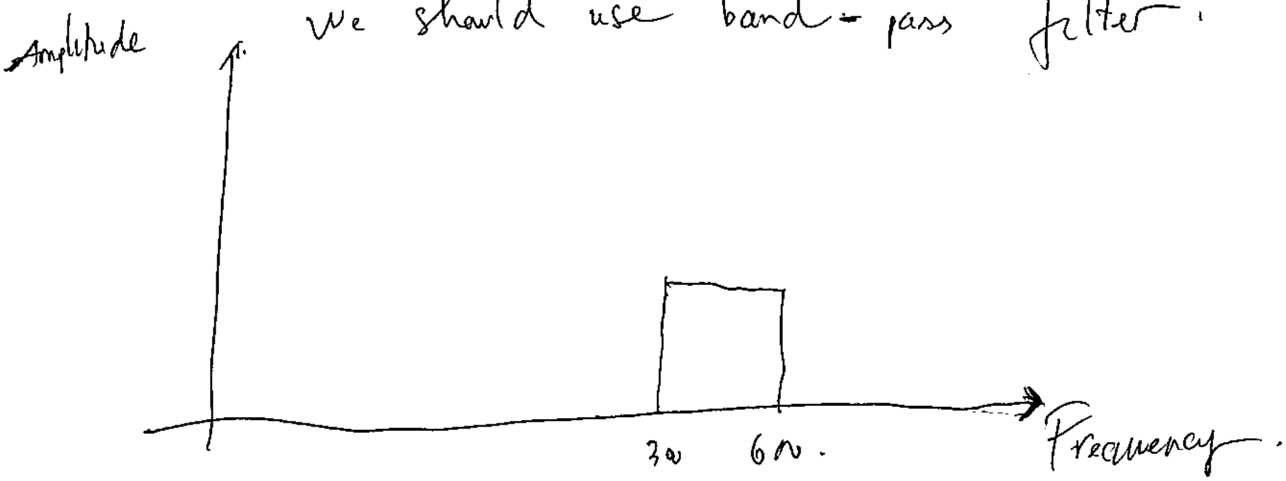
0

FFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

We should use band-pass filter.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

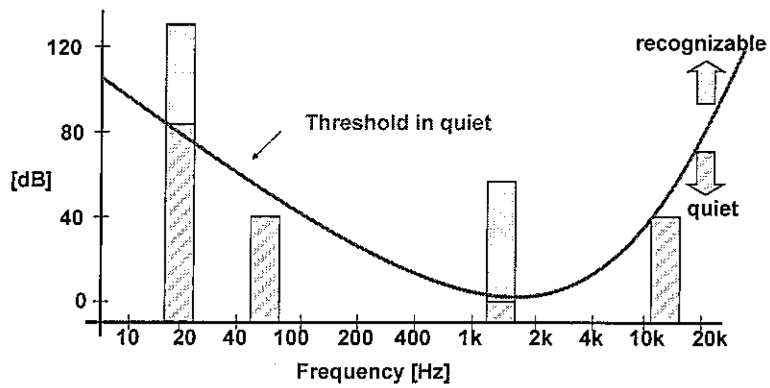
(1) Fourier Transform
Utilize [Time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation between left and right channel] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance.].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



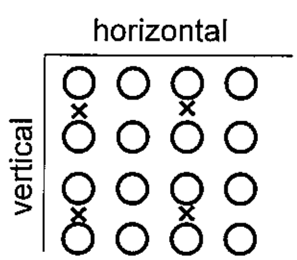
It supplies the audio more smooth

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



O Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] × 2160[lines/frame] × 8[bit] × 1/2]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \cdot \times 8 \cdot \times \frac{3}{2}$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/lines] × 2160 [lin/frame] × 8 × 30 × $\frac{3}{2}$]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is ~~the~~ compression ratio? (1 Mb = 10^6 bit)

Ans:[3840 [pixels/lines] × 2160 × ~~1080~~ [line/frame] ÷ 100 [Mbps]]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

2

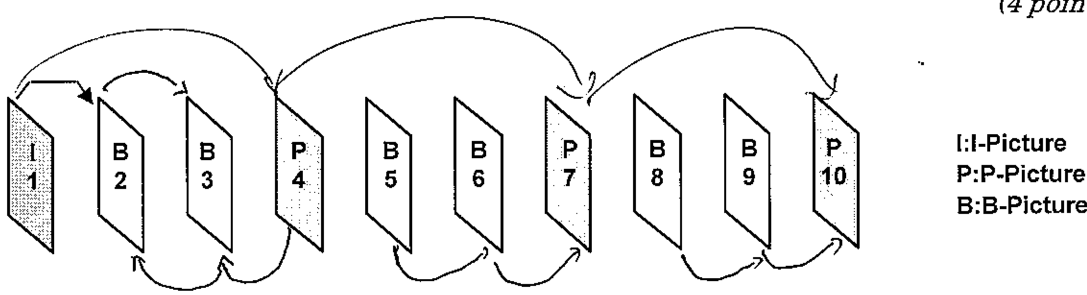
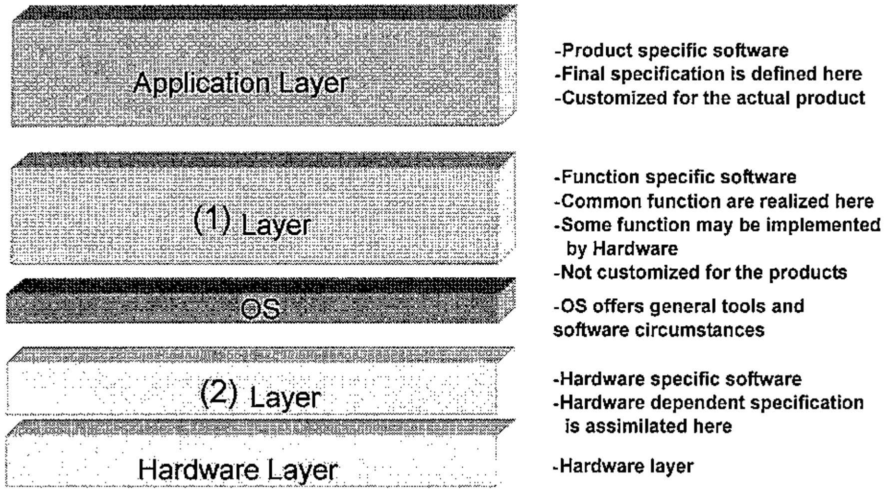


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

give application and media framework to ~~intel~~ interface with multimedia codecs and support components

OpenMax serves as a low level interface for audio, ~~and~~ ~~and~~ videos and imaging codecs used in embedded devices

20

ID code	2129
Name	Huynh Duc Huen

~~12~~

28

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Follow the Sampling theory, use the sampling frequency with condition:

$f_{sampling} \geqslant 2 f_{signal}$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) : - 4

(b) Signed Truncation : - 3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 12

(a) Calculate the maximum frequency CD can re-produce.

Sampling theory: $f_{sampling} \geqslant 2 f_{signal} \Rightarrow f_{signal} \leqslant f_{sampling}/2$

$\Rightarrow$ Maximum frequency CD = $f_{signal\,max}$ = $f_{sampling}/2$ = 48(kHz)/2 = 24 kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate = f . 24 . 6 = 48 (kHz) . 24 (bit) . 6 (channels) = 48.24.6 (bit/sec)

X

(c) Calculate the size of 60[min].

The size of 60(min) = 60 ~~bit rate = 60. 48. 24. 6 (bit)~~ X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Because $f_{signal} > f_{sampling}/2$

$\rightarrow$ Aliasing occurs in (48 − 30) = 18kHz X

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

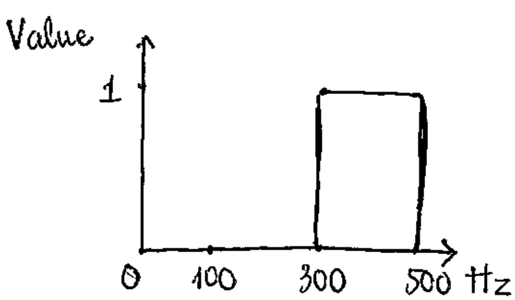
(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 You can do the process of FFT faster than with DFT.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We should use high pass filter to remove the components whose frequency below 300Hz.



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

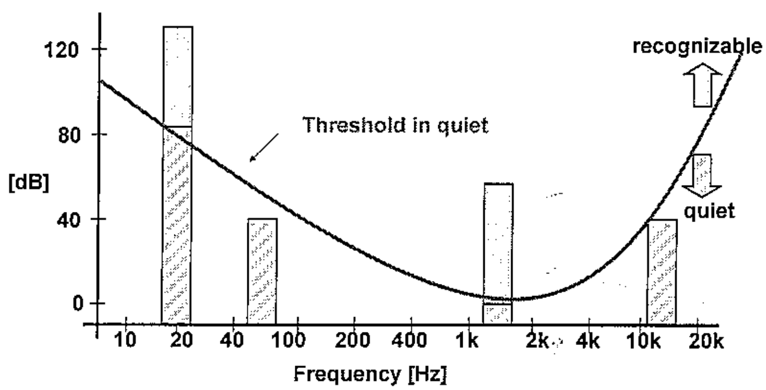
(1) Fourier Transform
Utilize [Time – Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



With each frequency, we have the dB threshold in quiet.
If the value (dB) is greater than the threshold, we can recognize the sound and if the value (dB) is ~~less~~ smaller than the threshold, we can not recognize the sound normally.
The threshold in quiet seperates the sound into 2 areas: one is ~~hearable~~ recognizable and another is ~~unheara~~ irrecognizable.

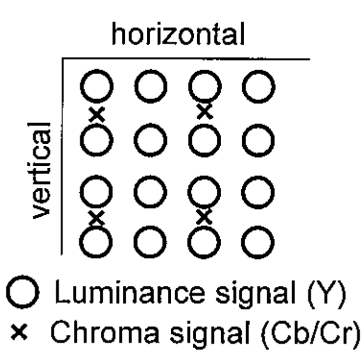
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

4 × 8,294,400

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [2 × 8,294,400 × 2]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [8294400 (pixels/frame)×(4+2) × 2]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 (pixels/line) × 2160 (lines/f) × 30 (frames) × 12]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans: [The ratio = Total data rate of UHD / ~~4K Vide~~ / (100.10^6)]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT → a) Probability theory technique

2) VLC → b) Time Domain technique

3) MC → c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

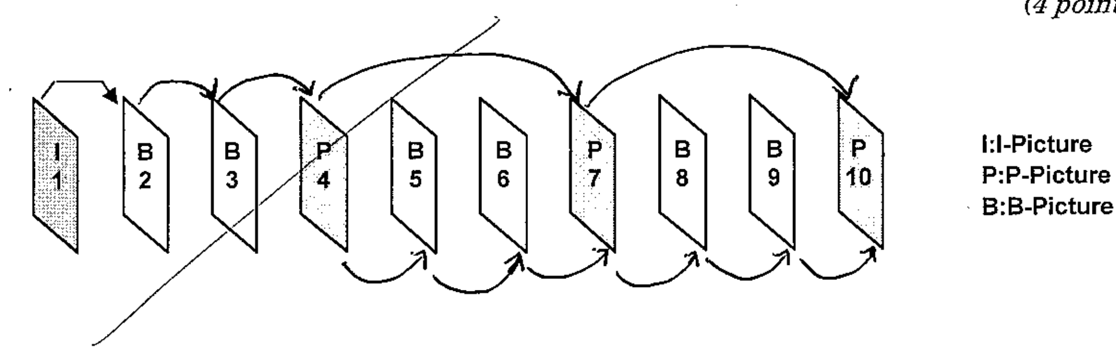
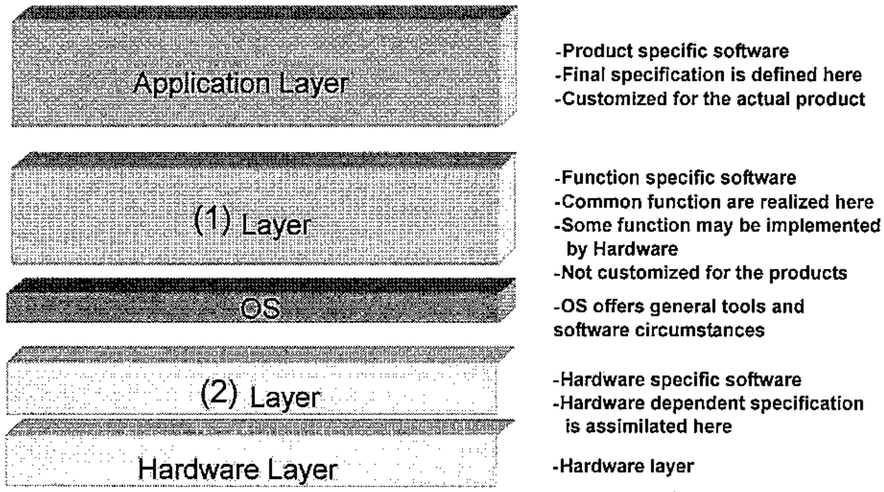


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Openmax is a royalty-free, cross-platform set of C language programming interfaces that provides abstractions for routines especially useful for audio, video and still images.

2

It gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unified manner.

6

ID code	2130
Name	Phan Hoàng Hiếu

~~48~~

52

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

0

1.1 How to prevent "Aliasing"? *(3 points)*

9

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

~~8~~ 6

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 * f_{max} \rightarrow$ ~~$f_{max} = f_s / 2 = 48 / 2 = 24$ kHz.~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate = (48 x1000) x 24 x 6 = ~~2304 x10~~^{3} (bit/sec)

(c) Calculate the size of 60[min].

Data size = Bitrate * 60 x 60 ÷

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias 18 kHz

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) ~~Poor~~

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

2

FFT	DFT
2 multiplication	16 multiplication
8 addition	12 addition

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

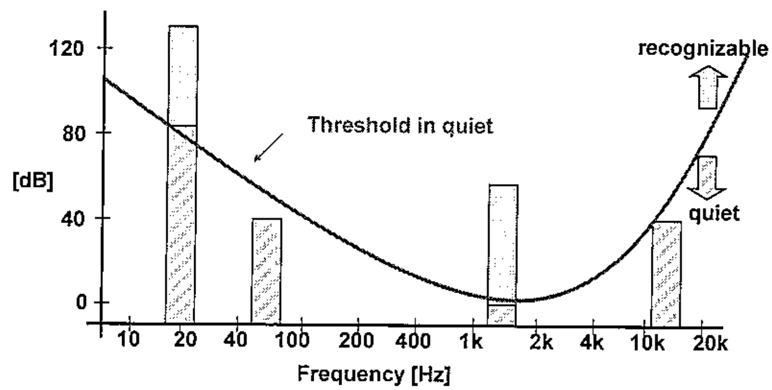
(1) Fourier Transform
Utilize [time - frequency)] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperrance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

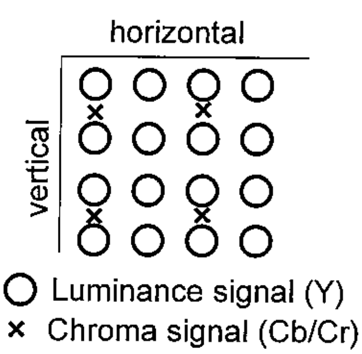
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])
3840 x 2160 (pixels /frame)

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 x 2160 x 8 x 2 x $\frac{1}{2}$ [bit / frame]

]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \times 8 \times \frac{3}{2}$ (bit / frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$(3840 \times 2160 \times 8 \times \frac{3}{2}) \times 30$ [bps]]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0 Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

0 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

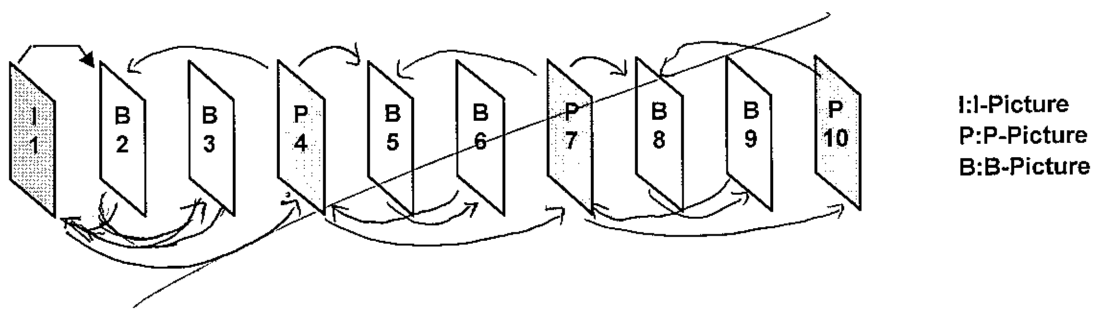
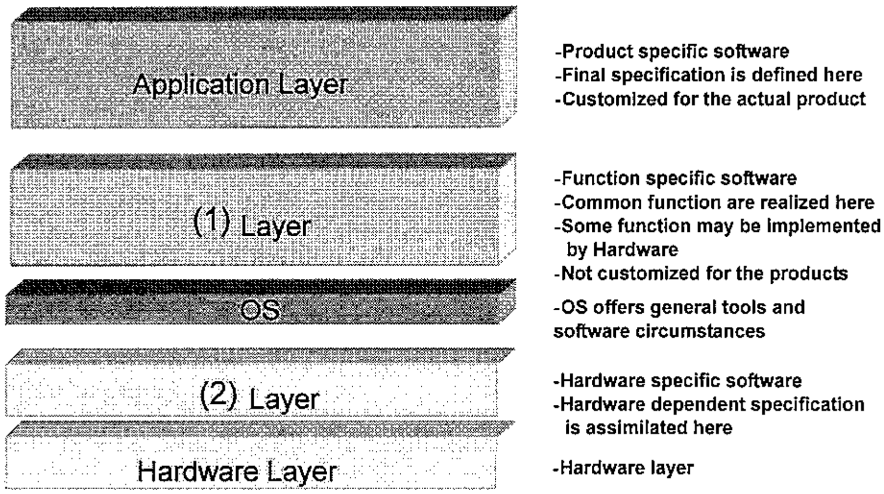


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

8

ID code	2131
Name	DƯƠNG QUỐC HOÀNG

~~50~~

58

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~4~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2f_m \rightarrow f_m \leq 48/2 = 24$ kHz ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= 48 \times 24 \times 6 \times 1000$ Hz [x]

(c) Calculate the size of 60[min].

Data size $= 48 \times 24 \times 6 \times 1000 \times 60 \times 60$ [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Cause alias ~~12 kHz~~ x

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple   (b) Complex

(c) Good   (e) Good

(d) Poor   (f) ~~Good~~ Poor

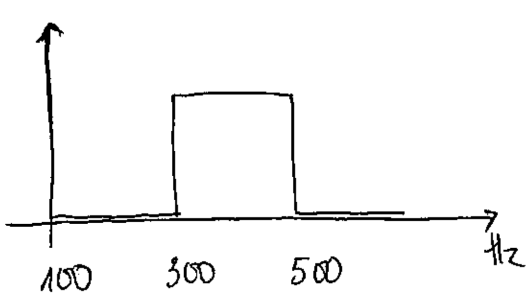
(g) Poor   (h) Good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

we should use Band Pass Filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

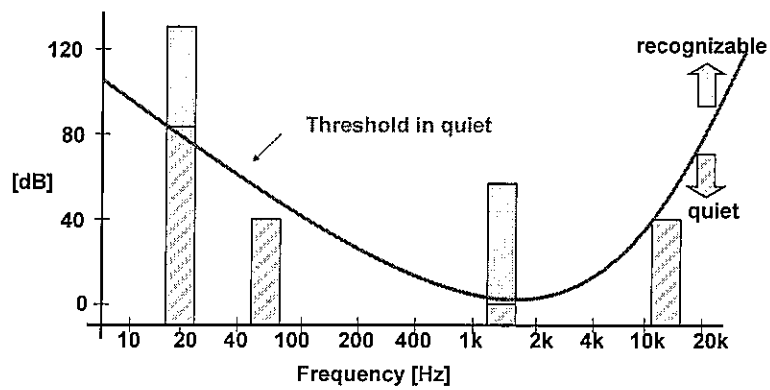
(1) Fourier Transform
Utilize [Time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance .].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



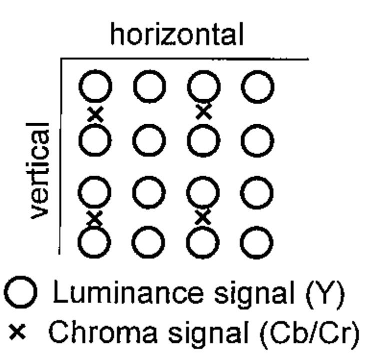
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840x2160x 8x3x 1/2~~]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

$3840 \times 2160 \times 8 \times 3 \times 1/2$ [bit/frame]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

$3840 \times 2160 \times 8 \times 3 \times 1/2 \times 30$ [bps]]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT b — a) Probability theory technique

0

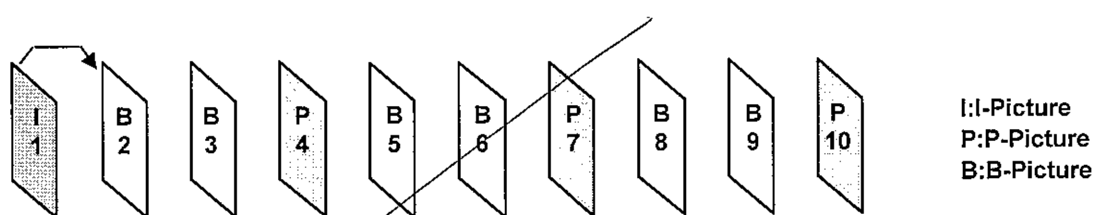
2) VLC c — b) Time Domain technique

3) MC a — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

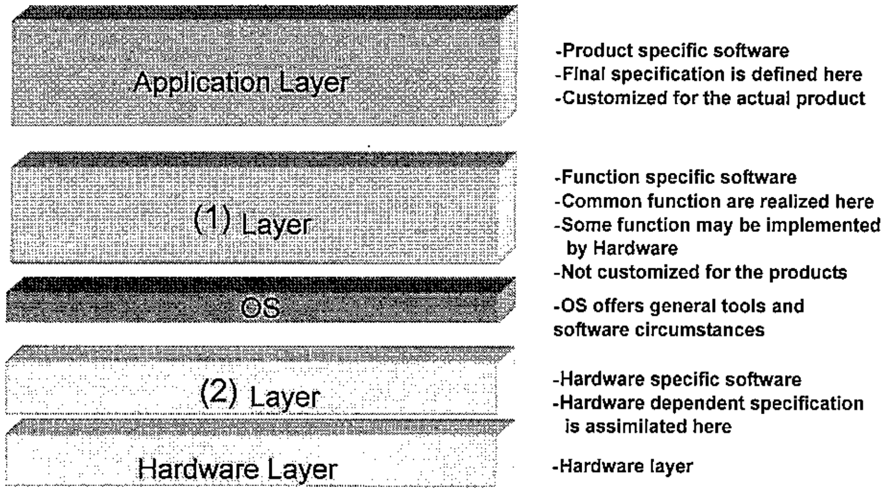


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

0

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

Give application and media for framework the ~~app~~ ability to interface with

2 Multimedia codecs. and supporting components in a unfield manner.

9

ID code	2132
Name	Nguyen. Van Hoang

33

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

(c) Calculate the size of 60[min].

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (　　　)	(b) (　　　)
Cost	Reasonable	Expensive
Quality	(c) (　　　) : for original signal (d) (　　　) : for repeating copy & signal transfer	(e) (　　　) : for original signal (f) (　　　) : for repeating copy & signal transfer
Stability	(g) (　　　) : for time variant, etc	(h) (　　　) : for time variant, etc
Portability	Difficult	Easy

(a) Simple　　　　(b) complex

(c) ~~bad~~ Poor　　　　(e) Good

(d) ~~bad~~ Poor　　　　(f) Good

(g) Poor　　　　(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

10

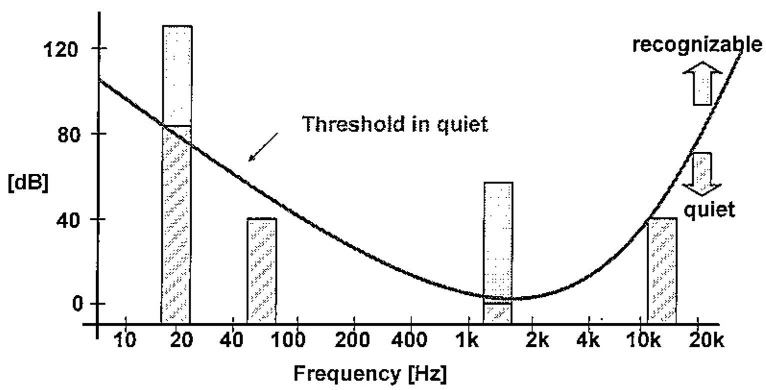
(1) Fourier Transform
Utilize [Freq transformation.] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data apperance.].

