浙江大学计算机学院
数字媒体与网络技术

Digital Asset Management
数字媒体资源管理

2. Introduction to Digital Media Format

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Outline

- Image format and coding methods
- Audio format and coding methods
- Video format and coding methods
- Introduction to HTML and XML
- Graphics format and coding methods

LZW Encode

"X X X D Z D D D Z D Z"

where the root values are X, D, Z. The following table follows the above encoding algorithm, showing the values of P, S and P + S (the pattern added to the dictionary) at the end of each iteration of the while loop, as well as the dictionary that is built up:

P	S	P + S	Output	Dictionary	
				Code	Pattern
				0	X
				1	D
				2	Z
	X	X			
X	X	XX	0	3	XX
X	X	XX			
XX	D	XXD	3	4	XXD
D	Z	DZ	1	5	DZ
Z	D	ZD	2	6	ZD
D	D	DD	1	7	DD
D	D	DD			
DD	Z	DDZ	7	8	DDZ
Z	D	ZD			
ZD	Z	ZDZ	6	9	ZDZ
Z		Z	2		

So the final output is:

"0 3 1 2 1 7 6 2"

And the input has been compressed from 11 symbols down to 8.

LZW Decode

"0 3 1 2 1 7 6 2"

The following follows the decoding algorithm, showing the necessary values for producing the decoded output:

P	C	LOOK_UP(P)	LOOK_UP(C)	Output	Dictionary	
					Code	Pattern
					0	X
					1	D
					2	Z
	0		X	X		
0	3	X	XX	XX	3	XX
3	1	XX	D	D	4	XXD
1	2	D	Z	Z	5	DZ
2	1	Z	D	D	6	ZD
1	7	D	DD	DD	7	DD
7	6	DD	ZD	ZD	8	DDZ
6	2	ZD	Z	Z	9	ZDZ

So the decoded output is:

"X X X D Z D D D Z D Z"

The grey rows show the situation where LOOK_UP(C) is output as soon as it is added to the dictionary, and it is added to the dictionary as

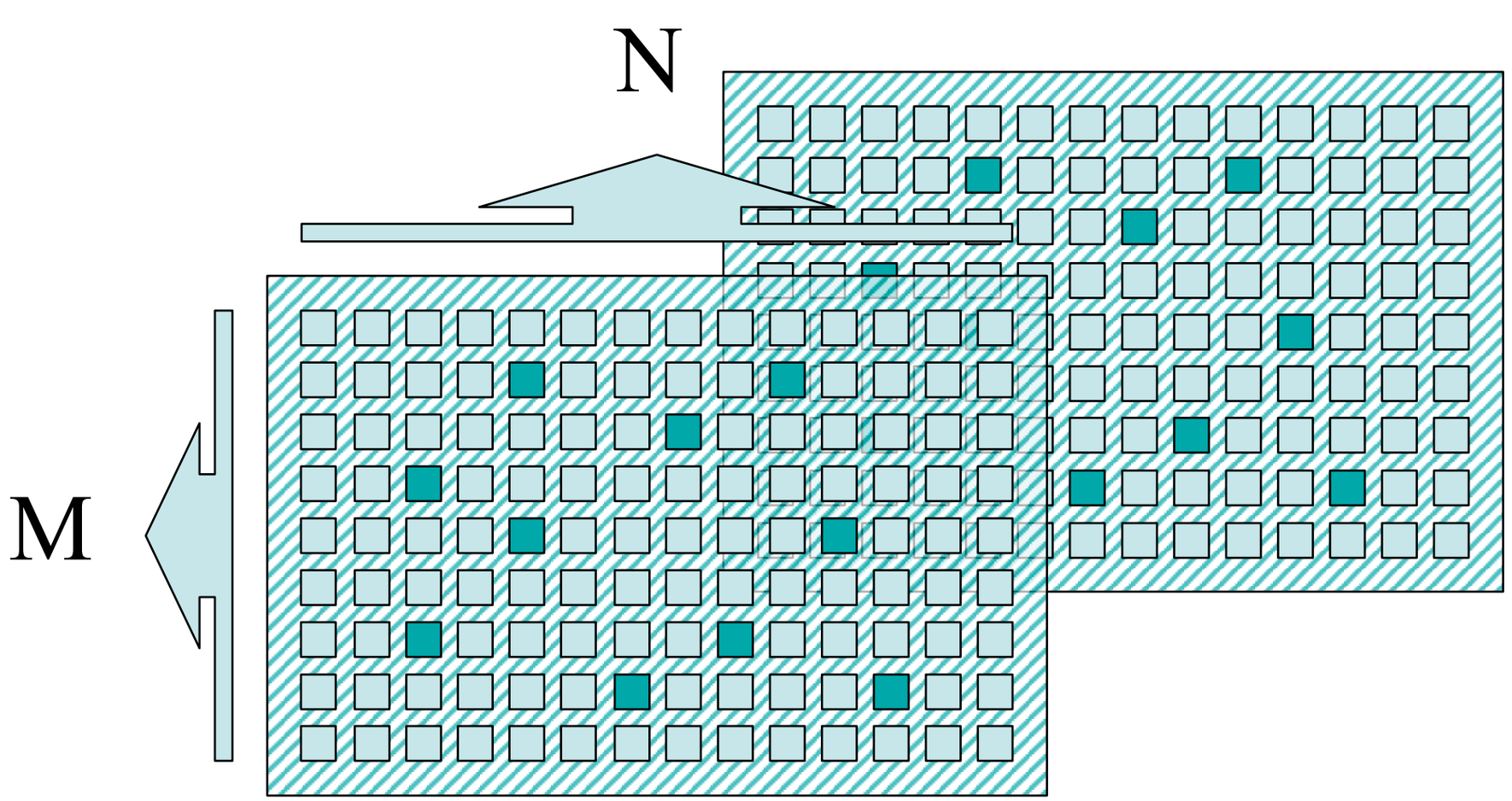
```
LOOK_UP(P) + 1st character of LOOK_UP(P)
```