2.2 Following figure shows a Psych-acoustic model.
07 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

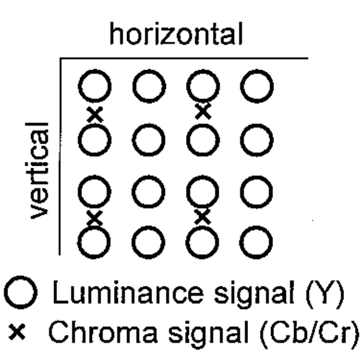
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique — 1 – c

2) VLC — b) Time Domain technique — 2 – a

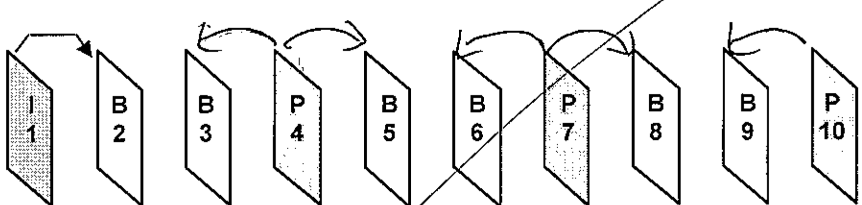
6

3) MC — c) Frequency domain technique — 3 – b

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)



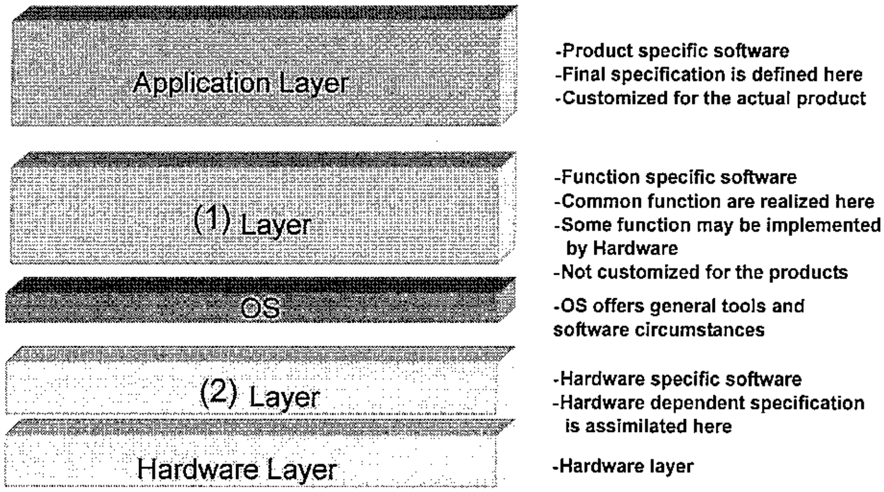
I:I-Picture
P:P-Picture
B:B-Picture

0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

3

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2133
Name	Thịnh Quang Hưng

~~48~~

12

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampling frequency should be 2 times higher than the signal brandwidth (Nyquist frequency)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48kHz}{2} = 24\ kHz$ ✓

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48 . 1000 . 24 . 6 [x]

(c) Calculate the size of 60[min].

48 . 1000 . 24 . 6 . 60 . 60 [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_m = \frac{f_s}{2} = \frac{48kHz}{2} = 24kHz$

→ Aliasing occurs.

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Complex)	(b) (Simple)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Good) : for repeating copy & signal transfer	(e) (poor) : for original signal (f) (poor) : for repeating copy & signal transfer
Stability	(g) (Good) : for time variant, etc	(h) (poor) : for time variant, etc
Portability	Difficult	Easy

(a) Complex

(b) ~~Simple~~

(c) Good

(e) ~~poor~~

(d) ~~Good~~

(f) ~~poor~~

(g) ~~Good~~

(h) poor

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

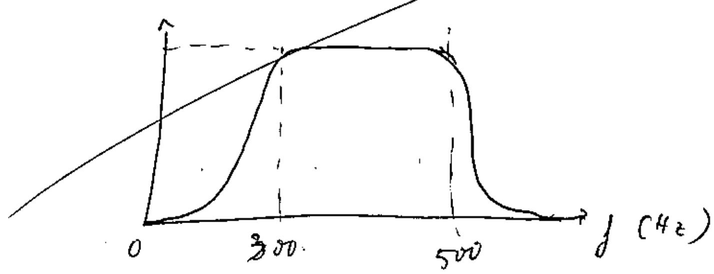
1

	DFT	FFT
Multiplex	N^2	$N(\log_2 N - 1)$
ADD	$N(N-1)$	$N \cdot \log_2 N$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

High pass Filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

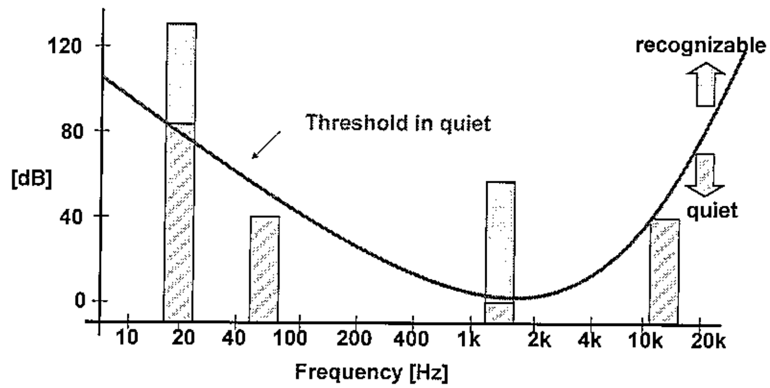
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance.].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

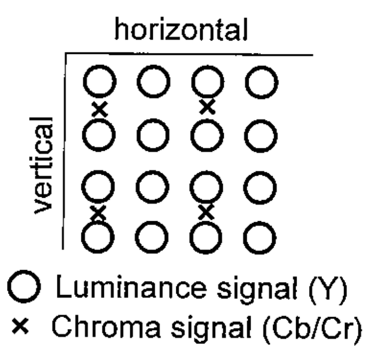
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixels/line] × 2160 [lines/frame] · 24 [bit/frame] · 30 [frame/s]]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]
(4 points)

0

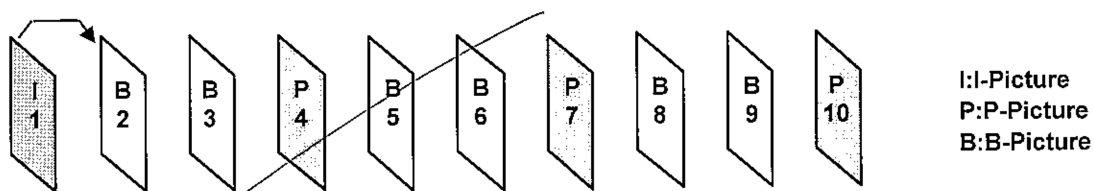
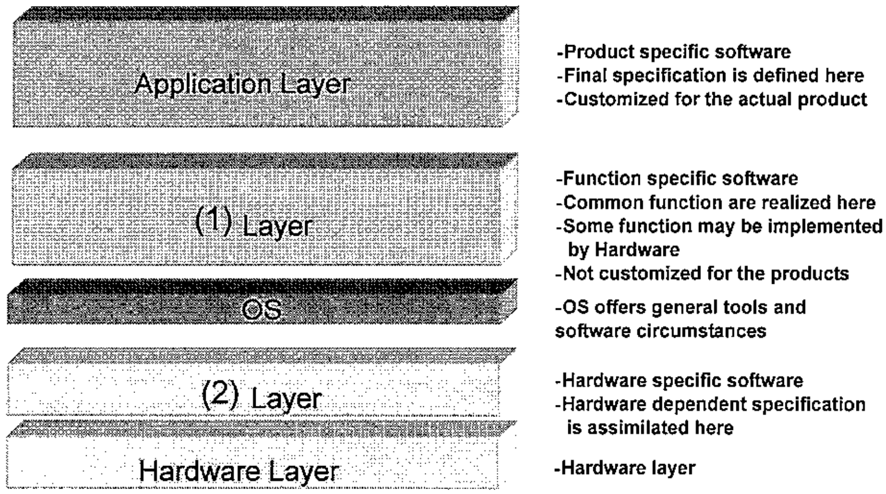


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- Serve as low level interface for audio, video, ... used in embedded devices.

0

- Give the applications and frameworks the ability to interface lower layer.

16+3

ID code	2135
Name	Hoang Viet Khanh

RVC "System Solution"

Examination

November 24, 2017

~~30~~ 32

1. Digital Signal Processing

0 1.1 How to prevent "Aliasing"? *(3 points)*

9 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

~~10~~ 2 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

~~6.48.10³.24.~~ ~~2.48.10³.~~ = ?

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~2.48.10³.24.6.~~ = ?

(c) Calculate the size of 60[min].

$2.48.10^3.24.6.60.60.$ = ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing. ?

2

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Simple~~ ~~complex~~ (b) ~~Complex~~ ~~Simple~~.

(c) good (e) ~~poor~~

(d) ~~difficult~~ (f) ~~easy~~

(g) Expensive (h) ~~Reasonable~~.

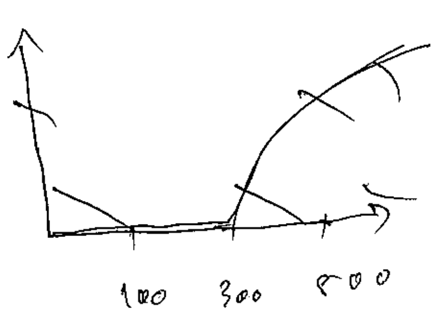
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

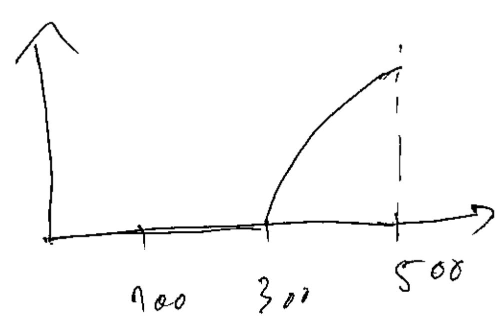
0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

high-pass filter.





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

0

(1) Fourier Transform
Utilize [Discrete Cosine Transform.] transformation.

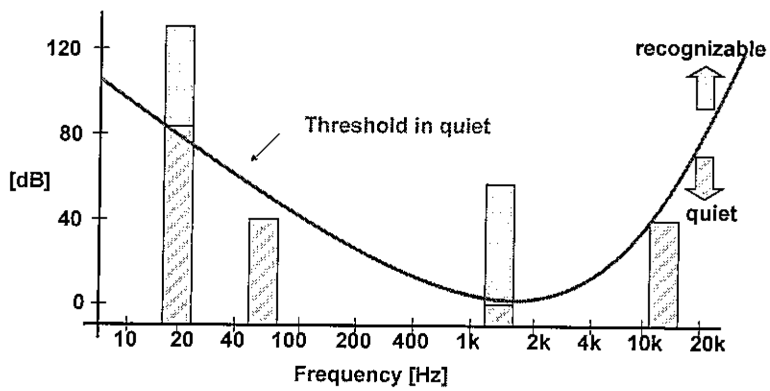
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

(5 points)

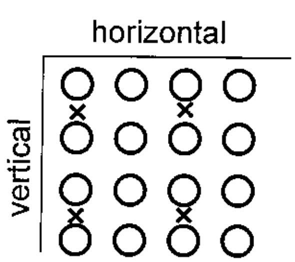


Estimate data for compress Audio but Human ~~ear~~ Still can ~~hear~~ yell good when hear audio after ~~decord~~. ~~decode~~. uncompress.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) 4[pixels/line] × 4[lines/frame]

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [2[pixels/line] × 2[lines/frame] × 2.
]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] × 2160 [lines/Frame] × $\frac{1}{2}$ + 3840 × 2160.

]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 × 2160 × 30 × 8 + 3840 × 2160 × 30 × $\frac{1}{2}$ × 8. unit ?

]

7

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$\dfrac{3840 \times 2160 \times 30 \times 8 + 3840 \times 2160 \times 30 \times \frac{1}{2} \times 8}{100 \cdot 10^6}$.]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — c) Frequency domain technique

2) VLC — a) Probability theory technique

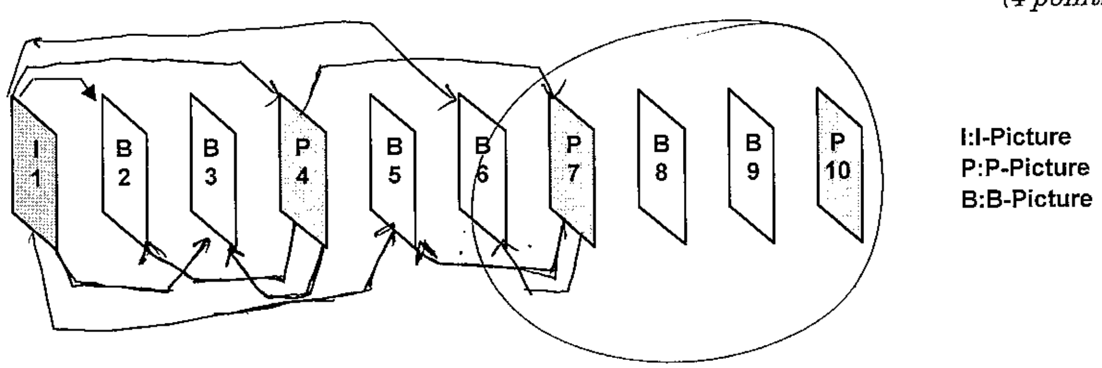
3) MC — b) Time Domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

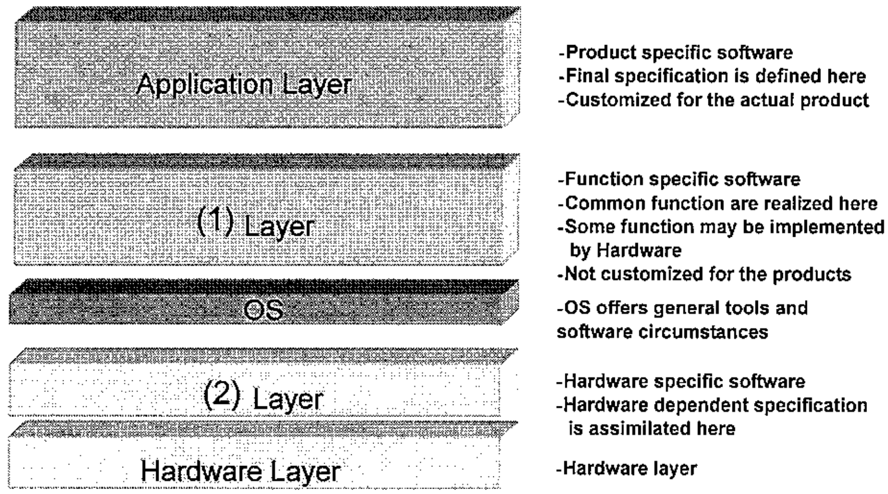


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a)~~ API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

8

ID code	2136
Name	Bùi Anh Khoa

~~33~~

39

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampled frequency must ~~less~~ bigger than twice of frequency of signal:

$f_s > 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation - 3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

10

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48}{2} = 24 (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

24 . 48 (kHz) . 6 (bit/sec)

(c) Calculate the size of 60[min].

24 . 48 (kHz) . 6 . (60 . 60) .

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

It causes Aliasing

6 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple ~~Complex~~ (b) Complex ~~Simple~~

(c) Good (e) ~~Poor~~

(d) ~~Difficult~~ (f) ~~Easy~~

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 FFT is faster than DFT

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We ~~can use~~ High ~~Low~~ filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

0

(1) Fourier Transform
Utilize [DCT ~~DF~~] transformation.

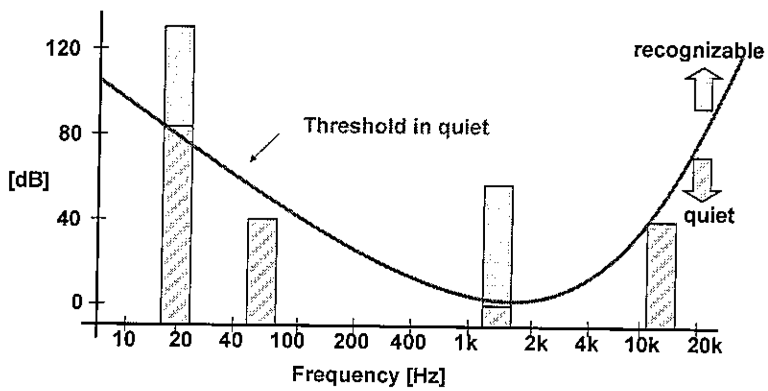
(2) Stereo Coding
Utilize the property of [reference frame] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [zig variable length].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)



It shows that a range of threshold people can re hear, and regcognize.

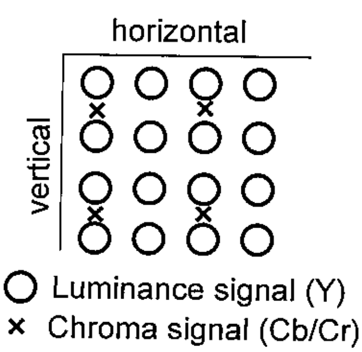
3. Video Coding

3.1 Picture format
Calculate the Video data number below.

(3 points for each)

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (~~Cr and~~ Cb total)
Ans: [(3840 × 2160)/4 · 8 · 30 (bit / sec)]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \times 2160 \cdot 8$ (bit / frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \times 2160 \cdot 8 \cdot 30$ (bit / sec)]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[$\frac{3840 \times 2160 \cdot 8 \cdot 30}{100 \text{ Mbps}}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT - b a) Probability theory technique

2) VLC - a b) Time Domain technique

2

3) MC - c c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

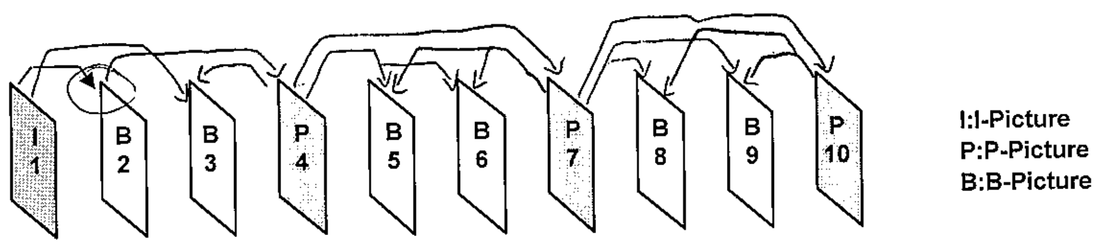
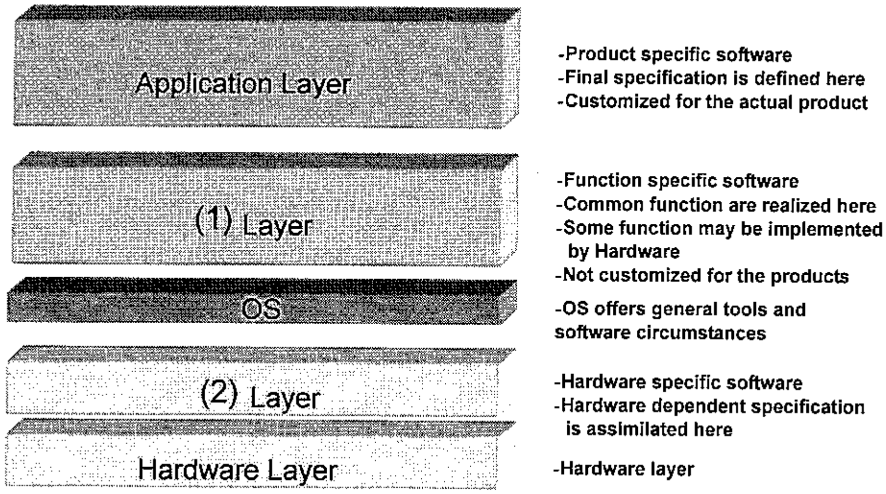


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

- easy for using
- supports many tools.

12

ID code	2137
Name	Nguyen Tung Lam

~~35~~ 43

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

~~Suppose an analog signal~~

~~suppose sampled frequency~~

~~suppose an analog signal which has frequency component equals the digitalized signal sampled~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off)

~~3~~

(b) Signed Truncation

−3

(c) Rounding

~~4~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 10

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m <= f_s/2 = \frac{48 KHz}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = $(48 \cdot 10^3) \times 24 \times 6$ (bit)

(c) Calculate the size of 60[min].

data size = bitrate $\times (60 \times 60)$ ~~(dB)~~

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 KHz~~

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complexible

(c) good

(e) good

(d) ~~bad~~ poor

(f) ~~good~~ good

(g) ~~bad~~ poor

(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

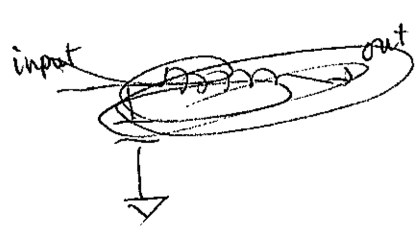
07

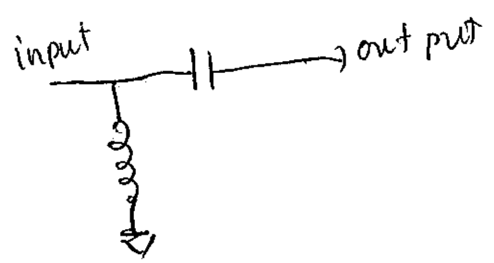
~~[illegible]~~ continuing signal.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

00

Filter is : higher bandwidth filter.





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10 *(5 points for each: total 15 points)*

(1) Fourier Transform
Utilize [~~time domain to~~ frequency domain] transformation.

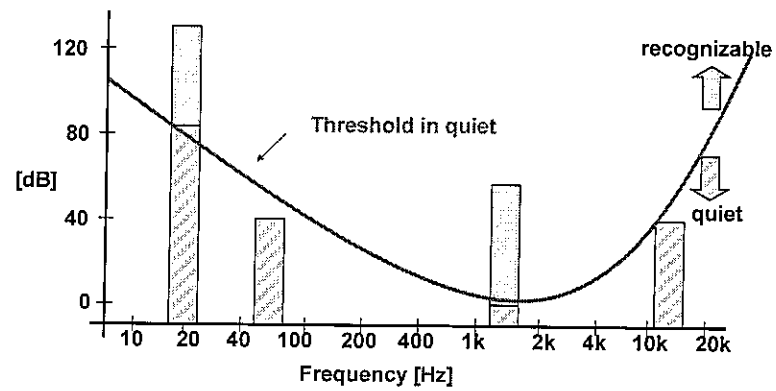
(2) Stereo Coding
Utilize the property of [channels] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.

2 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Meaning and purpose of this Psych-acoustic model in Audio Encoding is to know relationship between power and frequency that it make sure human can be recognizable or not.
Therefore, we can control power follow frequency to make sure it's enough to recognize by human

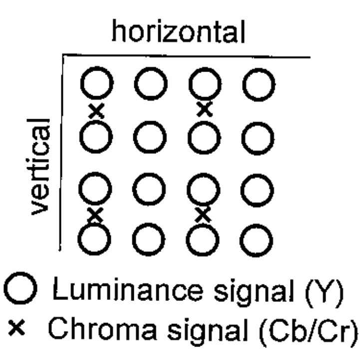
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 bit.

17

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 [pixels/line] x 2160 [pixels/line] x 16 [bits]

]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 [pixels/lines] x 2160 [pixels/line] x 16 [bits] x 30 [Frames/sec]

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[$\dfrac{3840 \times 2160 \times 16 \times 30 \text{ [bps]}}{100 \cdot 10^{6} \text{ [bps]}}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

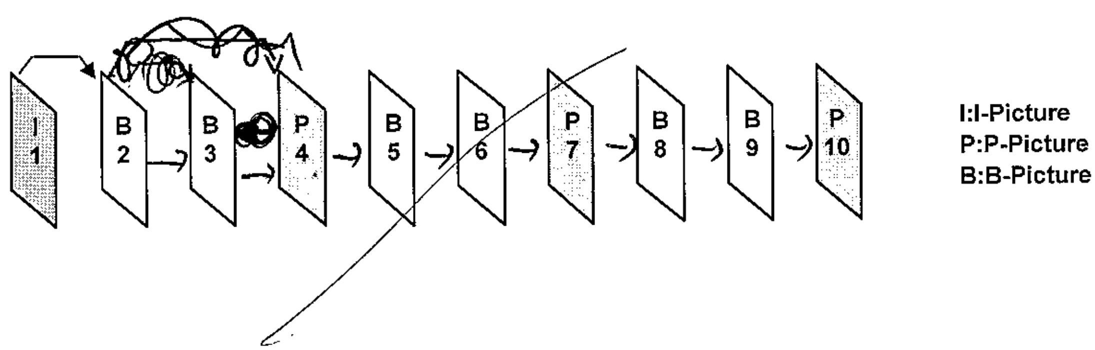
2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

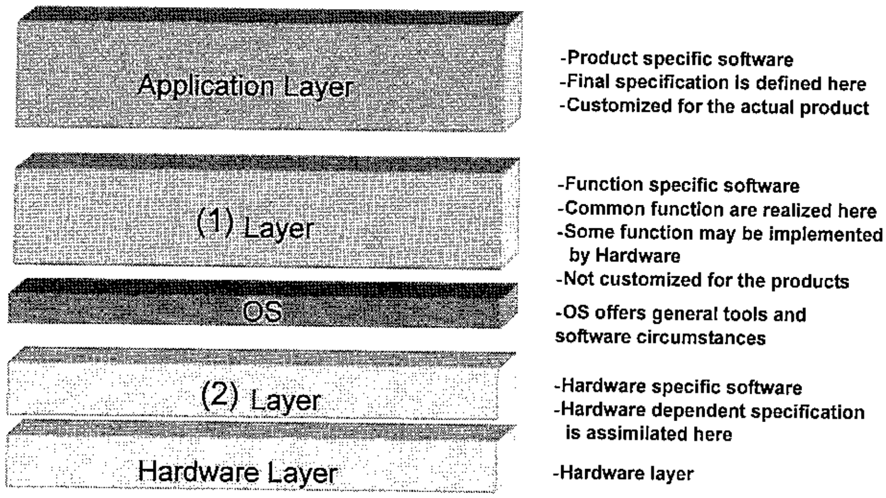


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

10

ID code	2139
Name	Đặng Trần Công Lý

35

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

1) Nyquist : $f_{sampling} \geq 2f_m$ (1)

2) (1) is realized, signal can be reproduced by digital signal.

3) (1) is false → aliasing signal.

$f_{aliasing} = f_s - f_m$.

3

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

~~-3~~ ~~-4~~

(b) Signed Truncation

-3

(c) Rounding

~~4~~

0

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

~~6912~~ 6,912 MB.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

55296000

(c) Calculate the size of 60[min].

$1,990656 \cdot 10^{11}$ B

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Complex)	(b) (Simple)
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) (difficult) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) (easy) : for repeating copy & signal transfer
Stability	(g) (poor) : for time variant, etc	(h) (good) : for time variant, etc
Portability	Difficult	Easy

(a) ~~complex~~

(b) ~~simple~~

(c) ~~poor~~ ~~difficult~~

(d) ~~difficult~~

(e) ~~easy~~

(f) ~~easy~~

(g) poor

(h) good

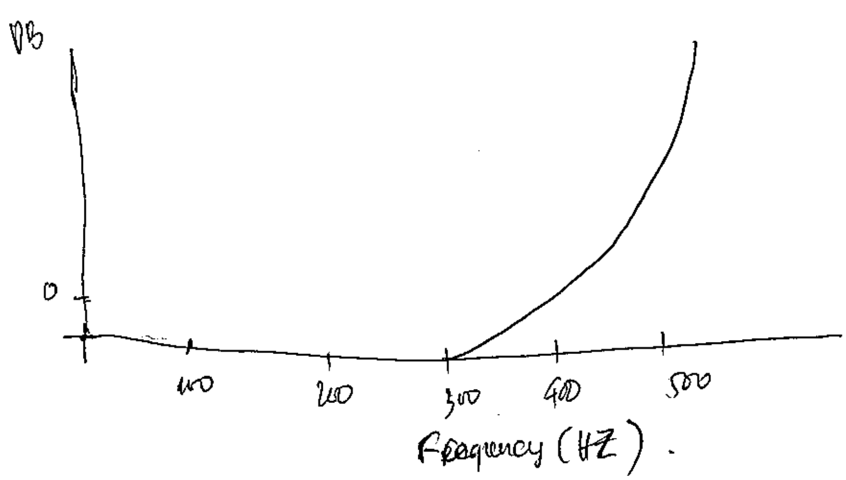
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

	Analog		Digital.
Signal Analysis	Fourier transform	→	DFT FTT DCT
Signal Processing	Laplace transform	→	Z transform.

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

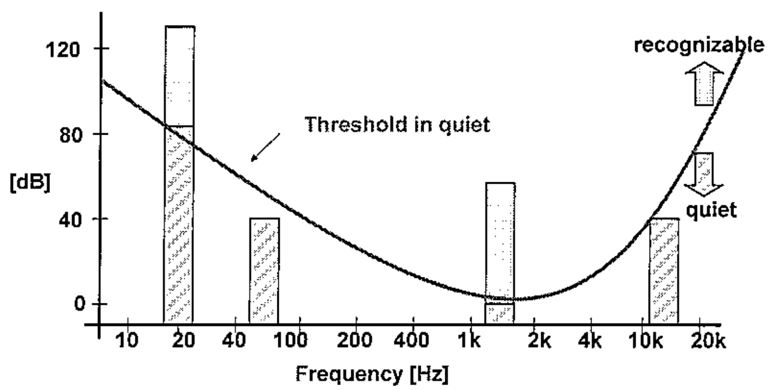
(1) Fourier Transform
Utilize [Time- Frequency] transformation.

(2) Stereo Coding
Utilize the property of [~~corelation~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

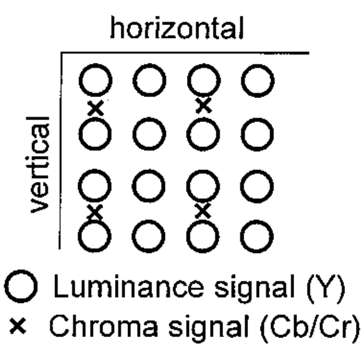


The hearing sensatation that corresponding to sound levels is the loudness of the sound.
→ Hearing range & hearing threshold are exist.
→ We can delete the information that we can hear.
– the sensitivity of the human being is not constants for the frequency of the signals.
– When a big sound exist, there is "malking" effect arround the that sound.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 × 2160 × ~~8~~ + 3840 × 30 × 2160]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [

~~3840 x 30 = 1152~~ 115200

3840 x 2160 x 8 = 66355200]

4) Calculate total data rate of UHD/4K Video data above

Ans: [

~~3840 x 30 = 115200~~

3840 x 30 x 2160 = 248832000]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

0

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

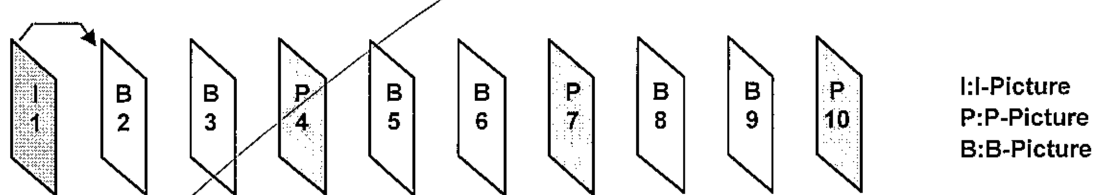
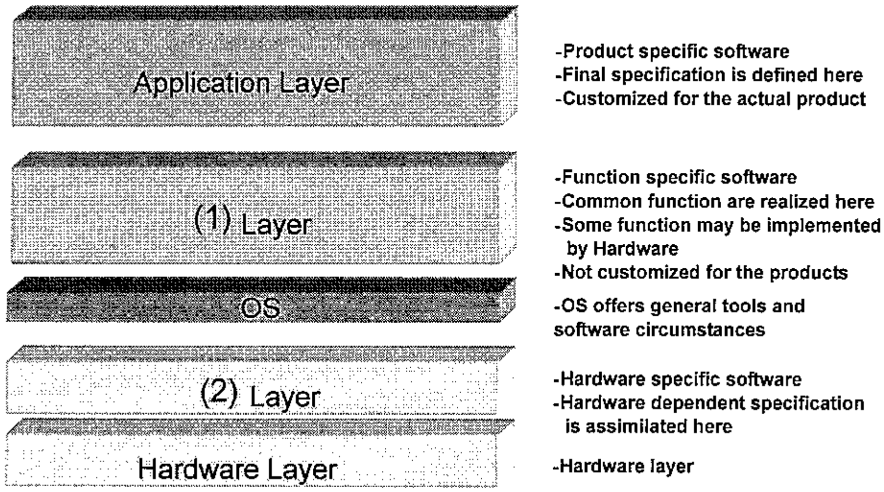


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2 OpenMAX IL serves as low level interface for audio, video & imaging codes used in embbeded devices.

- It gives application & media framework the ability to interface with multimedia codecs & supporting components in a unified maner.

8

ID code	2140
Name	Đặng Văn Năm

~~27~~

31

RVC "System Solution"

Examination

November ~~24,~~ 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

00

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) ~~3~~

(b) Signed Truncation -3

(c) Rounding -~~3~~

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~4~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2f_m \Rightarrow f_m = 48k/2$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= (48 * 1000) * 24 * 6$

(c) Calculate the size of 60[min].

= bit rate * 60 * 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

A~~lais~~ Alias ~~= 18 kHz~~

12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) ~~Difficult~~ (f) ~~Easy~~

(g) Poor (h) Good

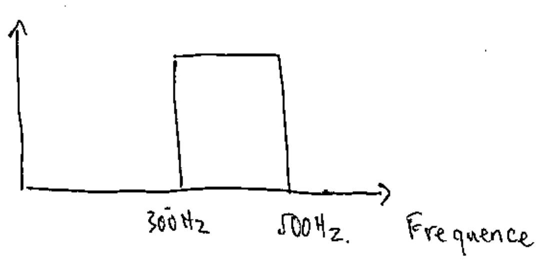
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0 Efficience

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

~~Using : High pass filter.~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

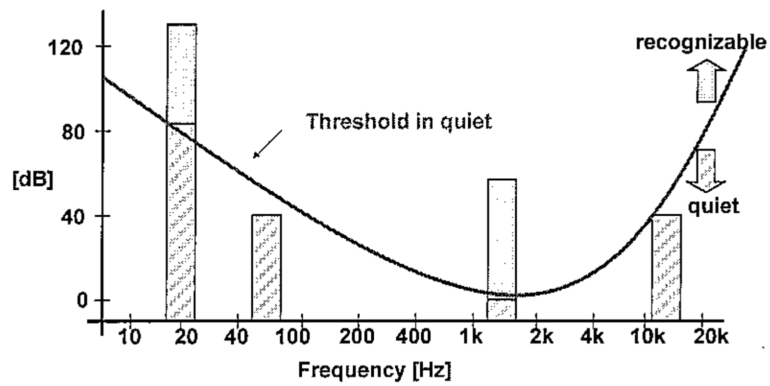
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

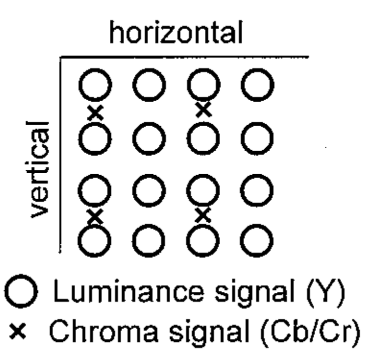


This figure show the way to eliminate the low Frequency to reduce the data size (or volume) of a file Audio.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 x 2160~~
(3840/2) * (2160/2)]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$(3840 \times 2160) + (3840/2) \times (2160/2)$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$[(3840 \times 2160) + (3840/2) \times (2160/2)] \times 30$]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[25]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

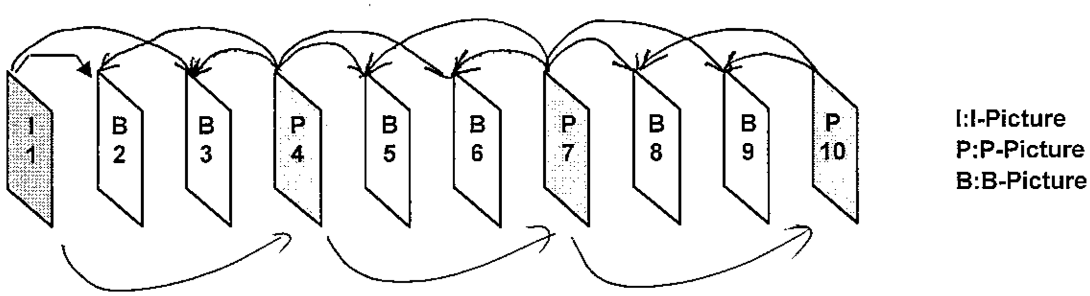
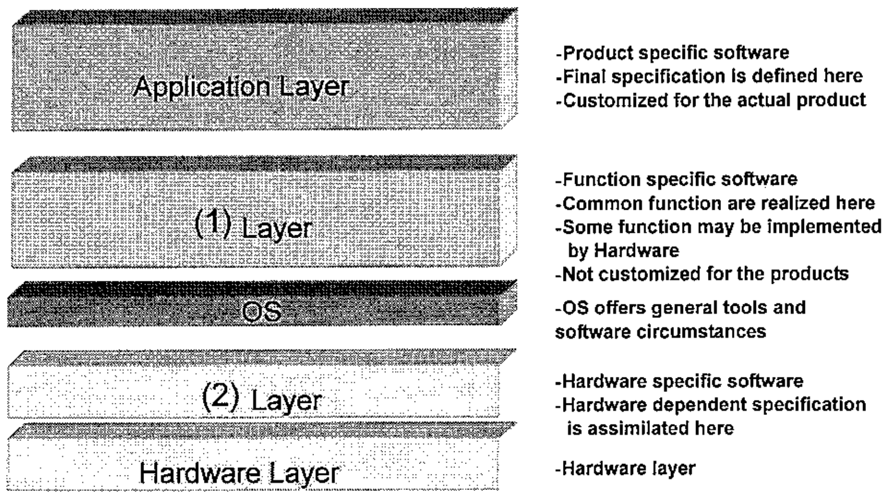


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

High performance

0

17

ID code	SW2145
Name	Võ Lê Quỳnh Như

67

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Make the sampling frequency is 2 times higher than the signal bandwidth ($f_s > 2f_m$)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

4

(a) Calculate the maximum frequency CD can re-produce.

~~$f_s \geq 6 * f_m \Leftrightarrow f_m \leq f_s / 6$~~ = ?

Maximum: $f_s / 6$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48 * 1000) * 24 * 6 = [?]

(c) Calculate the size of 60[min].

datasize = bitrate * (60 * 60) = [?]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias : 18kHz.~~

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple
(b) Complex
(c) Good
(e) Good
(d) Poor
(f) Good
(g) Poor
(h) Good

3

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- The number of multiplication and addition of FFT algorithm are fewer than DFT. It is fast calculation algorithm of DFT

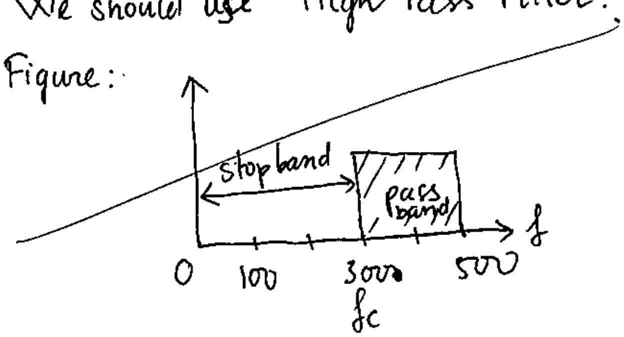
+ Multiplication: DFT: $N^2 \rightarrow$ FFT: $\frac{N(\log_2 N - 1)}{2}$

+ Addition: DFT: $N(N-1) \rightarrow$ FFT: $N \log_2 N$

0.5

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

- We should use High Pass Filter:
- Figure:



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

10

(1) ~~Fourier Transform~~
~~Utilize [Time~~] transformation.

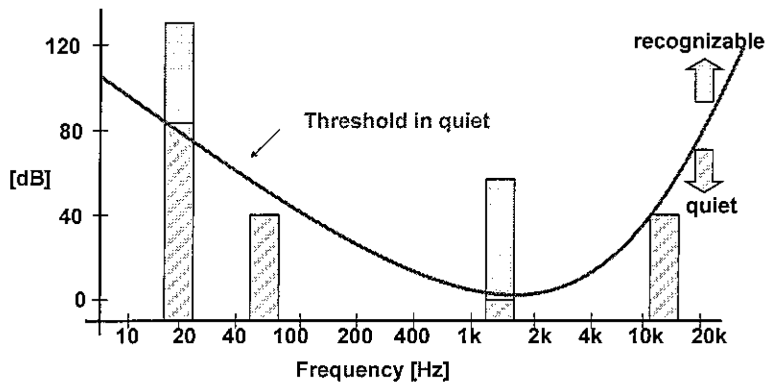
(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

5

(5 points)



- Because the hearing sensation that corresponding to sound level is the loudness of the sound so hearing range and hearing threshold are exists.
Therefore, we can delete the information that we can't hear so that data size and encoding / decoding cost can be reduced.

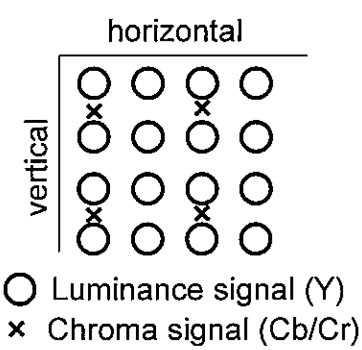
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume (Cr and Cb total)
Ans: [3840 × 2160 × 8 × 3 / 2]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2$ unit ?
]

4) Calculate total data rate of UHD/4K Video data above

3

Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2 \times 30$ unit ?
]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$3840 \times 2160 \times 8 \times 3 \cancel{\times 1/2} \times 30 \times 10^6 / 100$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

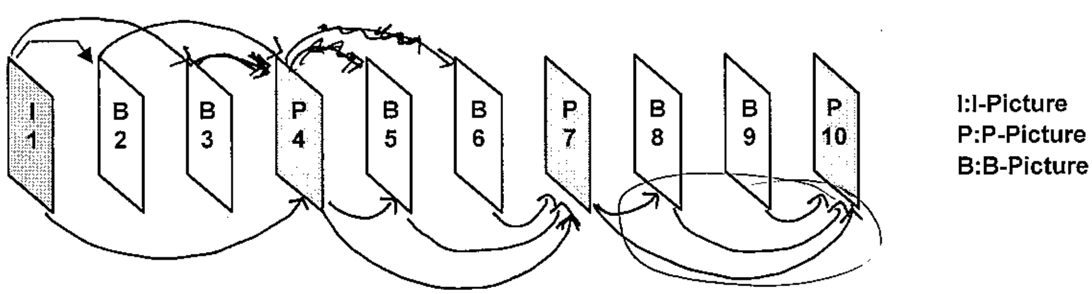
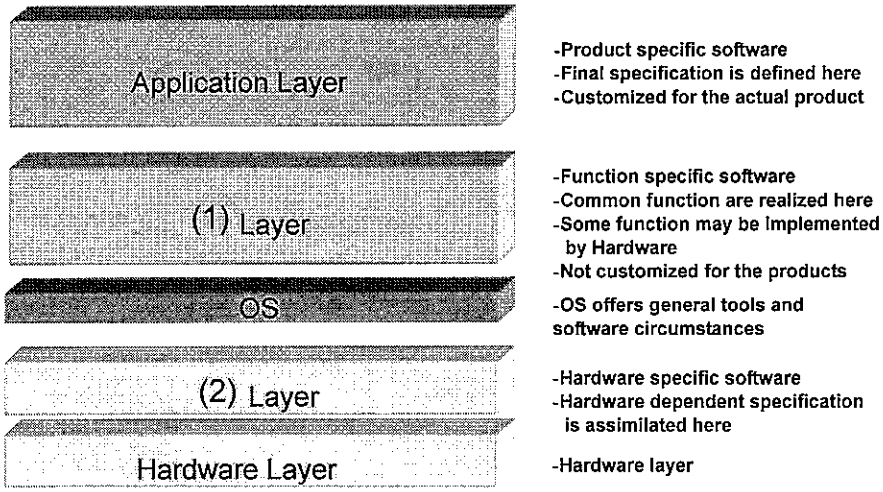


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



6

Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- ~~Open Max~~

2 - OpenMAX IL gives application and media frameworks, that ability to interface with multimedia codes and supporting components in unified maner.

9

ID code	SW2147
Name	Vu Quoc Son

~~23~~ 29

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

0 1.1 How to prevent "Aliasing"? *(3 points)*

0 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

~~8~~ 6 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s >= 2 * f_m \Rightarrow f_m <= f_s / 2 \Rightarrow$ Maximum frequency $= f_s / 2$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= (48 * 1000) * 24 * 6$

(c) Calculate the size of 60[min].

data size $=$ bit rate $* (60 * 60) = (48 * 1000) * 24 * 6 * (60 * 60)$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

14

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple — (b) Complex

(c) Good — (e) Good

(d) ~~Difficult~~ — (f) Good

(g) Poor — (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

07

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [ ] transformation.

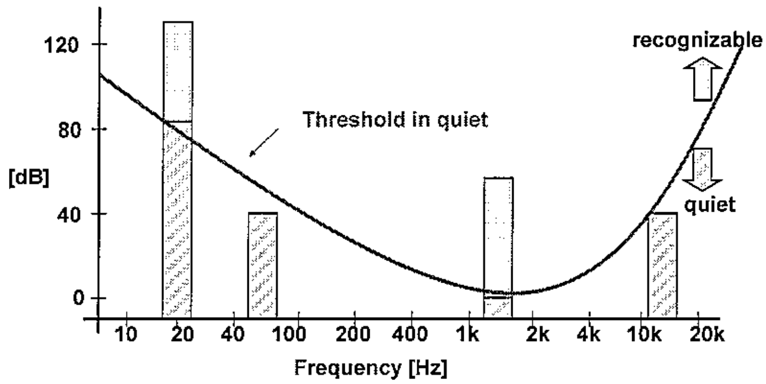
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

02

(5 points)



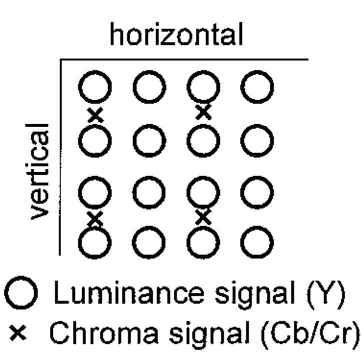
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] × 2160[line/frame] × 8 bit × 3
× $\frac{1}{2}$ =
]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840[pixels / line × 2160 [lines/frame] × 8 bit × 3 × 1/2 × 30 [/frames/sec]
]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 [pixels /line] × 2160 [lines/frame] × 8 bit × 3 × 1/2 × 30 [frames/sec]
]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[Compression ratio is ~ 20000 Mbps to 100000 Mbps]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

0 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

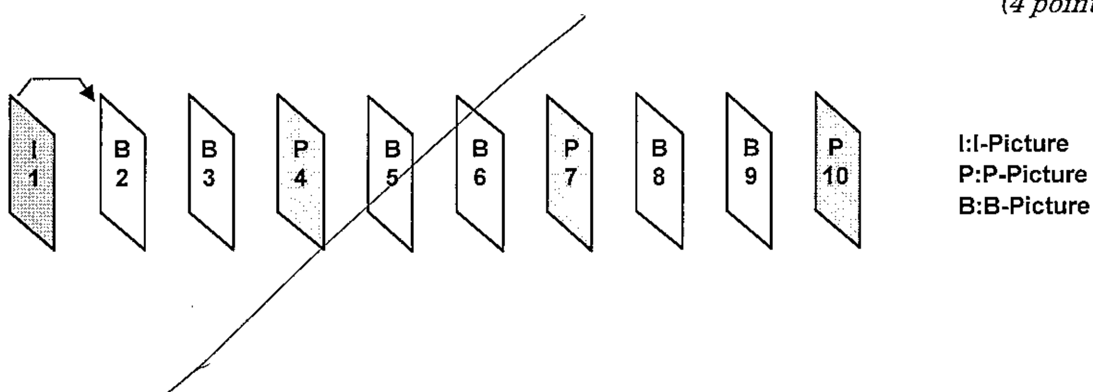
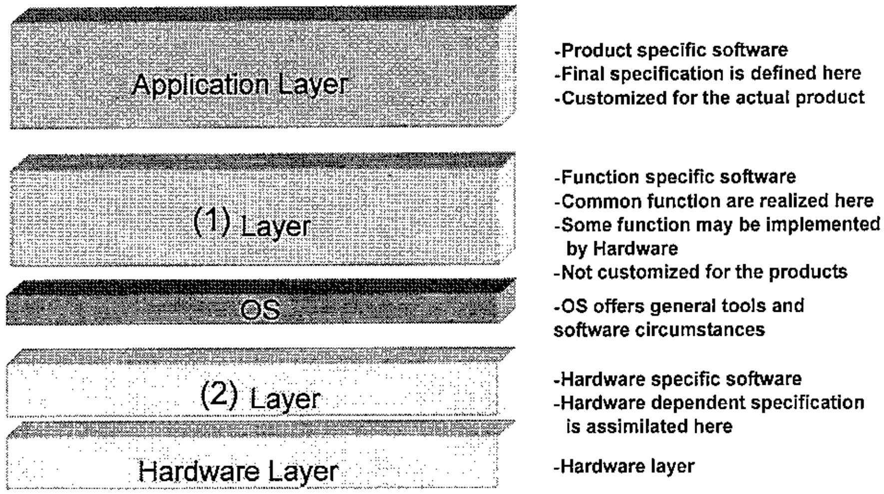


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

10

ID code	2148
Name	Nguyen Duc Tai

47

RVC "System Solution"

Examination

November 24, 2017

55

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$f_s \geq 2 \cdot f_m$.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2}$ [ ]

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate = $f_s \cdot 24 \cdot 6$ [ ]

(c) Calculate the size of 60[min].