This situation occurs when the algorithm comes across a code for C that is not in the dictionary. It is then deduced entirely from P as above, added to the dictionary, and then output. This case is caused in the encoding when the encoder outputs a code just after it was added to the dictionary.

2.3. Video formats and coding methods

Representations of video

- Sequence of images ?!?
  - Can be viewed as a 3-dimensional matrix
  - But it is only 50% correct



Common video formats

- AVI (Microsoft, Divx, …)
  - –avi, wmv, asf
- RM (Realplayer)
  - –rm, rmvb
- MOV (Quicktime)
  - –mov
- MPEG
  - –MPEG-1, MPEG-2, MPEG-4 …

http://www.bigbuckbunny.org/index.php/download/

Video compression standards

- MPEG standards
  - Audio/Video compression, storage and play back standards
  - MPEG-1: VCD
  - MPEG-2: broadcast TV, e.g., DVD、HDTV etc.
  - MPEG-3: replaced by MPEG-2
  - MPEG-4: network video transfer，stream media
  - MPEG-7:
  - MPEG-21:

- ITU-T H.26x series

MPEG-1 Standard ISO/IEC 11172-2 (1991)

"Coding of moving pictures and associated audio for digital storage media"

- **Video**
  - –optimized for bit rates around 1.5 Mbit/s
  - –originally optimized for SIF picture format,
  - –but not limited to it:
    - [**NTSC based**] : 352x240 pixels at 30 frames/sec
    - [**PAL based**] : 352x288 pixels at 25 frames/sec
  - –progressive frames only
    - no direct provision for interlaced video applications, such as broadcast television

MPEG-2 Standard ISO/IEC 13818-2 (1994)

- Video
  - –2-15 or 16-80 Mbit/s bit rate (target bit rate: 4…9 Mbit/sec)
  - –TV and HDTV picture formats
  - –Supports interlaced material