Size = $f_s \cdot 24 \cdot 6 \cdot 60 \cdot 60$ [ ]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$f_a = 48 - 30$ [ ]

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Sip~~ Simple　　(b) complex

(c) good　　(e) good

(d) poor　　(f) ~~p~~ good

(g) poor　　(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1

Time ~~Calculation numbers of mt~~

	DFT	FFT
multiplex	N^2	$\frac{N(\log_2 N-1)}{2}$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

60

We should use to high pass filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

15

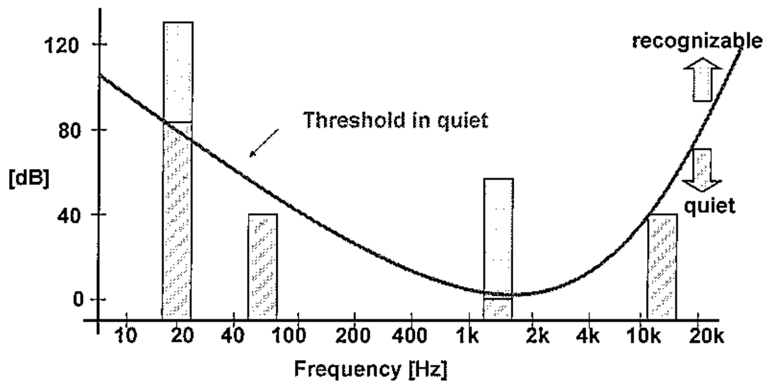
(1) Fourier Transform
Utilize [time - frequency] transformation.

(2) Stereo Coding
Utilize the property of [~~correlation~~ correlation audio data] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
2 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

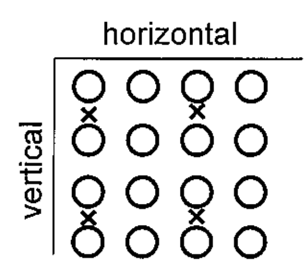
(5 points)



- Hearing range and hearing threshold are exist
  ⇒ We can delete the information that we can't hear
- the sensitivity of the human being is not constant for the frequency of the signals
- When a big sound exists, there is "masking" effect around the that sound
- The hearing sensation that corresponding to sound level is the loudness of the sound

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 . 480 . 8 . 3 .]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} \cdot 30$ unit?]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} \cdot 30$ unit ?]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

3 Ans:[ratio $= \cancel{\dfrac{100 \cdot 10^6}{3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} \cdot 30}}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

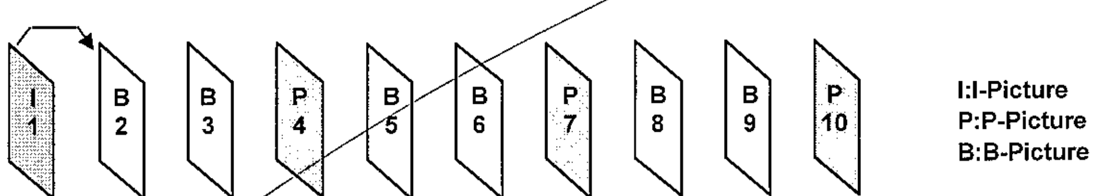
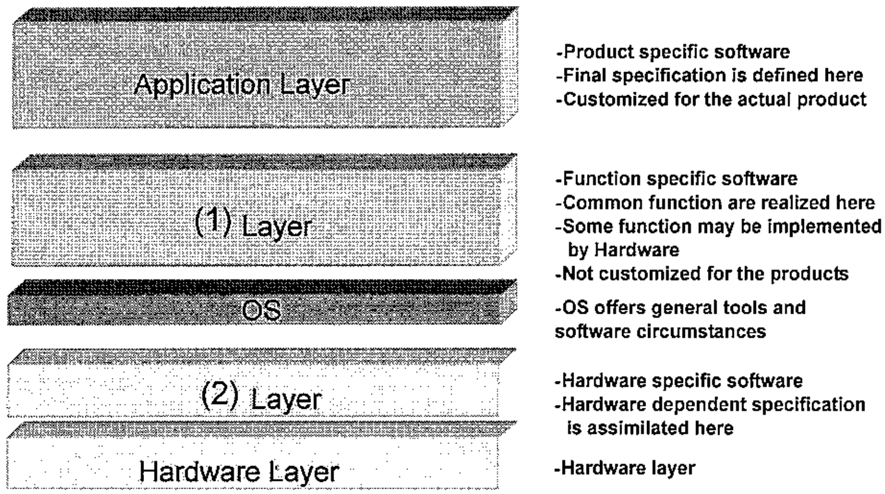


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

3

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

OpenMax IL gives applications and media frameworks the ability to ~~integr~~ interface with multimedia codecs and supporting components in a unified manner

12

ID code	2149
Name	Van Cong Minh Tai

~~33~~

RVC "System Solution"

Examination

November 24, 2017

32

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sample frequency ≥ 2 Signal frequency

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) -4

(b) Signed Truncation -4

(c) Rounding ~~-3,5~~ -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels.
Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~0~~ 6

(a) Calculate the maximum frequency CD can re-produce.

48(kHz)/2

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$48.10^3.24$ 2

(c) Calculate the size of 60[min].

$48.10^3.24.2.60.60$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias: 18kHz ?~~

14. Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) ~~Good~~ (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

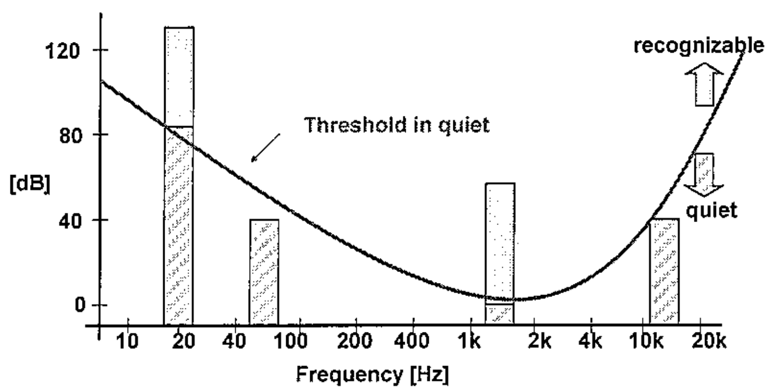
(1) Fourier Transform
Utilize [time→frequency] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



Human's ears can only regconize ~~f~~ frequency from 20 Hz to ~~20H~~ 20kHz
So ~~of~~ we can eliminate ~~o~~ others signal ~~to~~ frequence ~~out~~ which have less than 20Hz and more than 20kHz

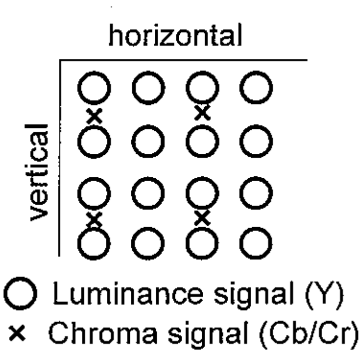
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~3840 . 2160 . 2^8 . 3 . 2/3~~
$2^8 . 3 .$ ~~3/3~~ 1/2]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \cdot 2160 \cdot 2^8 \cdot 3$]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \cdot 2160 \cdot 2^8 \cdot 3 \cdot 30$]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$(3840 \cdot 2160 \cdot 2^8 \cdot 3 \cdot 30)/(100 \cdot 10^6)$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.
1) DCT — a) Probability theory technique
2) VLC — b) Time Domain technique
3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

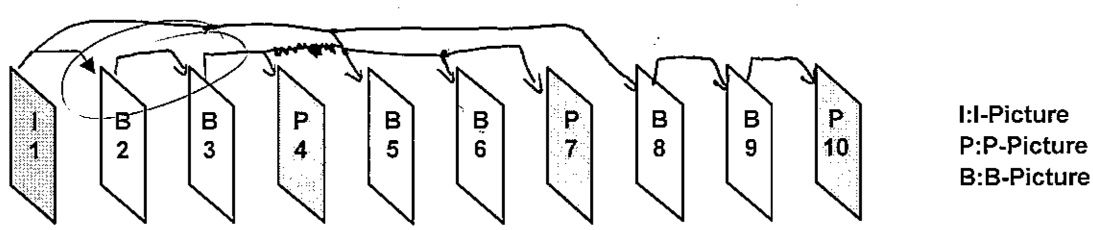
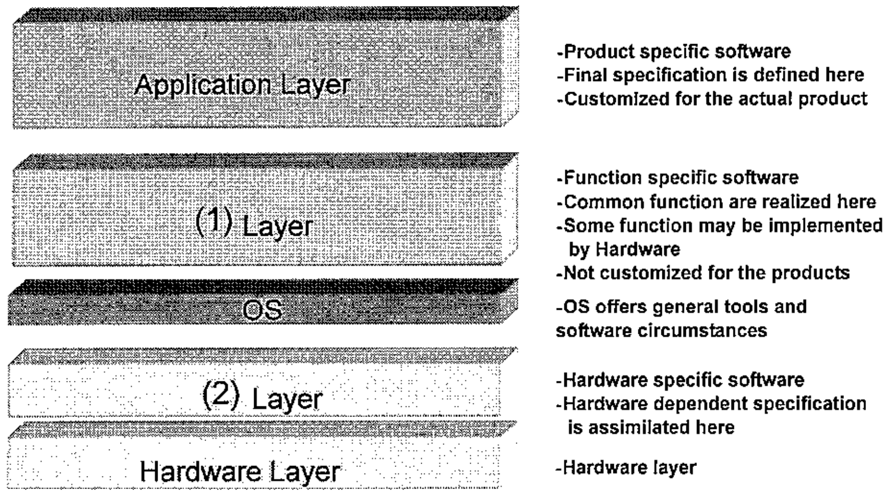


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2150
Name	Nguyen Nhat Tan

~~35~~ 39

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

$f_{sample} \geq 2 f_{signal}$

6 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) ~~3~~

(b) Signed Truncation -3

(c) Rounding -4

~~4~~ 8 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = \frac{1}{2} f_{sample} = \frac{48\ kHz}{2} = 24\ kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$BR = f_{sample} \cdot 24 \cdot 6 = 48000 \cdot 24 \cdot 6 =$

(c) Calculate the size of 60[min].

$= 60 \cdot 60 \cdot BR = 60 \cdot 60 \cdot 48000 \cdot 24 \cdot 6 =$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

The ~~signal sampled signal has~~

The frequency of ... ~~the signal~~ is 6 KHz ...

6

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Complex　　　(b) ~~Simple~~

(c) Good　　　(e) Good

(d) ~~Good~~　　　(f) Good

(g) ~~Good~~　　　(h) ~~Poor~~

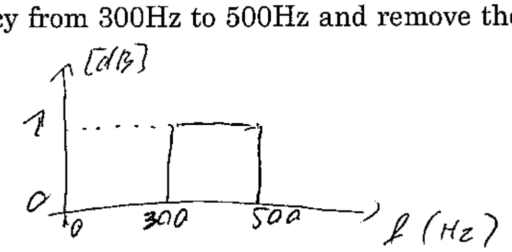
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

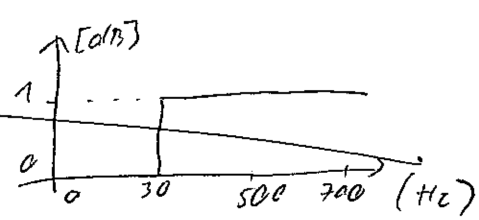
1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

2

Band pass filter



~~High pass filter~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

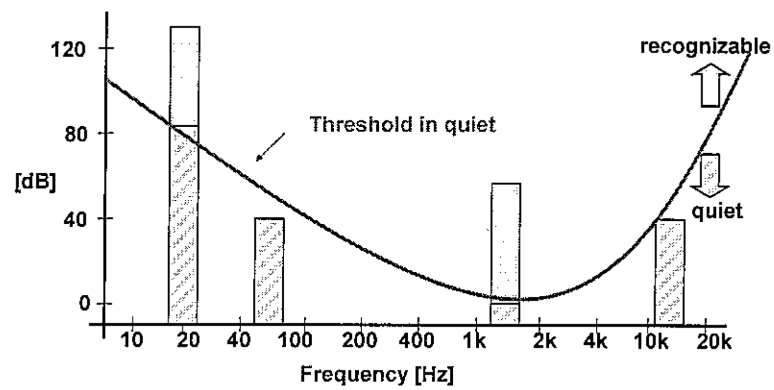
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

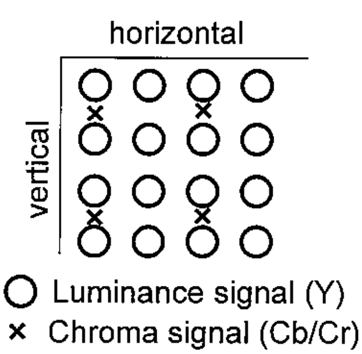


It uses to remove the audio data which human cannot hear to ~~reed~~ reduce data size

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [

$= \frac{1}{4}$ Luminance pixed number [pixels/frame]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [[pixels/frame]

= luminance pixel number + Chrominance pixel number [pixels/frame]]

= $\frac{5}{4}$ 8294400 [pixels/frame]

4) Calculate total data rate of UHD/4K Video data above

Ans: [

= totaldata volume [pixels/frame] × 8 [bit/pixels] × frame rate [frame/sec]]

= $\frac{5}{4}$ 8294400 × 8 × 30 = 2488320.000 [bps]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0 Ans:[= 2.488.320.000 [bps] / $100 \cdot 10^6$ [bps]]

≈ 25

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

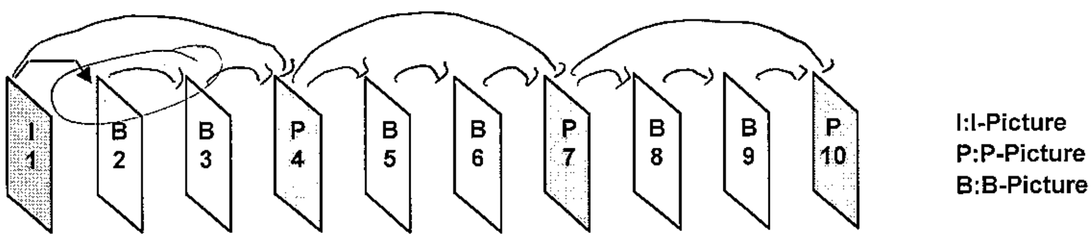
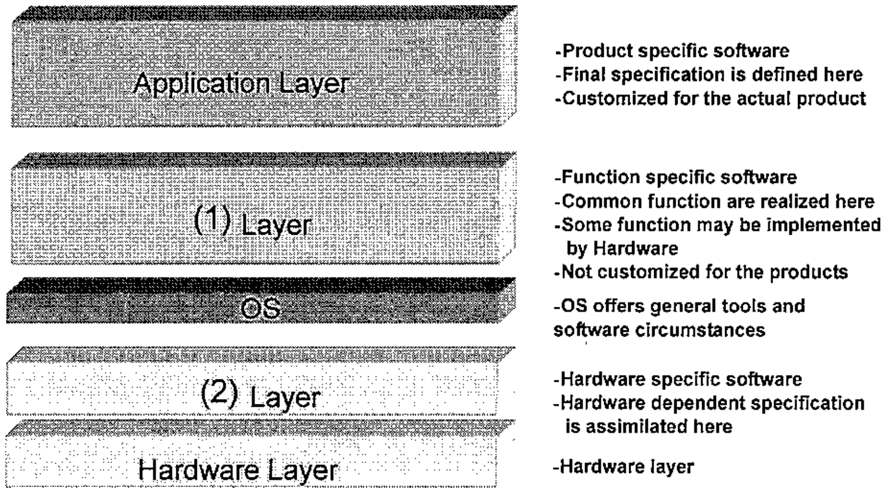


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

13

ID code	215 3
Name	Dao Minh Tien

53

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 - The frequency for sampling must equal or bigger than the frequency of the analog signal

- f

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) ~~-3~~

(b) Signed Truncation -3

(c) Rounding - 4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

6

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = \frac{48}{2} = 24$ (kHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate = $24 * 6 * \frac{1}{48.10^{-3}} = 3.10^3$ (bit/sec) X

(c) Calculate the size of 60[min].

Size of 60 [min] = $3.10^3 * 60 * 60 =$ [X]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

- The Aliasing will happen with frequency :

- f = ~~18~~ 18 kHz

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Complex (b) Simple

(c) Reasonable (e) Expensive

(d) Poor (f) Good

(g) Difficult (h) Easy

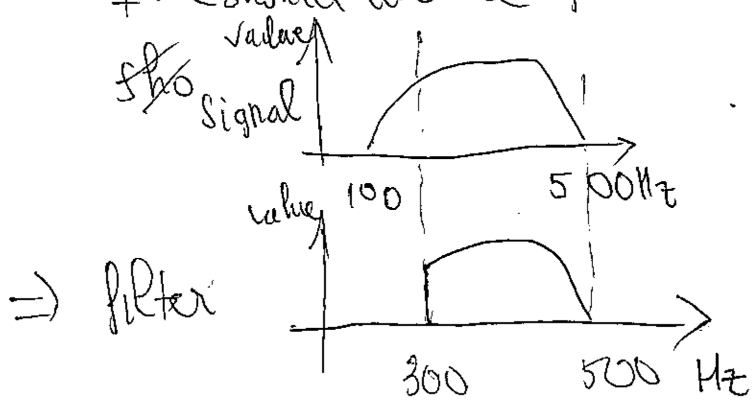
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1

+ We should we the filter which frequency bigger than 300 Hz



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

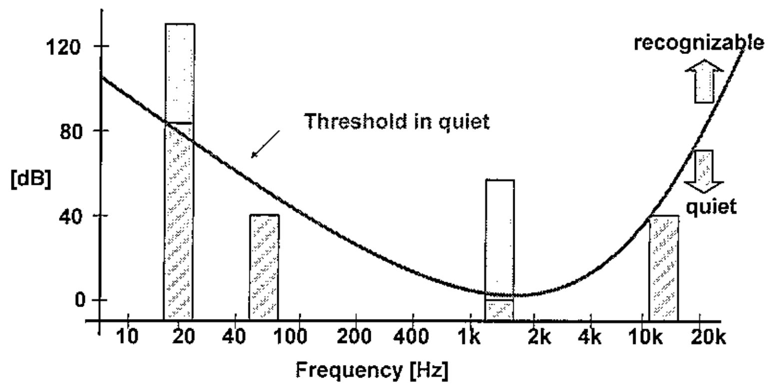
(1) Fourier Transform
Utilize [Time frequency] transformation.

(2) Stereo Coding
Utilize the property of [correclation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [Data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

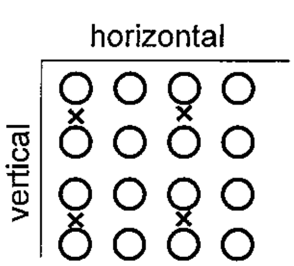


_The figure show us some rates that human ear can catch the ~~sy~~ signal from the Audio from the recognizable area.
_In some case, ~~..~~ to reduce the size of data, they can use filter to reduce some signal that ~~b~~ people can't hear.
_~~But some people can recognize catch~~

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [~~##~~ 3840 * 2160 * 8 * 3 * 1/2 ~~*30~~ unit ?]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 * 2160 * 8 * 3 * 1/2 * 30 unit?]

3

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	b c	a) Probability theory technique
2) VLC	C a	b) Time Domain technique
3) MC	a b	c) Frequency domain technique

0

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

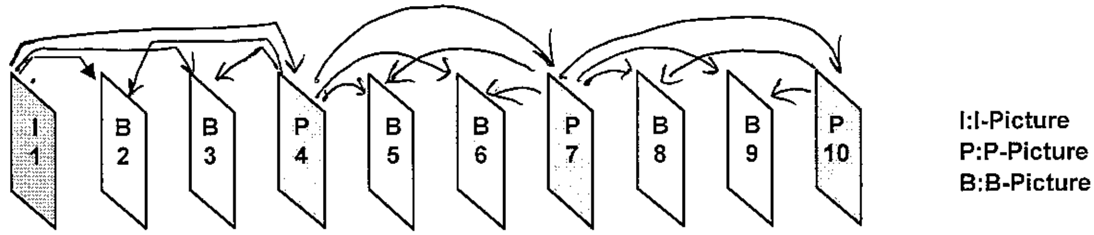
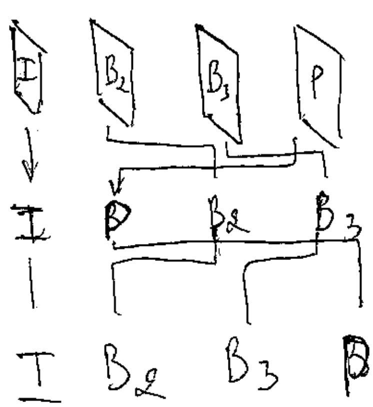


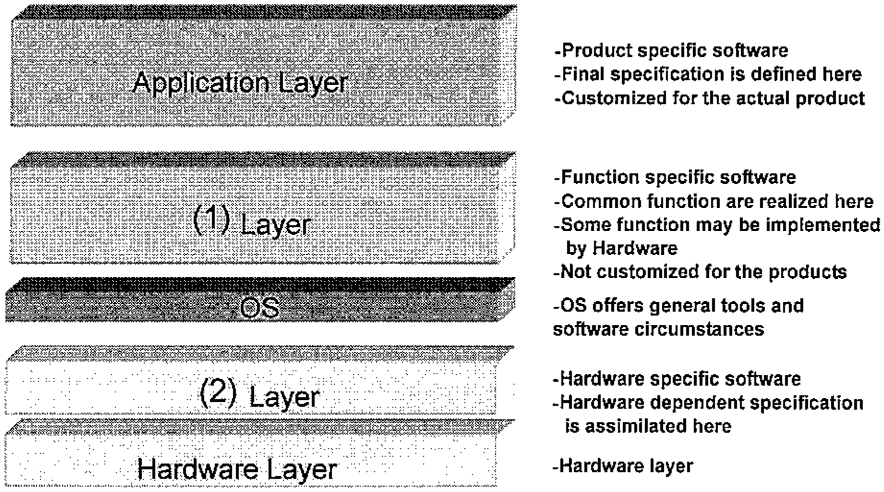
Figure 2.1. Prediction of MPEG1/2 Video coding

Encoded



4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

- ~~Sg~~ C ~~langug~~ language program interface

0 -

12

ID code	2154
Name	Nguyen Thanh Toan

19

28

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

08 1.1 How to prevent "Aliasing"? *(3 points)*

Signal Quantization.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

00

(a) Truncation (round off) : -1

(b) Signed Truncation : -3.

(c) Rounding : 0

8 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

48.1000.6 [Hz] = ?

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48.1000.24.6 [bit/sec]. = ? ✓

(c) Calculate the size of 60[min].

48.1000.24.6.60.60 [bit] = ? ✓

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

So zero signal will be ~~born~~ created. ?

2

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) (Poor) : for original signal (f) (easy.) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Resonable.~~ (b) ~~Expensive~~

(c) good (e) ~~poor.~~

(d) ~~simple~~ (f) ~~complex.~~

(g) ~~Resonable. Easy~~ (h) ~~Expen Difficult.~~

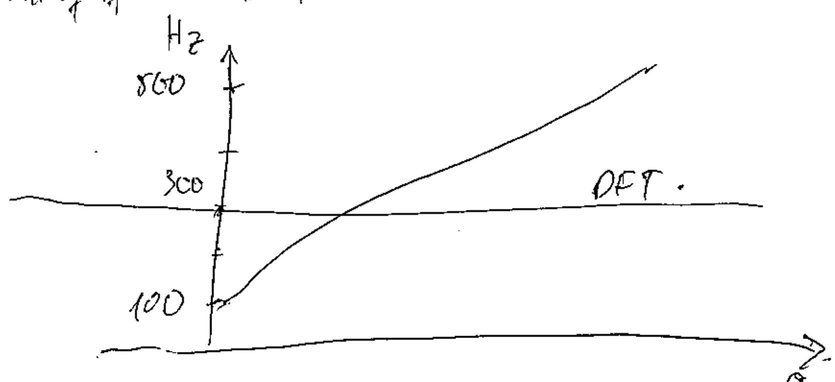
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

kind of filter: DFT



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

0

(1) Fourier Transform
Utilize [ ] transformation.

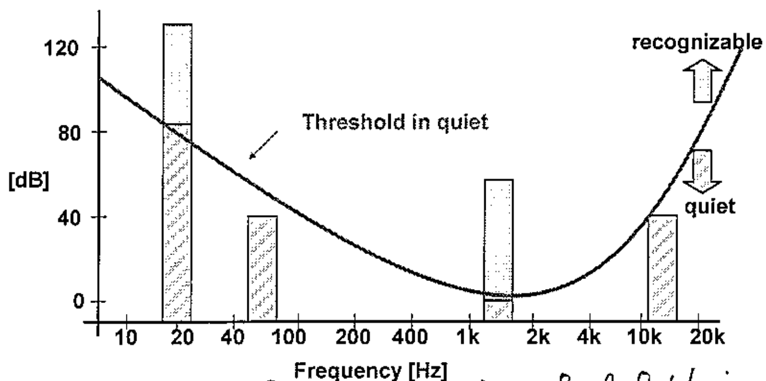
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

5



- Meaning: divide signal into 2 regions: + above thresh hold in quiet : people can hear.
+ below thresh hold in quiet : people can not hear.
- Purpose: ~~Excute~~ Determine region which can be removed ~~excuted (filted)~~ to get high effecency compression in Audio Encoding. (reduce size of data when encoding). but do not effect people's recognization.

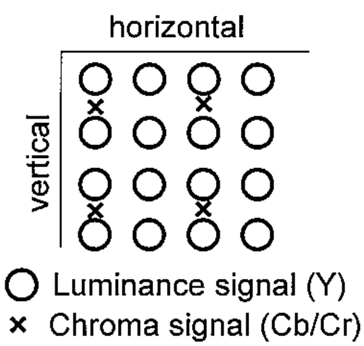
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~(8294400 [pixels/line] /4)~~ x 2

~~= (4147200 [pixels/line]~~]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [(8294400 /4)×8 ~~×30~~ [bit].]

4) Calculate total data rate of UHD/4K Video data above

Ans: [(8294400/4)×8 × 30 [bit/s]]

$\times \frac{3}{2}$

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

8

Ans:[$\frac{100 . 10^6}{(8294400/4)\times 8 \times 30.}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

6

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

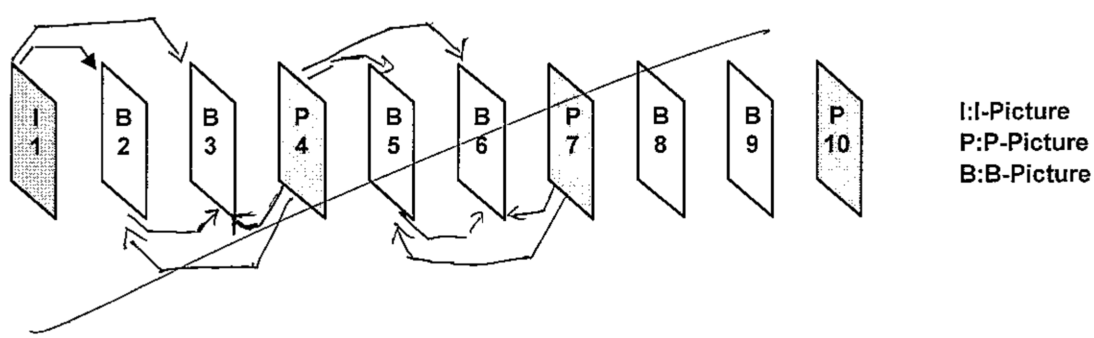
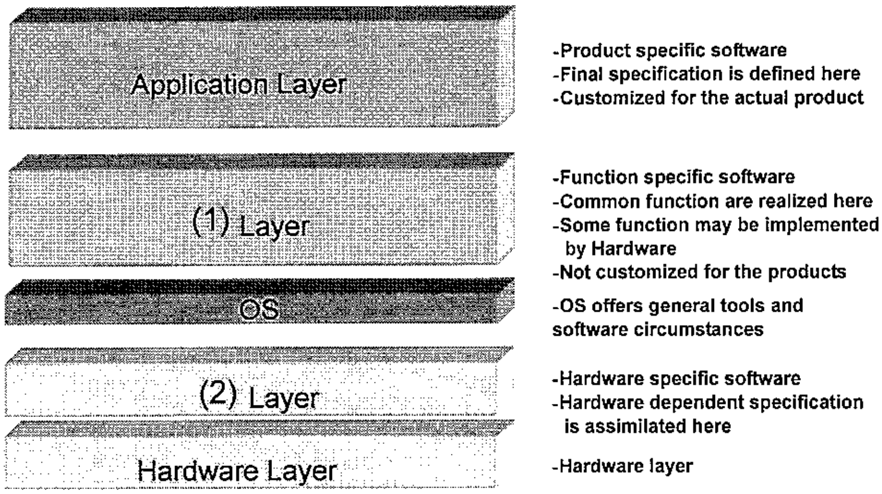


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

ID code	2155
Name	Trương Ngọc Trác

14

44

52

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

- sampling with $f_{sampling} \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) -3

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq 2 f_s$ ~~(kHz)~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = $f_s^{(kHz)} \times 24$ bit $\times$ 6 channel $\times 1000$ (bit/sec)

(c) Calculate the size of 60[min].

~~bit/sec~~ ~~bitrate =~~ size = bitrate $\times 60 \times 60$ (bit).

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

it will be aliased with ~~$f_a = f_s - f_m$~~

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Reasonable)	(b) (Expensive)
Cost	Reasonable	Expensive
Quality	(c) (Simple) : for original signal (d) (Difficult) : for repeating copy & signal transfer	(e) (Complex) : for original signal (f) (Easy) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Reasonable~~ (b) ~~Expensive~~

(c) ~~Simple~~ (e) ~~Complex~~

(d) ~~Difficult~~ (f) ~~Easy~~

(g) Poor (h) Good

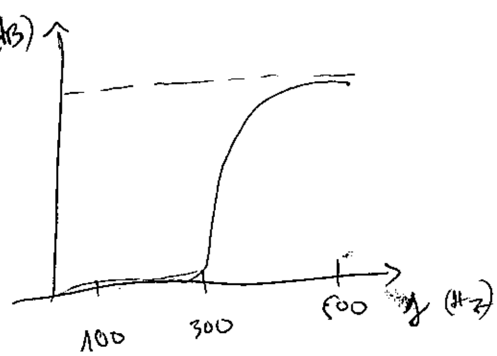
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 FFT can calculate faster than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

~~- high pass filter~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

M

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

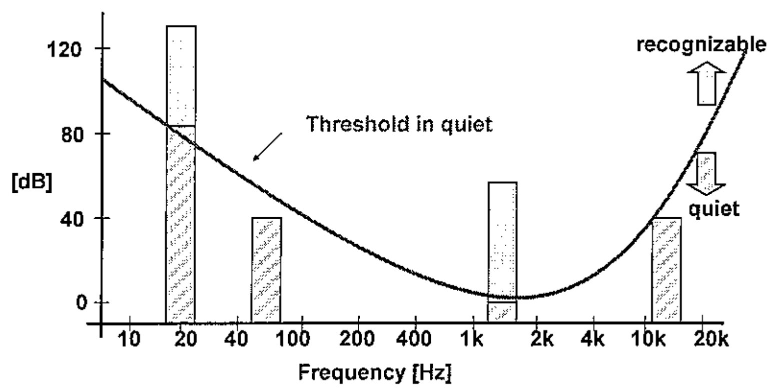
(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.

4

What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



* Meaning - the hearing range and hearing threshold → the hearing sensation ?

* Purpose - we can delete the unwanted sound we can hear
Ex: eliminate the noise,

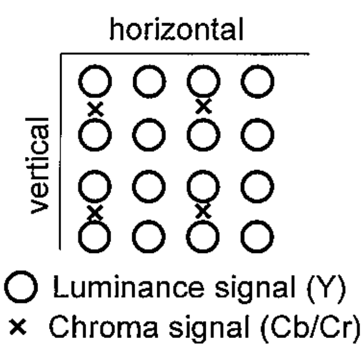
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[3840 (px/line) × 2160 (line/frame) × 30 (fps) × 24 (bit/pixel)) / 100Mbps]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT c	a) Probability theory technique
	2) VLC a	b) Time Domain technique
	3) MC b	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

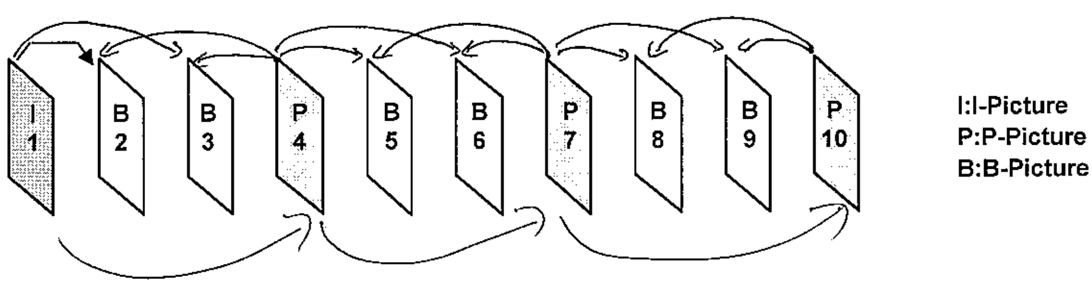
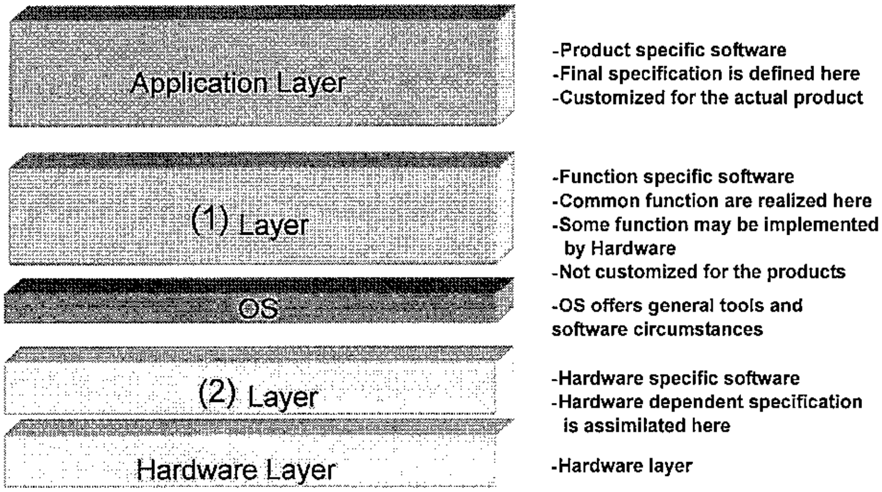


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

- OpenMAX IL serve as low level interface for audio, video & imaging codecs used in Embedded devices

- It gives applications & media frame work the ability to interface with multimedia codecs and supporting components in a unified manner

19

ID code	2157.
Name	Nguyen Lam Thu Tuan.

~~42~~
44

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 to prevent "Aliasing" $f_s \geq 2 f_m$.

6
1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) 0

(b) Signed Truncation −3

(c) Rounding −4

~~8~~
10
1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_s = 48kHz \Rightarrow f_m = \frac{f_s}{2} = 24$ kHz.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate = ~~48 . 1000 .~~ 24 . 2 ~~= 384 000 (bit/sec)~~

(c) Calculate the size of 60[min].

Data Size = 48 . 1000 . 24 . 60 . 60 . 2

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

$\begin{cases} f_m = 30kHz \\ f_s = 48kHz \end{cases} \Rightarrow f_a = 48 - 30 = 18$ kHz.

6

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Complex. (b) Simple

(c) Good. (e) ~~Poor~~

(d) ~~Difficult~~. (f) ~~Easy~~.

(g) ~~Expensive~~ (h) ~~Reasonable~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

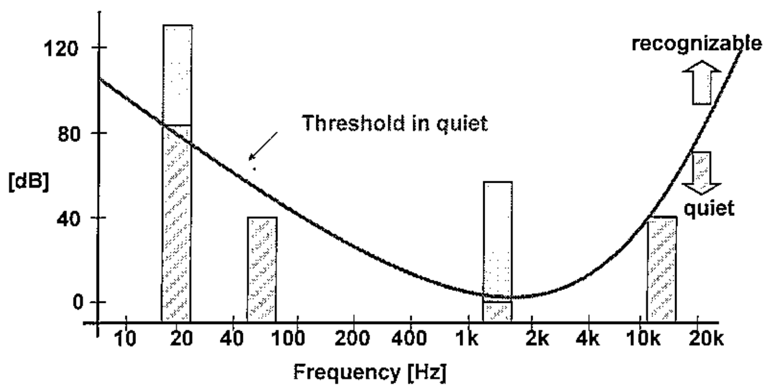
(1) Fourier Transform
Utilize [ ] transformation.

(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

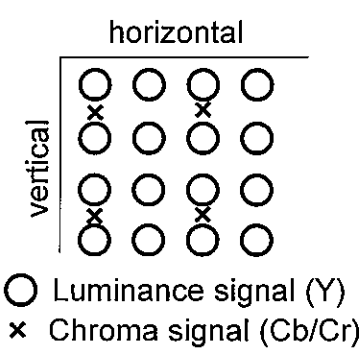
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation <u>with dimensions</u> like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [
$\frac{8\times3}{2} = 12.$
]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

3840 × 2160 × 12   unit ?   ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

3

3840 × 2160 × 12 × 30   unit ?   ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[   ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT   a) Probability theory technique

2) VLC   b) Time Domain technique

6

3) MC   c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

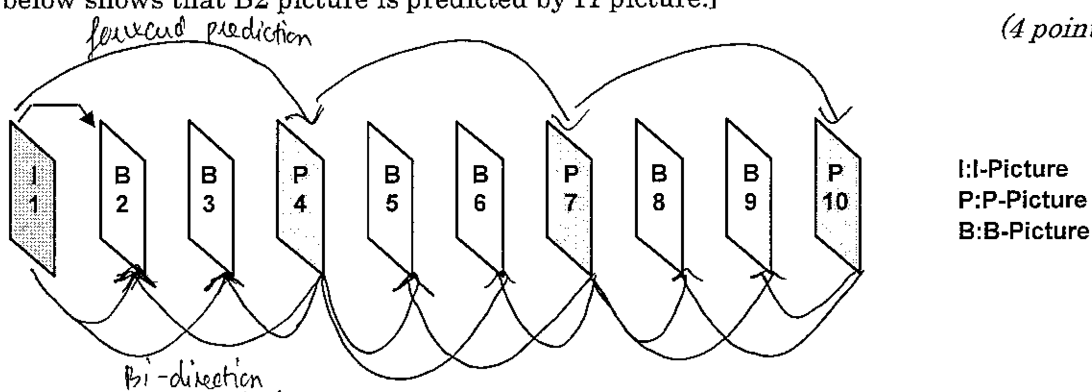
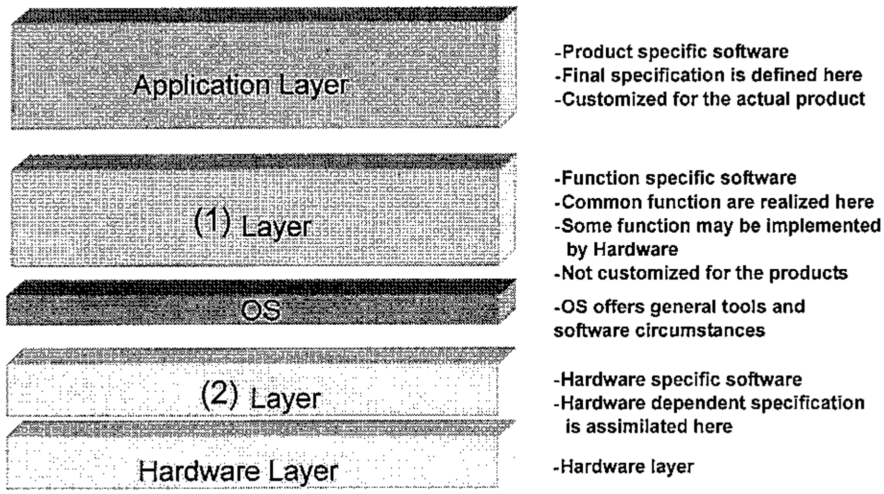


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL ~~d)~~ Driver

(2) ~~a)~~ API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2158
Name	Thanh Tung Pham

~~27.5~~ 33.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency must be atleast 2 times multiply by Maximum frequency of the Signal (Nyquist)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off) ~~-4~~ -3 0

(b) Signed Truncation -4 0

(c) Rounding -3 0

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

6

(a) Calculate the maximum frequency CD can re-produce.

$\frac{48\text{ kHz}}{2}$ 0

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~48.000 × 2^24 × 6.~~ 0

(c) Calculate the size of 60[min].

$48.000 \times 2^{24} \times 6 \times 60 \times 60$ 0 [B]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~"Aliasing" happens~~

~~(30k × 2)~~ − 48k Aliasing 0

10 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) good

(e) poor

(d) ~~Poor~~ difficult

(f) ~~good~~ easy

(g) poor.

(h) good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5

~~FFT is much faster than DFT~~

fourier tranform with FFT is faster than with DFT because FFT equation eliminates some redundant calculatons from DFT equation

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

We should use high pass filter (which allow high frequency signal to go though)

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [MPEG1] transformation.

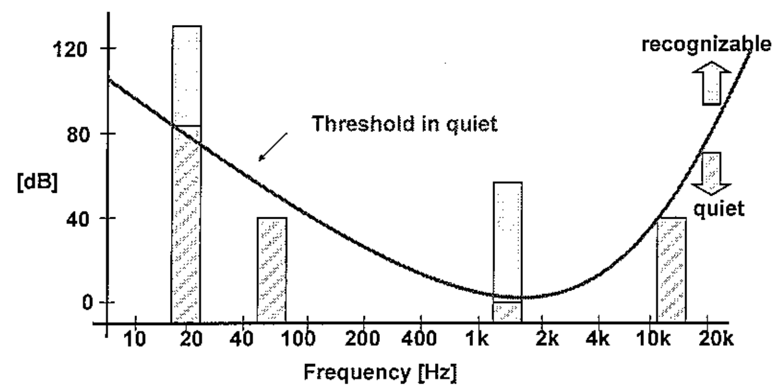
(2) Stereo Coding
Utilize the property of [MPEG2] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [H.264].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

1



- This Psych-acoustic model shows up frequency range that human being can hear (from 16 Hz → 20.000 Hz)

- In Audio encoding, designers have to folow the rule in the figure ~~in order to~~ because if encoded audio is out of the range (16 → 20 kHz) then no one is going to ~~use it~~ be able to hear anything

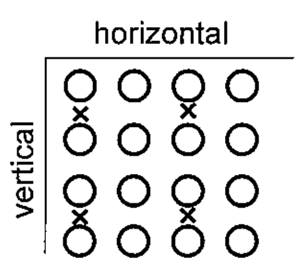
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 30 \times 2^8$]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[$\dfrac{3840 \times 2160 \times 30 \times 2^8}{100 \cdot 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

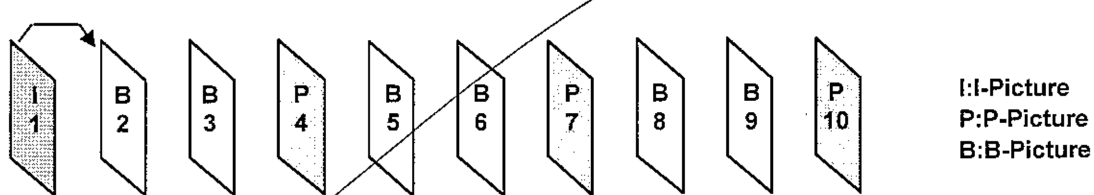
Ans.	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig:2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

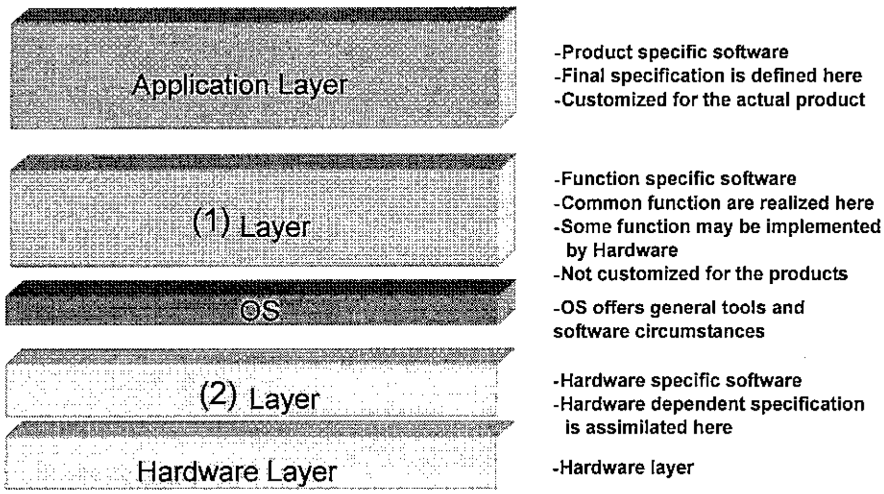


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

6

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

12

ID code	2159
Name	Nguyen Chan Uy

~~42~~

46

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

1

~~Folow~~ Use the Nyquist theory to get the sampling frequency

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~12~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{1}{2} f_{sample} = 24 \ (kHz)$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = $f_s * 2 *$ linear PCM = 48 * 2 * 24 (bit/sec)

(c) Calculate the size of 60[min].

Size = bitrate * 60 * 60 (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

The re-produce Signal ~~will be wrong~~

14 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple   (b) Complex

(c) Good   (e) ~~Poor~~

(d) Poor   (f) Good

(g) ~~Poor~~, Poor   (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

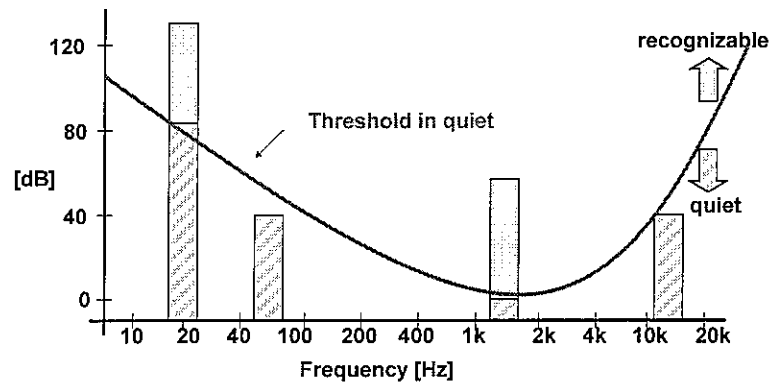
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
10
(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [~~Frequency domain~~] transformation.

(2) Stereo Coding
Utilize the property of [~~Quantization and output bit stream~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability ~~of [~~ Quantization and output bit stream].

2.2 Following figure shows a Psych-acoustic model.
2 What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)

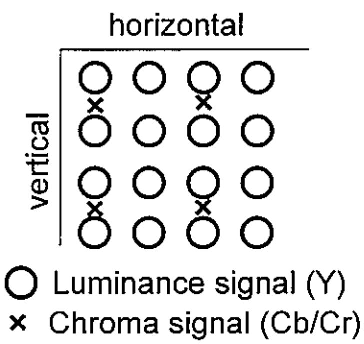


To reduce or cut the quiet in audio and keep the recognizable part to reduce the data size.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] * 2160[line/frame] * 8 * (3 + 1/6)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840[pixels/line] + 2160 [line/frame] + 8+3+$\frac{1}{2}$]

6

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840[pixels/line] + 2160[line/frame] × 8+3 ×$\frac{1}{2}$ + 30 [frame/sec] ?
]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

1 + c
2 + a
3 + b

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.] *(4 points)*

0

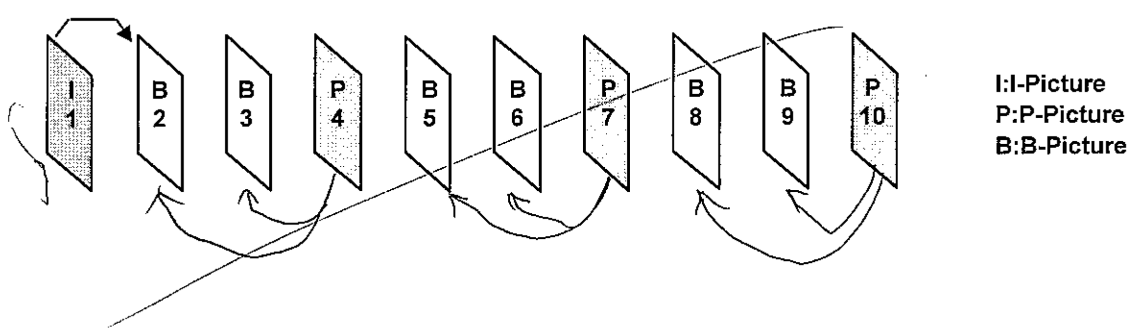
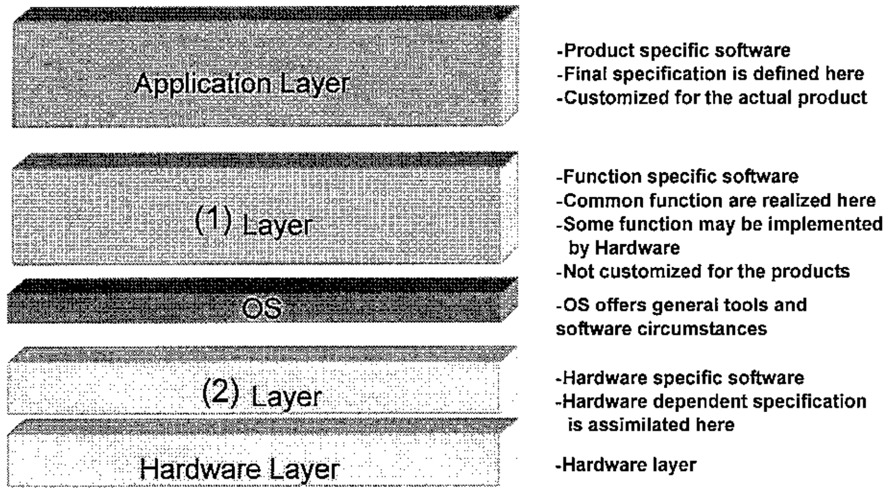


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

12

ID code	2160
Name	Do Hoang Van

~~30~~

34

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 Sampling frequency must 2 time higher signal frequency.
$f_s \geq 2 \times f_m$.

0 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -3

(b) Signed Truncation -4

(c) Rounding -3

~~8~~ 12 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.
~~$48 \times 10^3 \times 24 \times 6$~~ $48/2 = 24$ (kHz)

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].
$48 \times 10^3 \times 24 \times 6 = [?]$

(c) Calculate the size of 60[min].
$48 \times 10^3 \times 24 \times 6 \times 60 \times 60 = [?]$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?
Aliasing.
$f_{alias} = 48k - 30k = 18$ ~~kH~~ (kHz)

6 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) ~~Reasonable~~.

(c) Good

(e) Good.

(d) ~~Difficult~~

(f) ~~Easy~~ Simple

(g) ~~Difficult~~ Complex

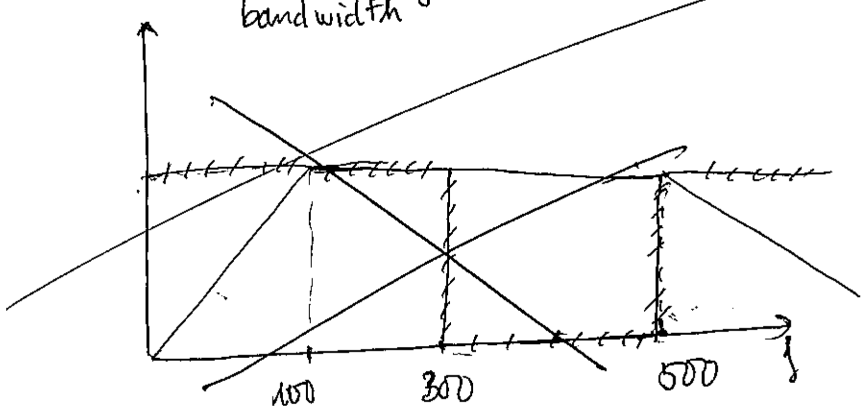
(h) ~~fi~~ ~~Easy~~.

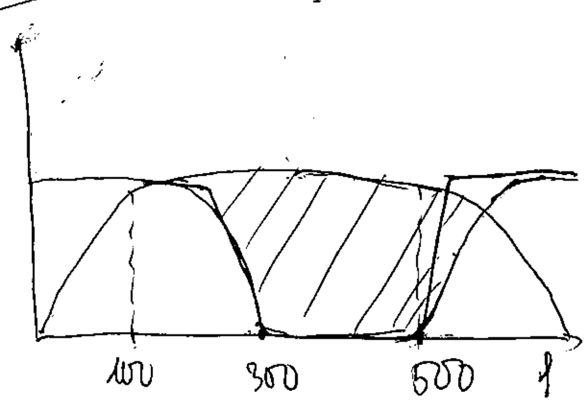
1 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

Reduce ~~cost~~ calaulating fomular by 4 time.

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

We use ~~bandbend~~ bandwidth filter.





2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

87

(1) Fourier Transform
Utilize [Signal Analysis] transformation.

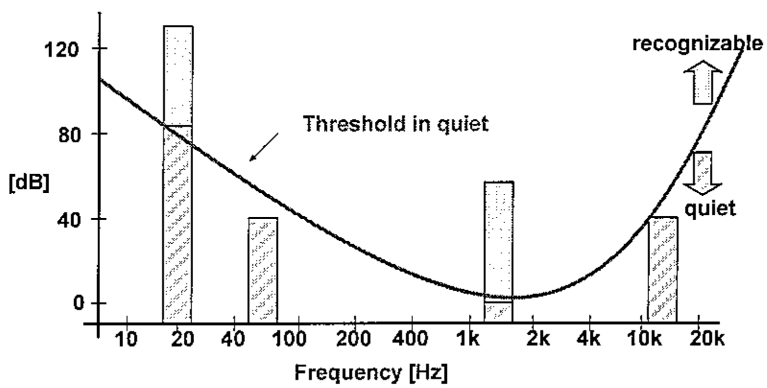
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [ ].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

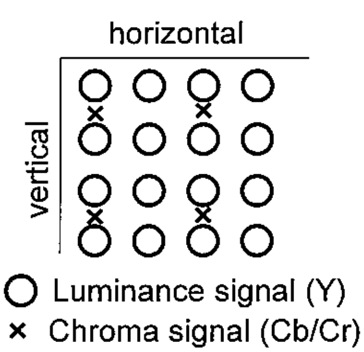
80

(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:



Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])
~~3840 x 2160 x 8 x 30~~

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [

]

4) Calculate total data rate of UHD/4K Video data above
Ans: [

]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT	c	a) Probability theory technique
2) VLC	a	b) Time Domain technique
3) MC	b	c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

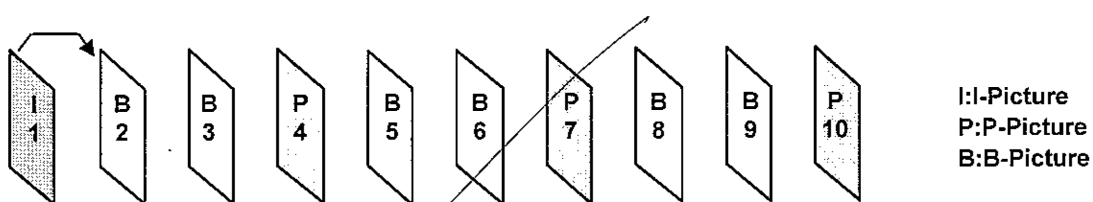
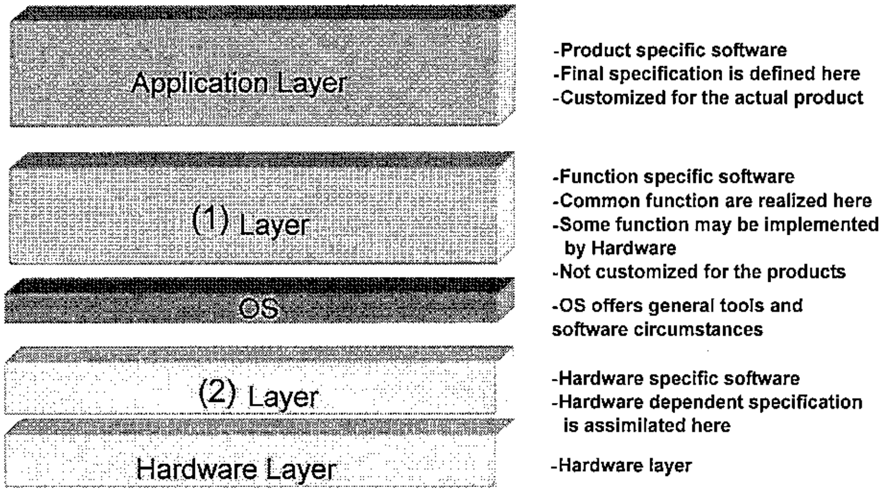


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

12

ID code	2163
Name	Tran Tuan Vu

~~44~~

50

RVC "System Solution" **Examination** ~~November 24, 2017~~

1. Digital Signal Processing

01 1.1 How to prevent "Aliasing"? *(3 points)*

Remove all signal have value smaller than threshold value.

3 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation ~~4~~

(c) Rounding ~~-3~~

~~08~~ 06 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can reproduce.

$\frac{48}{2}$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

48.1000 . 24 . 6

(c) Calculate the size of 60[min].

48. 1000. 24. 6. 60. 60

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
16 (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) ~~Complex~~ Simple
(b) ~~Simple~~ Complex
(c) ~~Reasonable~~ ~~Poor~~ Good
(e) ~~Expensive~~ Good
(d) ~~Difficult~~ Poor
(f) ~~Easy~~ Good
(g) Poor
(h) Good

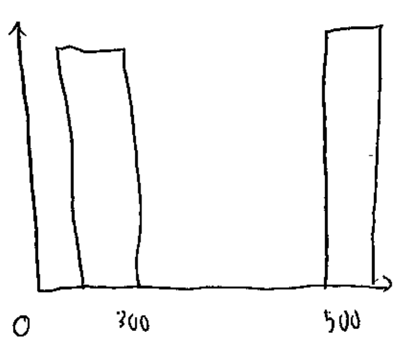
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

~~Stop-band filter.~~



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time space to frequency] transformation.

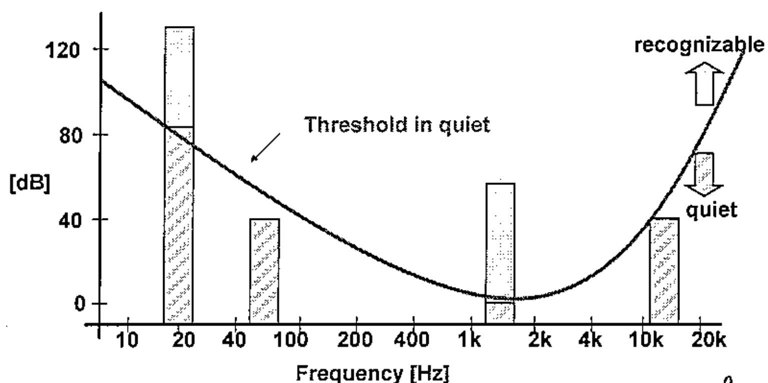
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [occurence OK].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

3



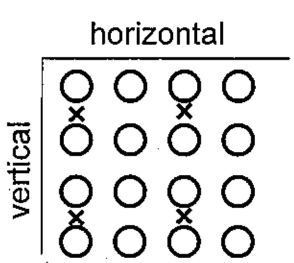
It will remove all noise ~~have liter~~ have value smaller than value of threshold depend on ~~p~~ frequency.

Purpose: Anti- ~~Alising~~ noise

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame]) 4. 4 = 16 (pixels/frame)

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [~~16.4~~ 16.3. $\frac{1}{2}$]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 . 2160 3.8 . $\frac{1}{2}$. 30]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

10

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

6

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

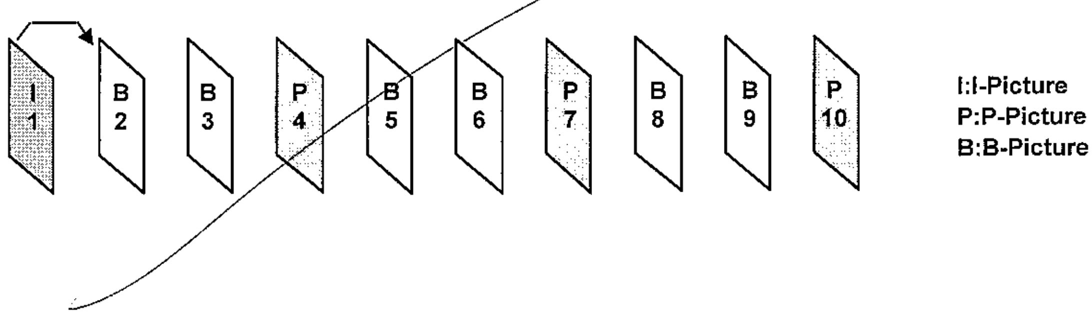
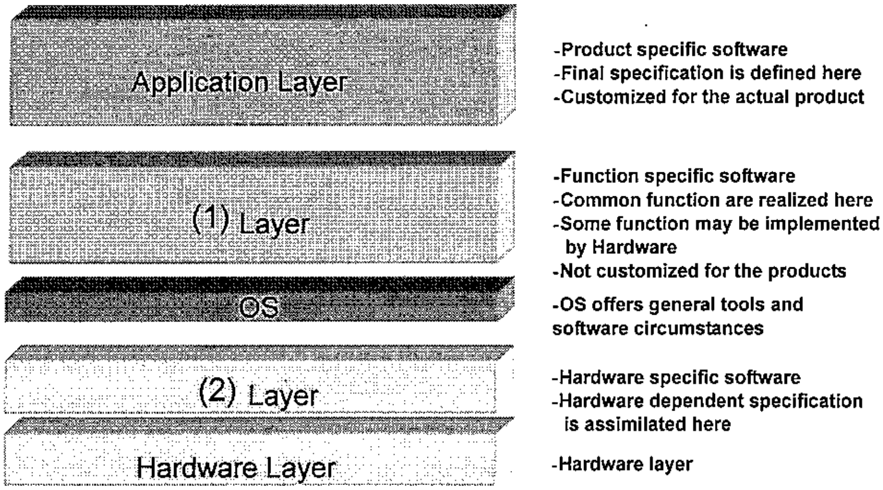


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

1 9 + 3

ID code	2167
Name	Hồ Huỳnh Quốc Chương

82.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

The sampling frequency must be equal or higher the Nyquist frequency

$f_s \geq 2 f_{max}$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

-4

(b) Signed Truncation

-3

(c) Rounding

-4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).

8

(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = \frac{1}{2} f_s = \frac{1}{2} \times 48kHz = 24kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$bitrate = f_s \times 24b \times 6 = 48 \times 24 \times 6 \times 10^3$

[0]

(c) Calculate the size of 60[min].

$size = bitrate \times length = (48 \times 24 \times 6 \times 10^3) \times 60 \times 60$

[0]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias ~~with frequency 18kHz~~

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords: (Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Good) : for original signal (d) (Poor) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) (Good) : for repeating copy & signal transfer
Stability	(g) (Poor) : for time variant, etc	(h) (Good) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) Complex

(c) Good

(e) Good

(d) Poor

(f) Good

(g) Poor

(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5

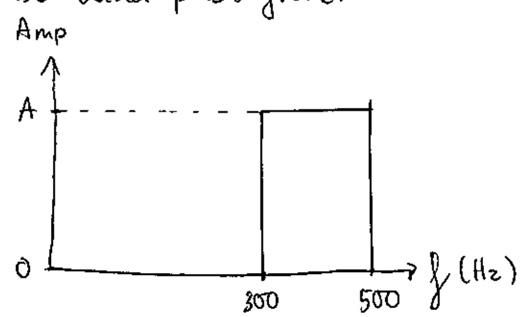
FFT calculate the results faster than the original method DFT

	FFT	DFT
Time consumpt	$\sim N\log_2(N)$	$\sim N^2$

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

3

Use Band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

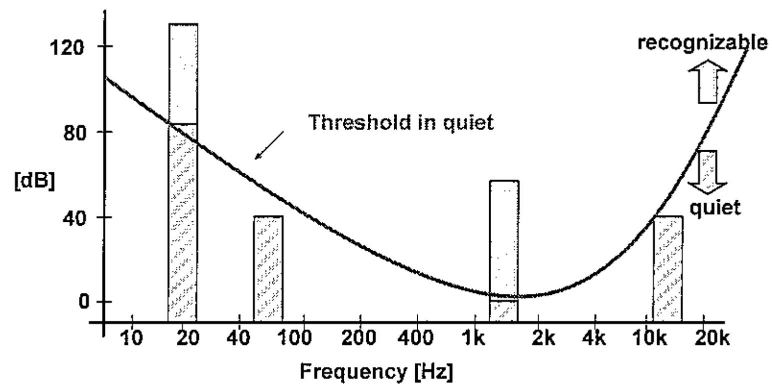
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [date appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

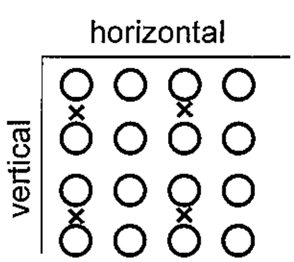


Human heared scense have a threshold depend on frequency of sound. ~~and~~ any sound below the threshold will never be heart by human, so the data of this ~~co~~ sound can be ignord for better data compression.

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 pixel/line x 2160 line/frame x 8bit/pixel x3 x 1/6 x30 frame/sec x (Run length) ~~sec~~ second]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [3840 pixel/line × 2160 line/frame × 30 frame/sec × 8bit/pixel × 3 × 0,5 × (Run length) second]

4) Calculate total data rate of UHD/4K Video data above

Ans: [3840 pixel/line × 2160 line/frame × 30 frame/sec × 8bit/pixel × 3 × 0,5]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans: [(3840 ~~pixel/line × 2160 line/frame × 30 frame/sec × 8bit/pixel × 3 × 0,5~~)/(100 × 10^6 bit/s)]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.
1) DCT — a) Probability theory technique
2) VLC — b) Time Domain technique
3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

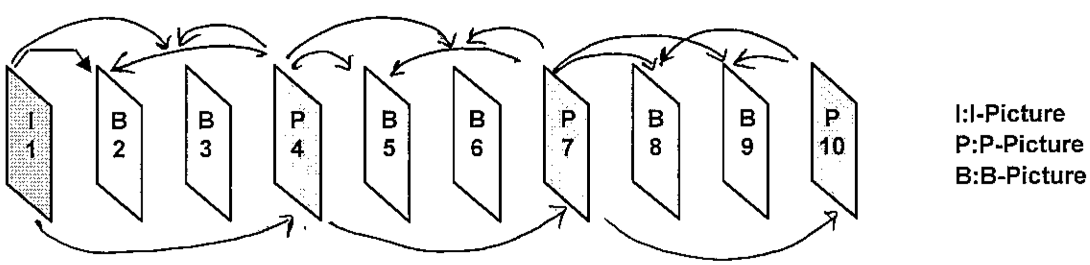
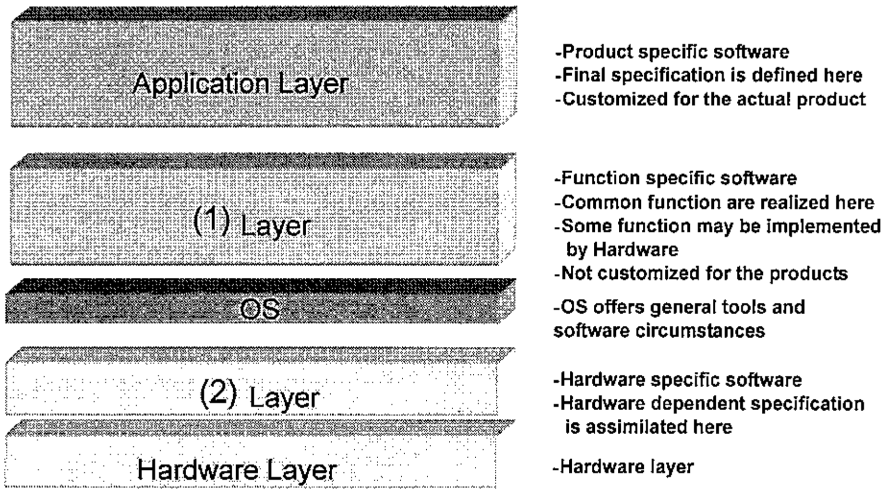


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

18 + 3

ID code	2168
Name	Lâm Thắng Đạt

~~75.5~~

RVC "System Solution" **Examination** November 24, 2017

29.5

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 The sample frequency is higher than double max frequency on this signal

$f_s \geq 2f_m$ (Nyquist)

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~8~~ 12

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq \frac{f_s}{2} = \frac{48}{2} = 24$ kHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bit rate = 48 . 1000 . 24 . 6 [bit]

(c) Calculate the size of 60[min].

Size of 60 min = Bitrate . 60 . 60 [bit]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing occur at f = 48 - 30 = 18 kHz

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

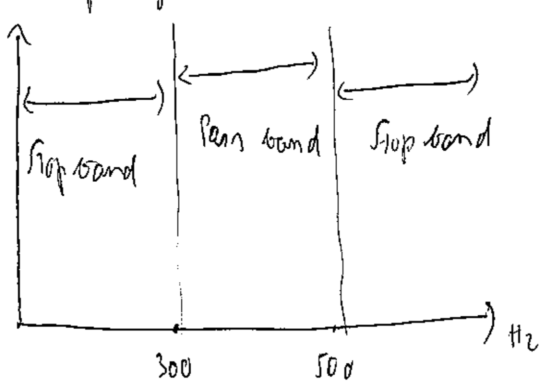
1.5 1.5 What is the advantage of FFT compare with DFT? *(3 points)*

FFT is fast calculation algorithm of DFT, for $N = 2^m$ cases

FFT has less multiplication and addition than DFT

2 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

Use band pass filter



2. Audio Coding

2.1 ~~Fill~~ out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

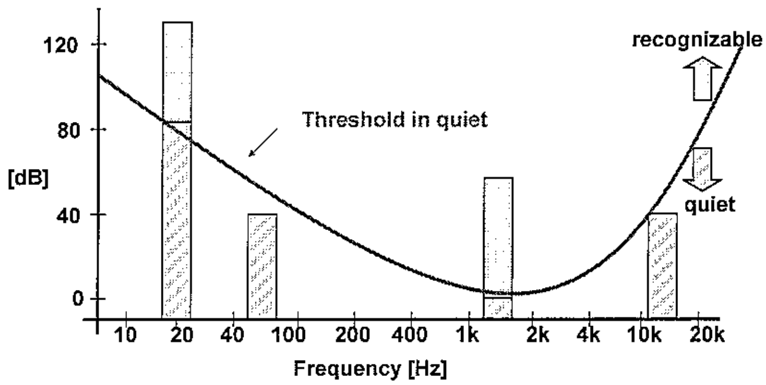
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

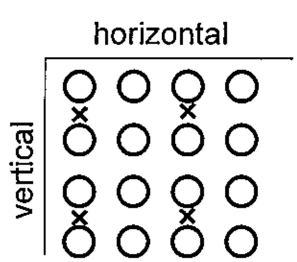
2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])
~~3840. 2160. 8. 3. 1/2.~~

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840. 2160. 8. 3. 1/2 (bits / frame)]

12

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [$3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2}$ (bits/frame)]

4) Calculate total data rate of UHD/4K Video data above

Ans: [$3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} \cdot 30$ (bps)]

9

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[$\dfrac{3840 \cdot 2160 \cdot 8 \cdot 3 \cdot \frac{1}{2} \cdot 30}{100 \cdot 10^6}$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT – c   a) Probability theory technique

6

2) VLC – a   b) Time Domain technique

3) MC – b   c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

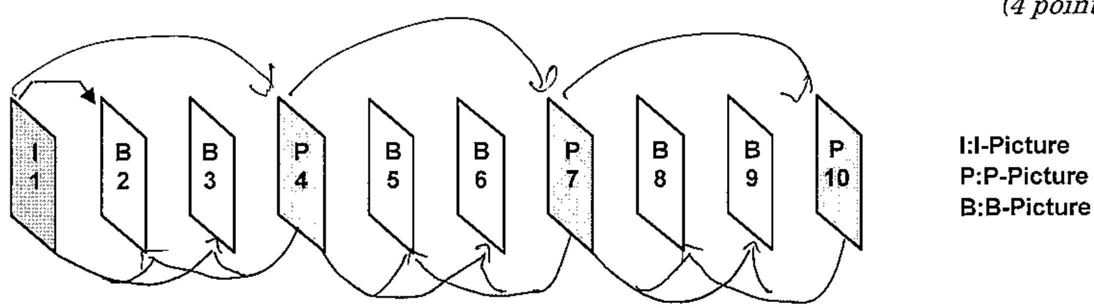


Figure 2.1. Prediction of MPEG1/2 Video coding

B B I B B P B B

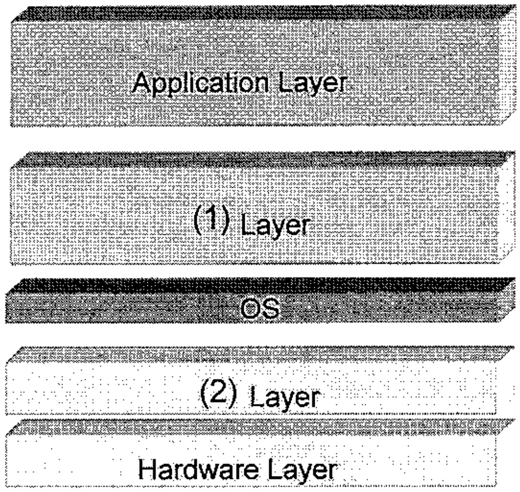
2 3 1 5 6 4 8

I B B P

1 2 3 4

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



-Product specific software
-Final specification is defined here
-Customized for the actual product

-Function specific software
-Common function are realized here
-Some function may be implemented by Hardware
-Not customized for the products

-OS offers general tools and software circumstances

-Hardware specific software
-Hardware dependent specification is assimilated here

-Hardware layer

Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

0

Describe briefly the advantages of OpenMAX IL *(2 points)*

Open max IL serves as a low level interface for audio video and imaging codes used in embedded devices, It give application and media frame works the ability to interface with multimedia codes and supporting components

8

ID code	2169
Name	LE QUI DON

(40)

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency ≥ Nyquist frequency.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off)

(b) Signed Truncation

$-1,1 \rightarrow -2$; $-0,1 \rightarrow -1$; $0,1 \rightarrow 1$; $1,1 \rightarrow 2$.

(c) Rounding

$-1,6 \rightarrow -2$; $-2,4 \rightarrow -1$; $-0,8 \rightarrow 0$; $0,6 \rightarrow 1$

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

(a) Calculate the maximum frequency CD can re-produce.

4

24 KHz

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$\frac{144}{48000}$ (bit/s)

(c) Calculate the size of 60[min].

144x3600

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

aliasing.

16 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.5

FFT is fast calculation algorithm of DFT, for $N = 2^n$ case

FFT has less multipliation and addition than DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

1.5

Band Pass Filter.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

10

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [~~time~~ ~~Frequency~~ Time - frequency .] transformation.

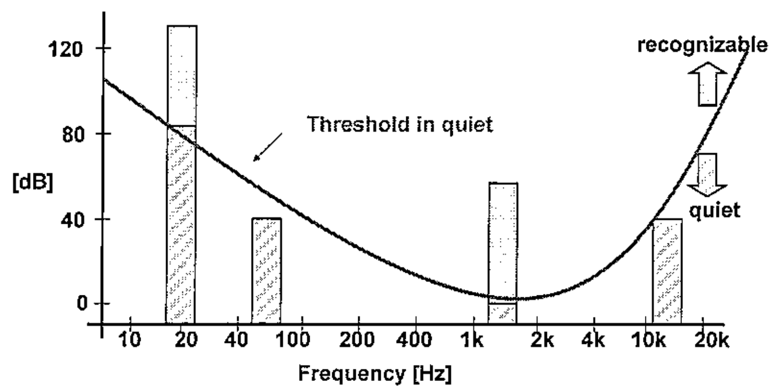
(2) Stereo Coding
Utilize the property of [~~frequency~~ ~~Audio data~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance → data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

0

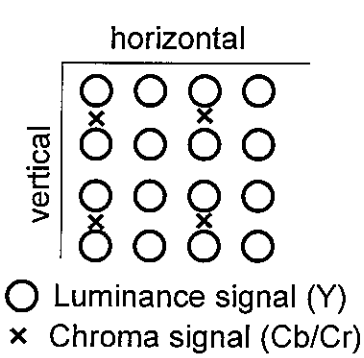
(5 points)



3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT → a) Probability theory technique

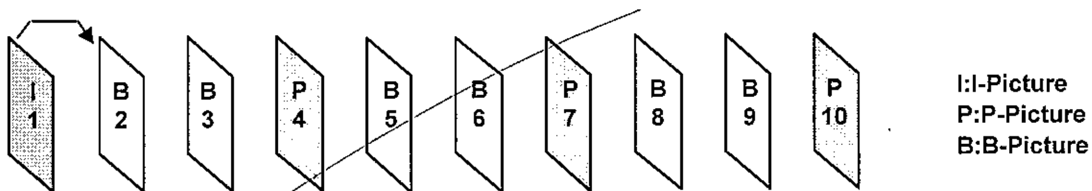
0 2) VLC → b) Time Domain technique

3) MC → c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

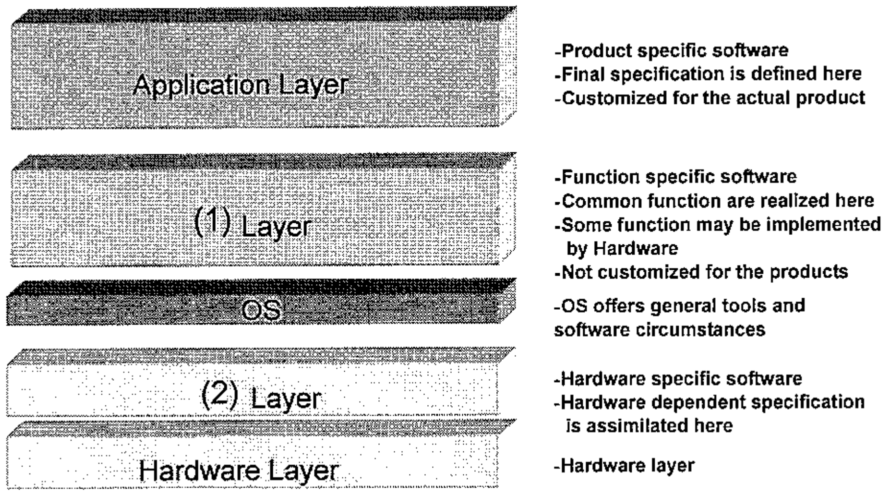


0

Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL ~~d)~~ Driver

6

(2) a) API ~~b)~~ Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

Open max IL serves as a done level interface for audio and gaming codes used in embeded driver
It give application and media frame work chiving to interface with multimedia codes and
supporting ampunern.

14

ID code	2171
Name	Tran Huu Nghi

~~59~~ 63

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 use $f_s \geq 2f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

-4

(b) Signed Truncation

-3

(c) Rounding

-4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

8

(a) Calculate the maximum frequency CD can re-produce.

$f_m \leq f_s/2 \leq \frac{48\,KHz}{2} = 24\,KHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

Bitrate = 48kHz*1000 * 24bit * 6channels [x]

(c) Calculate the size of 60[min].

60*60* bitrate [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

aliasing will appear and ~~$f_a = 6\,KHz$ (30-24=6)~~

= ? x

12 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple   (b) Complex
(c) Good   (e) Good
(d) ~~Poor~~ Difficult   (f) ~~Easy~~
(g) poor   (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 Easier and more simple.

0 1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

use low pass filter.

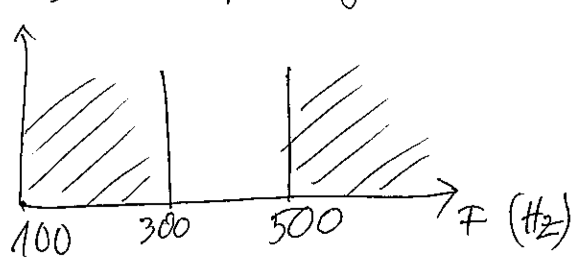


Figure.

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

M

(1) Fourier Transform
Utilize [Time – Frequency] transformation.

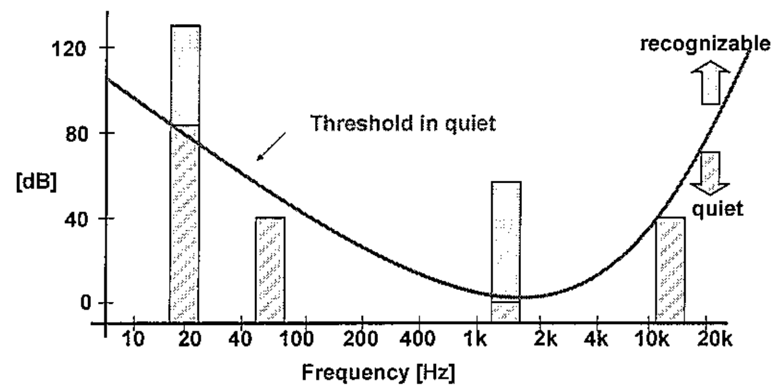
(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)

1



Depending of power and frequency.

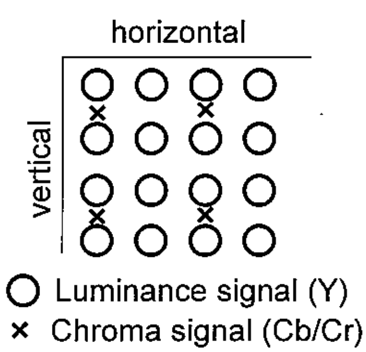
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 [pixels/line] * 4
2160 [lines/frame] * 2.]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840[pixels/line] * 2160[lines/frame] * 8 * 1/2 . × 3]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 [pixels/line] * 2160 [lines/frame] * 8 * 1/2 * 30 × 3]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

0

Ans:[$[100 \text{ Mbps} * 10^6] / [\cancel{\text{total data rate}}]$]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT (c) — a) Probability theory technique

2) VLC (b) — b) Time Domain technique

3) MC ~~b~~ (a) — c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

4

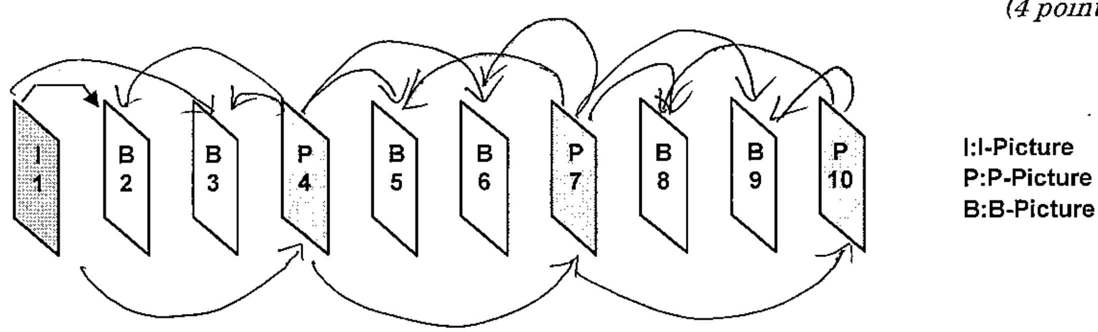
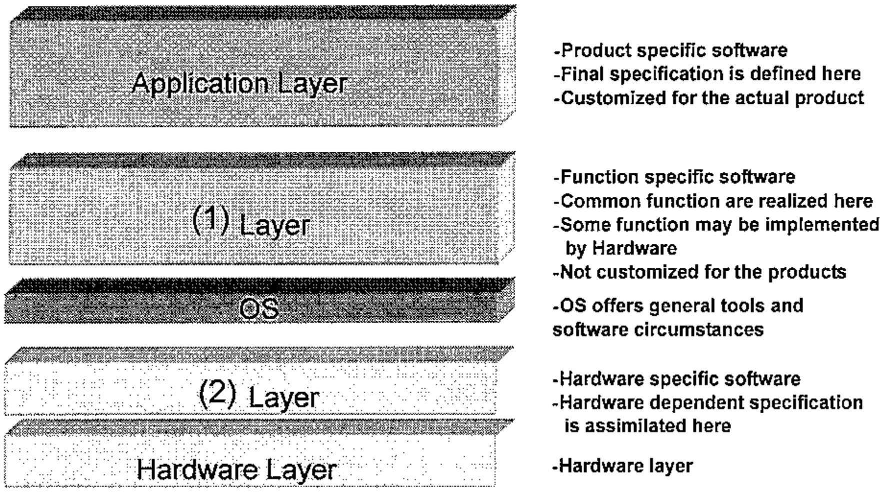


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

it gives applications and media frameworks and the ability

2 to ~~in~~ interface with ~~m~~ multimedia ~~codecs~~ codecs and supporting components in a unified manner.

8

ID code	2172
Name	Nguyen Cong Nhat

~~61.5~~
63.5

RVC "System Solution"

Examination

November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

~~→ Sampling frequency > Nyquist frequency~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off)

[-3.75] → [~~-3.75~~]

(b) Signed Truncation

[-3.75] → [~~-4~~]

(c) Rounding

[-3.75] → [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

12

(a) Calculate the maximum frequency CD can re-produce.

$f_m = \frac{f_s}{2} = \frac{48}{2} = 24\ kHz$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$bitrate = (48.1000).24.6 = 6912.10^3 (bit/s)$

(c) Calculate the size of 60[min].

$datasize = bitrate . (60.60) . \cancel{6} (bit)$

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~it will be alias = 18 kHz~~

1

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) simple
(b) Complex
(c) good
(e) good
(d) poor
(f) good
(g) poor
(h) good

1.5

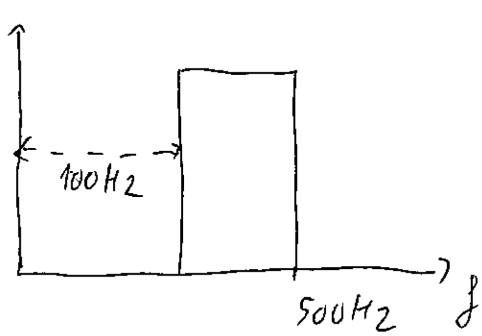
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

- FFT in fast calculation algorithm of DFT for $N = 2^m$ cases
- FFT has less multiplication and addition than DFT

3

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

use Band pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

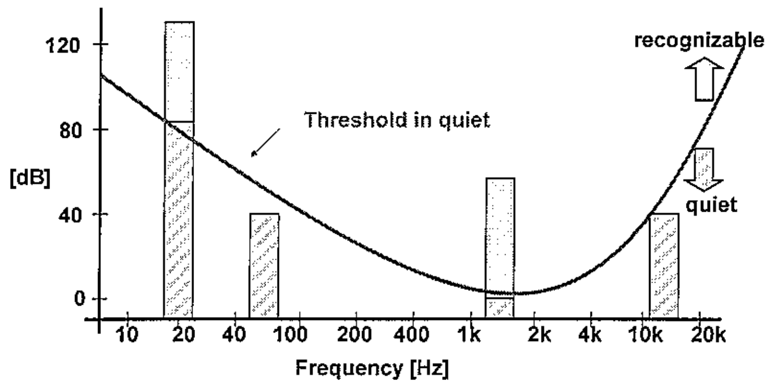
(1) Fourier Transform
Utilize [time – frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation ~~between~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data ~~appearance~~ appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



— The meaning: The hearing sensation that corresponds to sound levels in the loudness of the sound → hearing range and hearing threshold are exist.

— purpose: We can delete the information that we can't hear

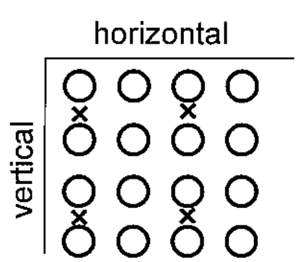
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840 × 2160 × 8 × 3 (bit/frame)]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 * 2160 * 8 (bit)]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 * 2160 * 8 * 30 (bits/s)]

0 5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

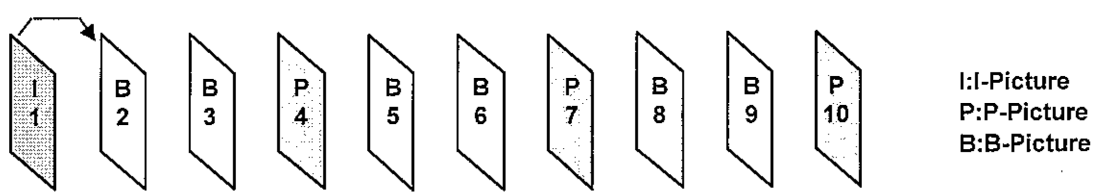
0 2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)



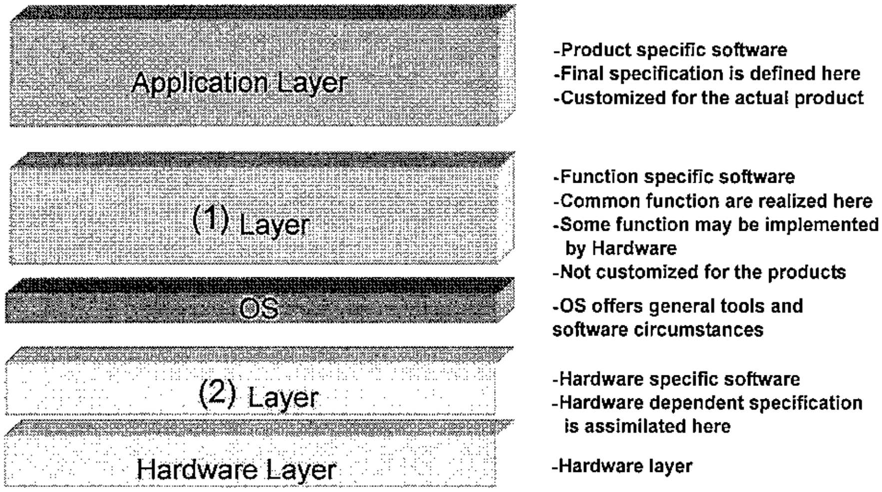
0

Figure 2.1. Prediction of MPEG1/2 Video coding

A Sequence frames have the same background — use inter prediction

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) a) API b) Middleware c) RTL d) Driver

6

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMax IL Serves as a low-level interface for audio, video and imaging codes used in embedded devices.

2

it gives applications and media frameworks the ability to interface with multimedia codes and supporting ~~with~~ components in unified manner.

11

ID code	2174
Name	Đinh Thị Thảo Vy

RVC "System Solution"

Examination

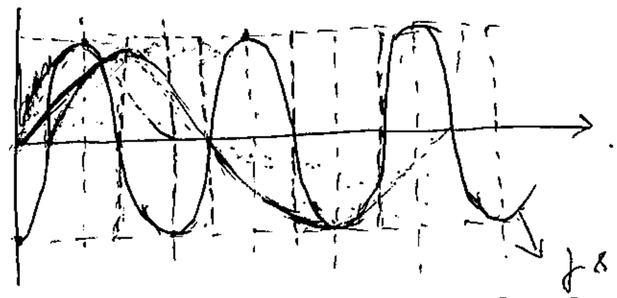
November 24, 2017

~~47~~ 55

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0



$f_s > 2 * f_m$?

aliasing happen.

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

3

(a) Truncation (round off) ~~[-3]~~

(b) Signed Truncation ~~[-4]~~

(c) Rounding [-4]

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result). *(4 points for each: total 16 points)*

~~8~~ 16

(a) Calculate the maximum frequency CD can re-produce.

$$f_s > 2 * f_m \rightarrow f_m = \frac{f_s}{2} = \frac{48kHz}{2} = 24\ kHz$$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

$$bitrate = (48 * 1000) * 24 * 6 = ?\ (bit/sec)$$

(c) Calculate the size of 60[min].

$$Size_{[60\,min]} = bitrate * 60 \cdot 60$$

?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

The aliasing will happen.

aliasing ⇒ 48 − 30 = 18 kHz

6 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex
(c) ~~Poor~~ (e) Good
(d) ~~difficult~~ (f) ~~easy~~
(g) Reasonable (h) ~~Reasonable~~

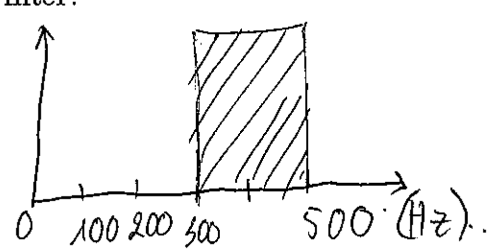
1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

Fast Fourier Transform | Discrete Fourier Transform

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0



filter.

filter : high-frequency filter

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time - Frequency] transformation.

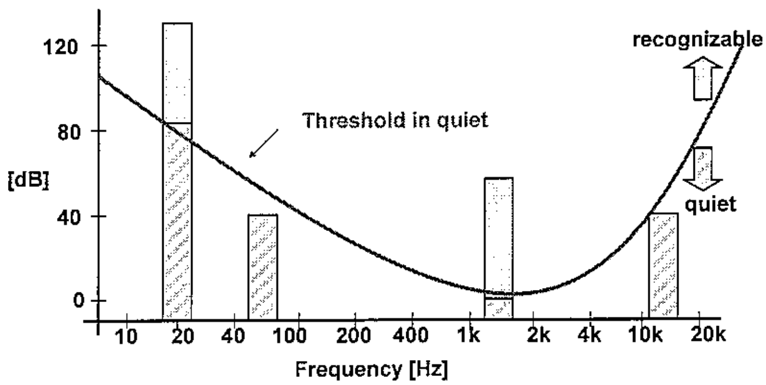
(2) Stereo Coding
Utilize the property of [Correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

4

(5 points)



There is a threshold in quiet of Psych-acoustic model. It help us can remove the signal ~~have~~ which have frequency lower than threshold when audio encoding. because ~~that~~ signals ~~never be heard by human~~. human cannot heard this signals. ~~(In example: the signal have frequency 4k~~ Hz

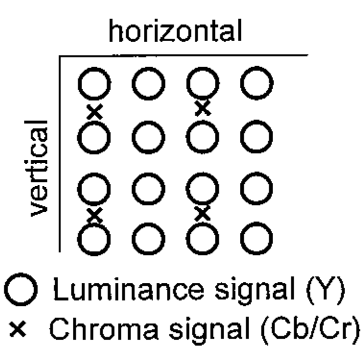
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT 1c	a) Probability theory technique
6	2) VLC 2a	b) Time Domain technique
	3) MC 3b	c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

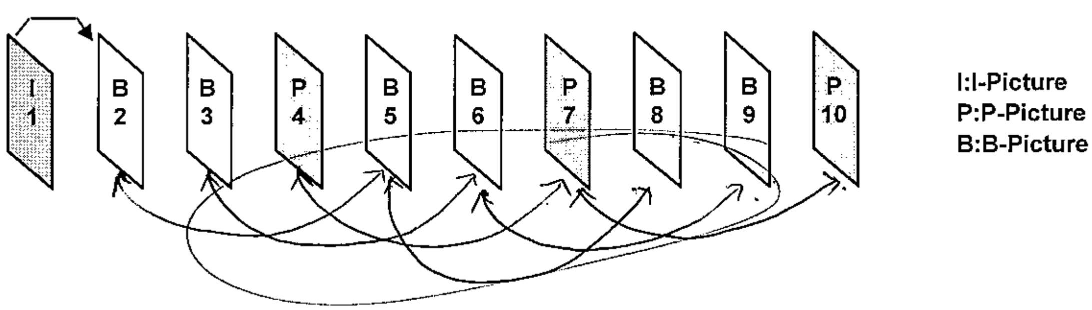
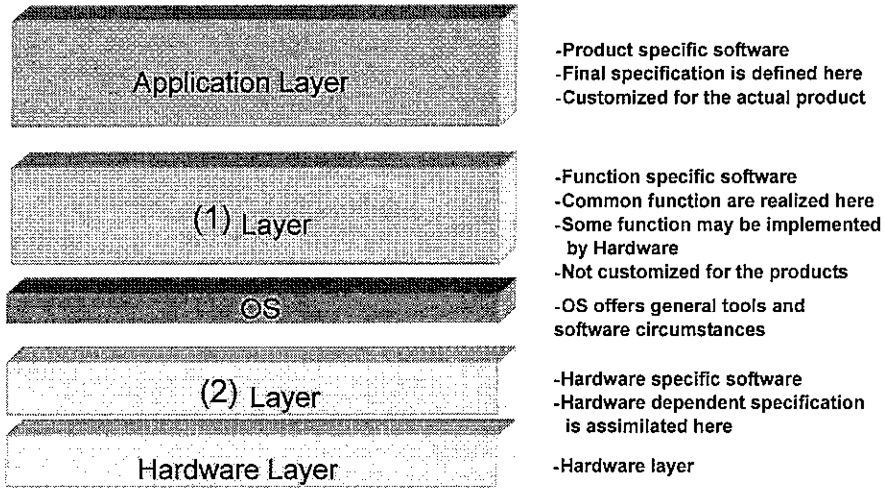


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

(1) ~~a)~~ API   b) Middleware   c) RTL   d) Driver

3

(2) a) API   b) Middleware   c) RTL   d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2 OpenMax IL is a royalty-free cross-platform set of C-language programing interface that provide abstration for routines especially useful for audio, video and still image.

Give a application and media framework the ability to interface with multimedia codes and supporting component in a unified manner.

8

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Name	Tiền Mỹ Hồng

55

RVC "System Solution" **Examination** November 24, 2017

57

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3 If sampling frequency $f_s < 2 f_m$, aliasing signal appears

Ex: $x(t) = \sin(2\pi \times 333)$

$f_m = 333 Hz$

$f_s = 500 Hz$

Aliasing signal has $f_a = 167 Hz$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

6

(a) Truncation (round off) $-\cancel{3}$

(b) Signed Truncation -3

(c) Rounding -4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

4

(a) Calculate the maximum frequency CD can re-produce.

~~$f_s >= 2 \times f_m \rightarrow f_m <= f_s/2$~~

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bitrate = (48 × 1000) × 24 × 2 [x]

(c) Calculate the size of 60[min].

datasize = bitrate × (60 × 60) [x]

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~Alias 18 kHz~~ !

16

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple (b) Complex

(c) Good (e) Good

(d) Poor (f) Good

(g) Poor (h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

0

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

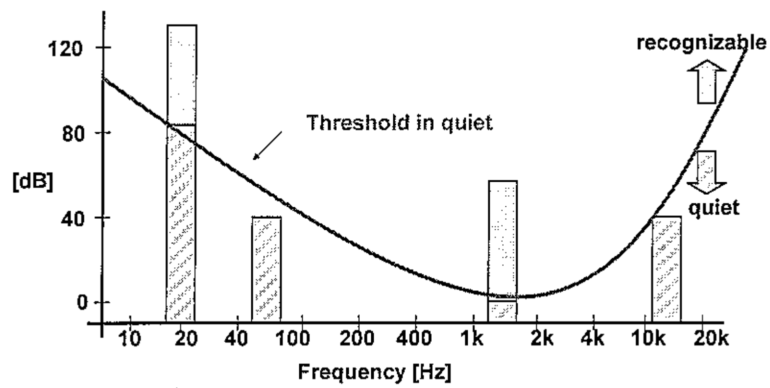
2.1 Fill out the blank 3 common methods which are used in Audio Encoding.
(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [Time – Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation ~~between~~] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

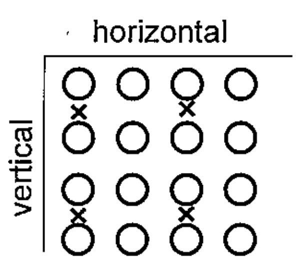
2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?
(5 points)



- loudness contours from Fletcher and Munson
- Hearing range and hearing threshold are ~~exit~~ exist
- Delete the information that we can't hear

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:
Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



○ Luminance signal (Y)
× Chroma signal (Cb/Cr)

1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [3840[pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] × 3 × 1/2
= 3840 × 2160 × 12 [bits/frame]
]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [3840 [pixels/line] × 2160 [lines/frame] × 8 [bits/pixel] × $\frac{3}{2}$
= 3840 × 2160 × 24 [bits/frame] / 2]

4) Calculate total data rate of UHD/4K Video data above
Ans: [3840 [pixels/line] × 2160 [lines/frame] × $\frac{24}{2}$ [bits/frame] × 30 [frames/sec]
= 3840 × 2160 × 24 × 30 [bps] / 2]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

0

Ans. 1) DCT a) Probability theory technique

2) VLC b) Time Domain technique

3) MC c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

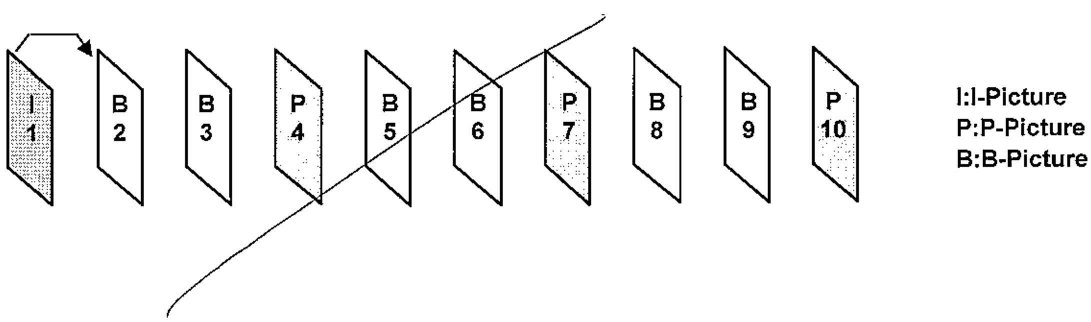
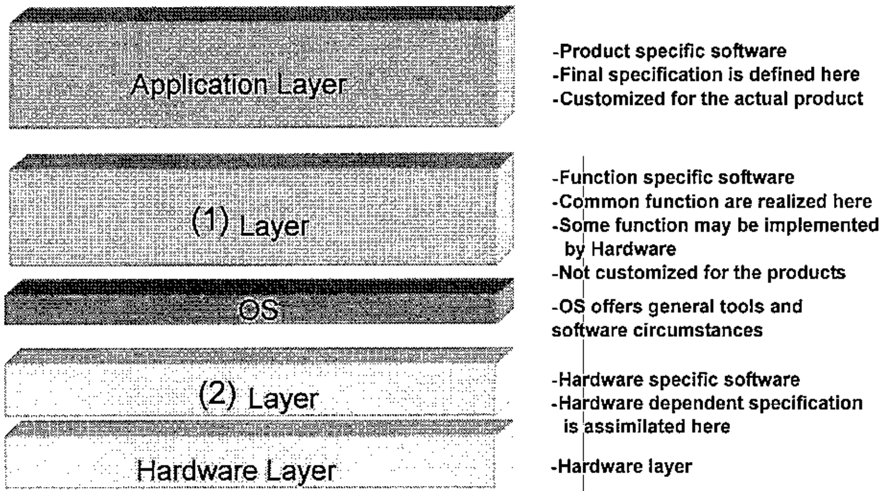


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

2

Describe briefly the advantages of OpenMAX IL *(2 points)*

OpenMAX IL serves as a low-level interface for audio, video, and imaging codecs used in embedded devices. It gives applications and media frameworks the ability to interface with multimedia codecs and supporting components in a unfied manner.

2

ID code	2176
Name	Vy Quoc Tuan

32

RVC "System Solution" **Examination** November ~~24~~, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

0

~~Increase frequency of the signal~~

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

0

(a) Truncation (round off)

(b) Signed Truncation

(c) Rounding

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

4

(a) Calculate the maximum frequency CD can re-produce.

~~$f_m = 2 \times f_s = 2 \times 48$~~ X

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~$f_s \times$ bit $\times$ channel $= 48 \times 16 \times 6 =$~~ X

(c) Calculate the size of 60[min].

~~min $\times$ second $\times$ bit $= 60 \times 60 \times 24$~~ X

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Alias $= f_{sample} - f_{sinal} = 48 - 30 = 18$ kHz

→ We have Aliasing

10 Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) (Simple)	(b) (Complex)
Cost	Reasonable	Expensive
Quality	(c) (Poor) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) (Good) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple

(b) complex

(c) ~~Poor~~

(e) Good

(d) ~~Difficult~~

(f) ~~Easy~~

(g) ~~Reason~~ Poor

(h) Good

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1 FFT : Simple, easy to use

DFT : difficult to ~~produce~~ use

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

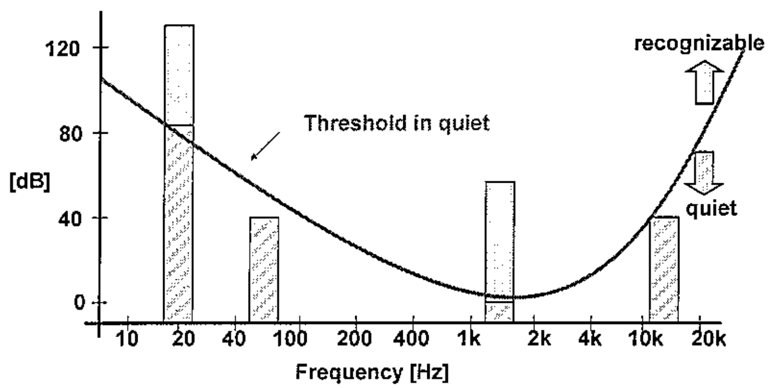
(1) Fourier Transform
Utilize [Time - Frequency] transformation.

(2) Stereo Coding
Utilize the property of [correlation] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

(5 points)



help control the process to operate smooth and not be interrupted

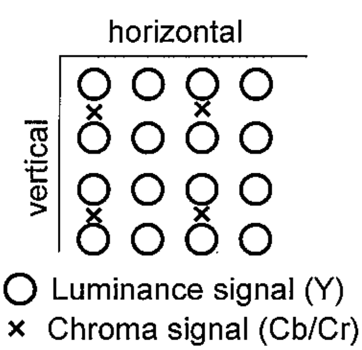
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [ ]

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [ ]

4) Calculate total data rate of UHD/4K Video data above
Ans: [ ]

0

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans.	1) DCT	a) Probability theory technique
	2) VLC	b) Time Domain technique
	3) MC	c) Frequency domain technique

2

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

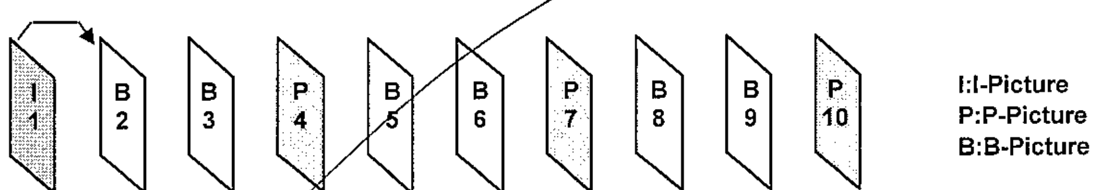
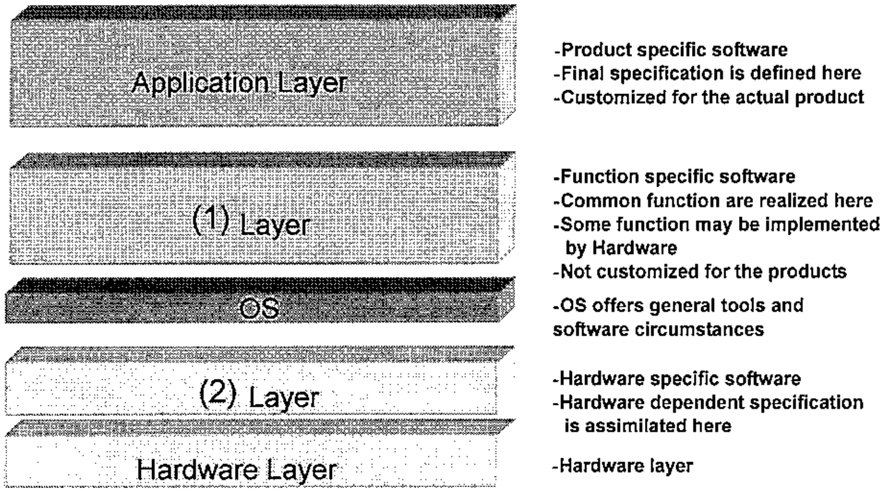


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

0

(1)	a) API	b) Middleware	c) RTL	d) Driver
(2)	a) API	b) Middleware	c) RTL	d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0

13

ID code	2177
Name	Trần Quang Vinh

~~53~~

55

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

1.1 How to prevent "Aliasing"? *(3 points)*

3

Sampling frequency should be 2 times higher than signal bandwidth (Nyquist frequency)

$f_s \geq 2 f_m$

1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

9

(a) Truncation (round off)

−4

(b) Signed Truncation

−3

(c) Rounding

−4

1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

~~16~~ 8

(a) Calculate the maximum frequency CD can re-produce.

$f_s \geq 2 f_m \Rightarrow f_m \leq f_s/2 = \frac{48}{2}\text{KHz} = 24\,(\text{KHz})$

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

bit rate $= f_s \times 24 \times 6 = 24 \times 10^3 \times 24 \times 6$ (bit/sec)

(c) Calculate the size of 60[min].

size $=$ bitrate $\times 60 \times 60 =$ ~~$24 \times 24 \times 6 \times 10^3$~~ $\times 60 \times 60$ (bit)

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

~~anal aliasing error 48kHz ?~~

4

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Complex, ~~simple~~

(b) simple ~~complex~~

(c) ~~expensive~~

(e) ~~reasonable~~

(d) poor

(f) good

(g) ~~difficult~~ easy

(h) ~~easy~~ ~~difficult~~

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

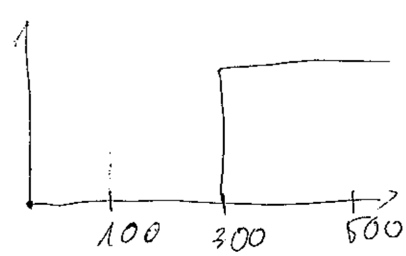
1

FFT is fast calculation algorithm of DFT

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

0.5

high pass filter



2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [time – frequency transform – fourier transform] transformation.

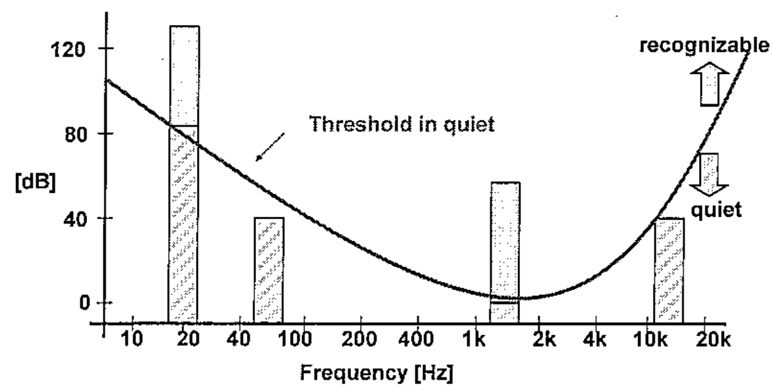
(2) Stereo Coding
Utilize the property of [correlection] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [data appearance].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

2

(5 points)

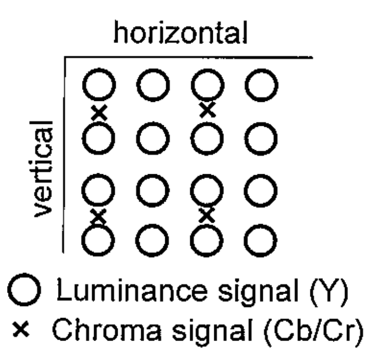


remove the sound that human can't hear

3. Video Coding

3.1 Picture format
Calculate the Video data number below. *(3 points for each)*
(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size: UHD/4K 3840 [pixels/line] x 2160 [lines/frame]
Color format: (4:2:0), 8 bits for each
Frame rate: 30 [frames/sec])



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [
~~3840 [pixels/line] × 2160 [lines/frame] × 3 × 1/2~~]

3840 × 2160 × 8 × 1/2 × 2

3) Calculate total data volume of 1 UHD/4K Video data
Ans: [$3840 \times 2160 \times 8 \times 3 \times 1/2$. Unit ?]

3

4) Calculate total data rate of UHD/4K Video data above
Ans: [$3840 \times 2160 \times 3 \times 1/2 \times 30$ unit ?]

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)
Ans:[200 ~ 1000 times]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

2

Ans. 1) DCT - c

2) VLC - ~~a~~ b

3) MC - ~~b~~ a

a) Probability theory technique

b) Time Domain technique

c) Frequency domain technique

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

0

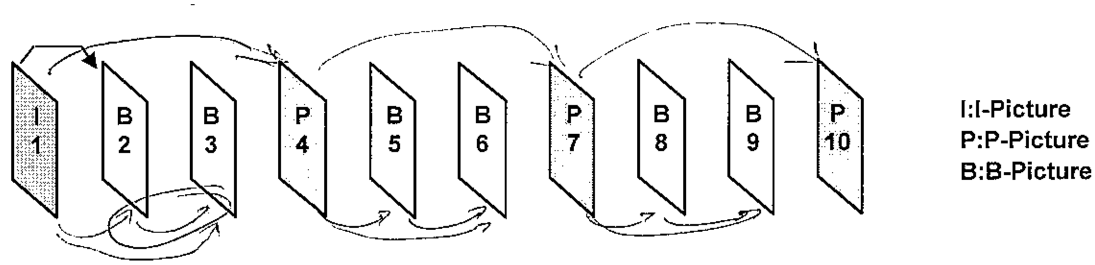
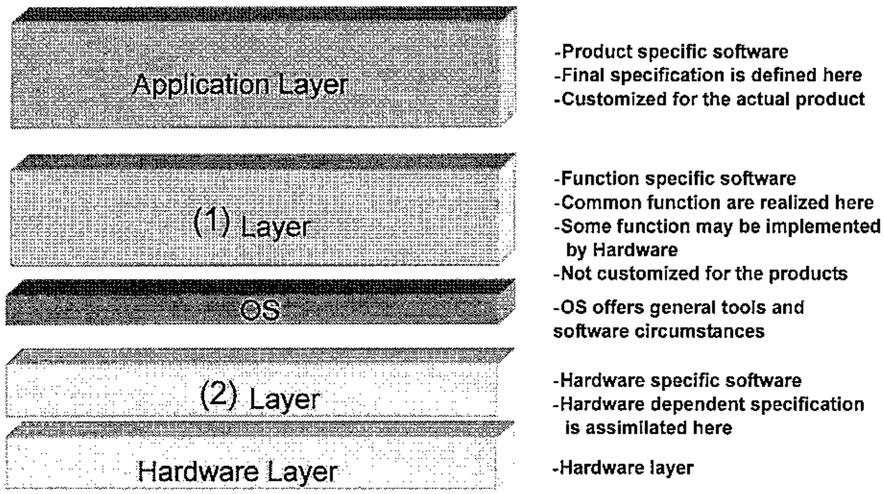


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

2

is a royalty-free, cross-platform set of C language programming interface that provide abstraction for routine.
~~it service~~ it give application and media frame work the ability to interface with multimedia codecs and support component in a unified manner.

18

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Name	Nguyen Le Phu Vinh

~~46~~ 50

RVC "System Solution" **Examination** November 24, 2017

1. Digital Signal Processing

3 1.1 How to prevent "Aliasing"? *(3 points)*

f: ~~is frequency operating frequency of system~~ sample freq.
f_{in}: is frequency of input signal.
Condition to prevent "Aliasing" is:
$f \geqslant 2 f_{in}$.

9 1.2 What is the integer value of the number [-3.75] after converting to integer number by using following methods of quantization? *(3 points for each: total 9 points)*

(a) Truncation (round off) -4

(b) Signed Truncation -3

(c) Rounding -4

~~14~~ 8 1.3 There is music CD that sampled by 48kHz, linear PCM by 24bit, recorded by 6 channels. Answer these questions about this CD.
(Only write down the formula and operation, don't need to calculate the final result).
(4 points for each: total 16 points)

(a) Calculate the maximum frequency CD can re-produce.

$f_{max} = \frac{48 kHz}{2} = 24 kHz$.

(b) Calculate the bit rate of the digitalized data of CD in [bit/sec].

~~bit rate = 24 . 48 kHz. (bit/sec).~~

(c) Calculate the size of 60[min].

size of 60 [min] = 24 . 48 kHz . 60 . 60 (bit) = ?

(d) Suppose an analog signal which has 30kHz component.
What will happen to the digitalized signal sampled by 48kHz?

Aliasing will occur ~~at~~ and ~~the digitalized signal which have fr~~.
the frequency of digitalized signal is 30kHz - ~~15 kHz~~

12

Fill out the blank (a), (b), (c), (d), (e), (f), (g), (h) using these keywords:
(Simple, Complex, Reasonable, Expensive, Good, Poor, Difficult, Easy)

(2 points for each: Total 16 points)

	Analog Processing	Digital Processing
Complexity	(a) ( )	(b) ( )
Cost	Reasonable	Expensive
Quality	(c) ( ) : for original signal (d) ( ) : for repeating copy & signal transfer	(e) ( ) : for original signal (f) ( ) : for repeating copy & signal transfer
Stability	(g) ( ) : for time variant, etc	(h) ( ) : for time variant, etc
Portability	Difficult	Easy

(a) Simple　　(b) Complex.

(c) Good　　(e) Good.

(d) ~~Poor~~ Difficult　　(f) ~~Good~~ ~~Easy~~.

(g) Poor　　(h) Good.

1.5 What is the advantage of FFT compare with DFT? *(3 points)*

1.6 Suppose a signal whose frequency from 100Hz to 500Hz. Which kind of filter we should use to keep the components whose frequency from 300Hz to 500Hz and remove the others? Draw the figure of that filter? *(3 points)*

2. Audio Coding

2.1 Fill out the blank 3 common methods which are used in Audio Encoding.

80

(5 points for each: total 15 points)

(1) Fourier Transform
Utilize [ ] transformation.

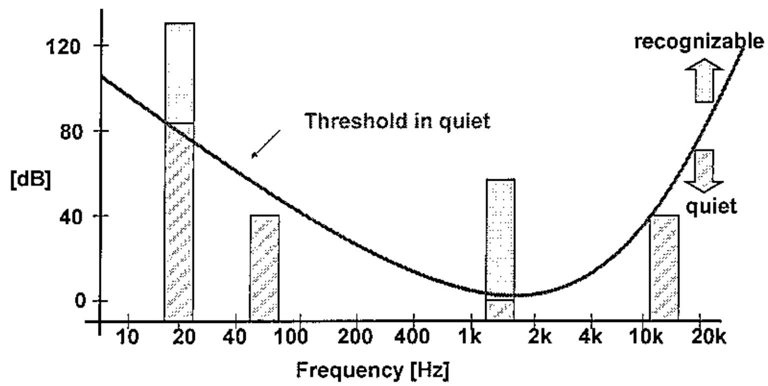
(2) Stereo Coding
Utilize the property of [ ] between audio data.

(3) Entropy Coding (Huffman Coding)
Utilize the probability of [~~Redundancy reduction~~].

2.2 Following figure shows a Psych-acoustic model.
What is the meaning and purpose of this Psych-acoustic model in Audio Encoding?

80

(5 points)



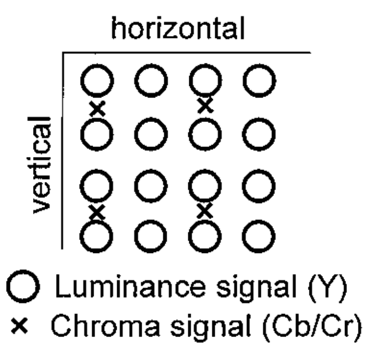
3. Video Coding

3.1 Picture format

Calculate the Video data number below. *(3 points for each)*

(There is no need to calculate, write only the equation with dimensions like the example blow:

Picture size:	UHD/4K	3840 [pixels/line] x 2160 [lines/frame]
Color format:	(4:2:0), 8 bits for each	
Frame rate:	30 [frames/sec])	



1) Calculate Luminance pixel number for one frame.
Example: 3840[pixels/line] x 2160[lines/frame]
(=8,294,400 [pixels/frame])

2) Calculate chrominance data volume. (Cr and Cb total)
Ans: [Chroma data volume = 3840 [pixels/line] × 2160 [line/frame] × 24 [bits/RGB]]

3) Calculate total data volume of 1 UHD/4K Video data

Ans: [~~Color~~ total data volume = 3840 [pixels/line] × 2160 [line/frame] × 24 [bit/RGB]]

4) Calculate total data rate of UHD/4K Video data above

Ans: [datarate = 3840 [pixels/line] × 2160 [line/frame] ×24 [bit/RGB] × 30 [frame/s] (bit/s)]

6

5) When the UHD/4K Video data above is compressed by H264/AVC, and resulting data (Video stream) rate is 100 Mbps, what is the compression ratio? (1 Mb = 10^6 bit)

Ans:[ ]

3.2 Coding technology (MPEG)

MPEG Video coding method is the combination of various techniques. There are 3 major techniques, used for MPEG. One is MC (Motion Compensation), the second is DCT (Discrete Cosine Transform) and the last is VLC (Variable Length Coding). Show the relations of these 3 methods and techniques by writing lines below. *(2 points for each)*

Ans. 1) DCT — a) Probability theory technique

2) VLC — b) Time Domain technique

3) MC — c) Frequency domain technique

6

3.3 Prediction method (MPEG)

(The figure below (Fig.2.1) shows the motion pictures. The rectangular shows the one picture. When this sequence is encoded by MPEG Video format, show the picture prediction relations by writing arrows in the Fig. below. [Note: I/P/B show picture type, and numbers show the order of the pictures. The arrow below shows that B2 picture is predicted by I1 picture.]

(4 points)

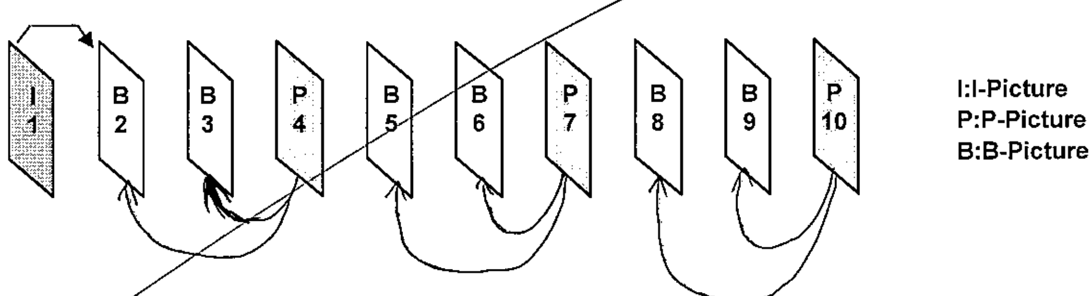
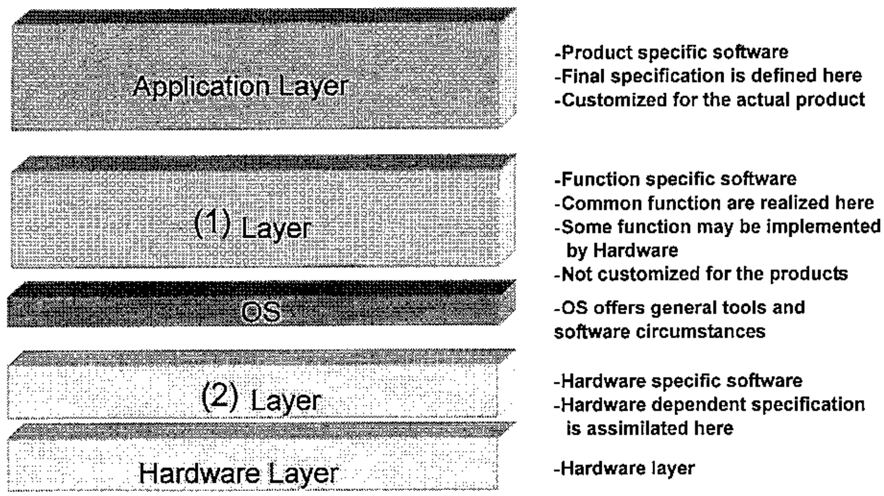


Figure 2.1. Prediction of MPEG1/2 Video coding

4. SoC architecture

Embedded software are divided into several layers as shown following figure.



Embedded software are divided into several layers as shown following figure.

Choose the correct name of layers (1) and (2) among a), b), c), d) *(3 point for each)*

6

(1) a) API b) Middleware c) RTL d) Driver

(2) a) API b) Middleware c) RTL d) Driver

5. Platform

Describe briefly the advantages of OpenMAX IL *(2 points)*

0