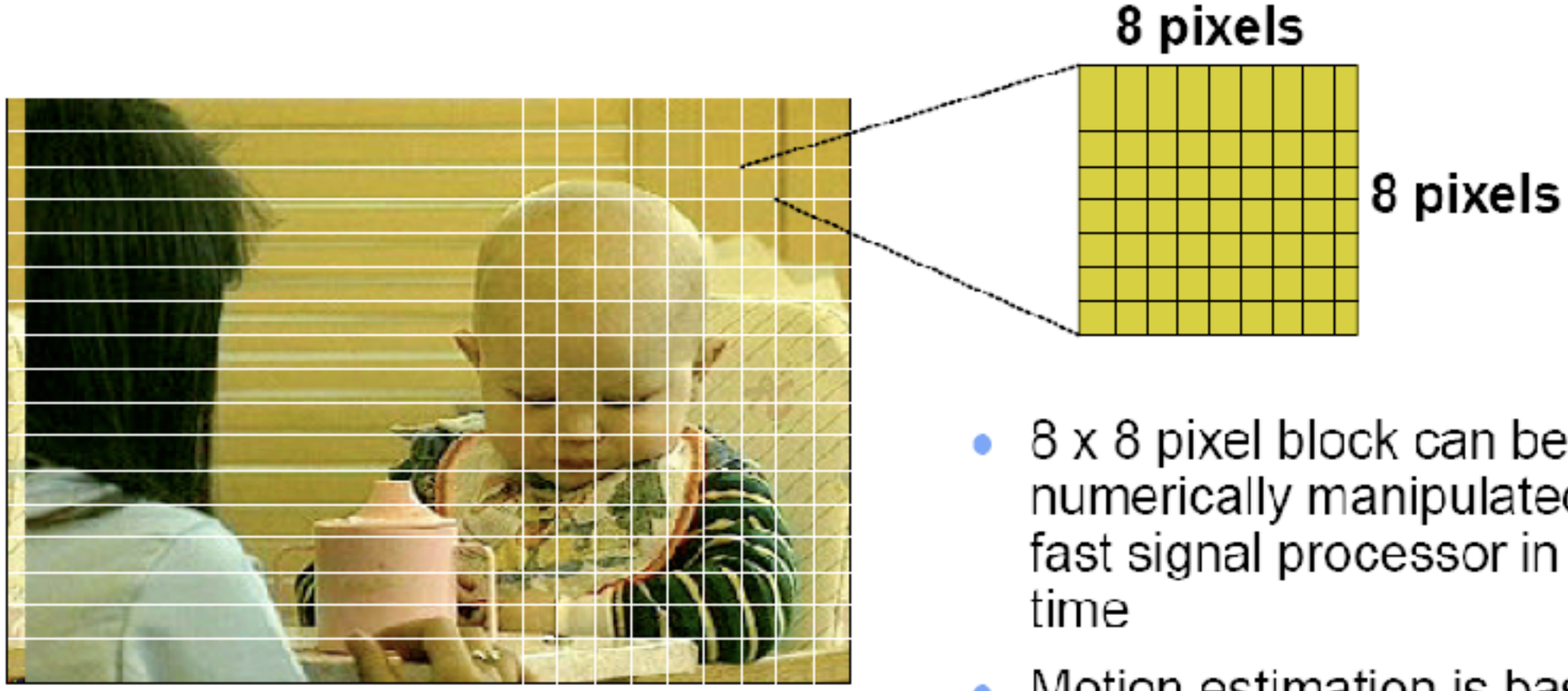
  - –MPEG-2 consists of *profiles* (类) and *levels* （级）
    - Main Profile, Main Level (MP@ML)
      - –720x480 resolution video at 30 frames/sec
      - – < 15 Mbit/sec (typical ~4 Mbit/sec)
      - –for NTSC video

    - Main Profile, High Level (MP@HL)
      - –1920x1152 resolution video at 30 frames/sec
      - –< 80 Mbit/sec (typical ~15 Mbit/sec)
      - –HDTV

MPEG-1 v.s. MPEG-2

- MPEG-1 Apps ~
  - –CD-I, digital multimedia,
  - –video database, e.g. video-on-demand
- MPEG-2 Apps ~
  - –satellite, cable, and terrestrial broadcasting,
  - –digital networks, and
  - –digital VCR

MPEG compression is based on 8 x 8 pixel block processing



- 8 x 8 pixel block can be numerically manipulated by fast signal processor in real time
- Motion estimation is based on comparing the blocks between series of pictures

MPEG: only compress moving parts

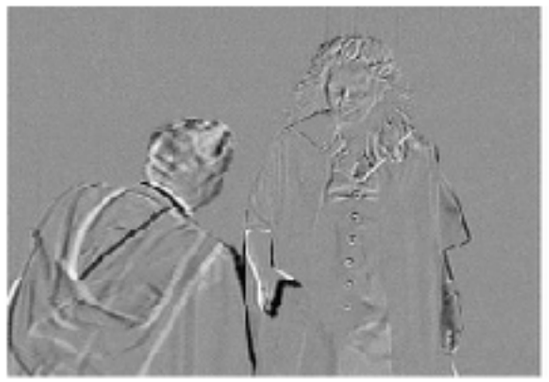
new picture

\-

previous picture

=

difference



Encoder

Decoder

difference

\+

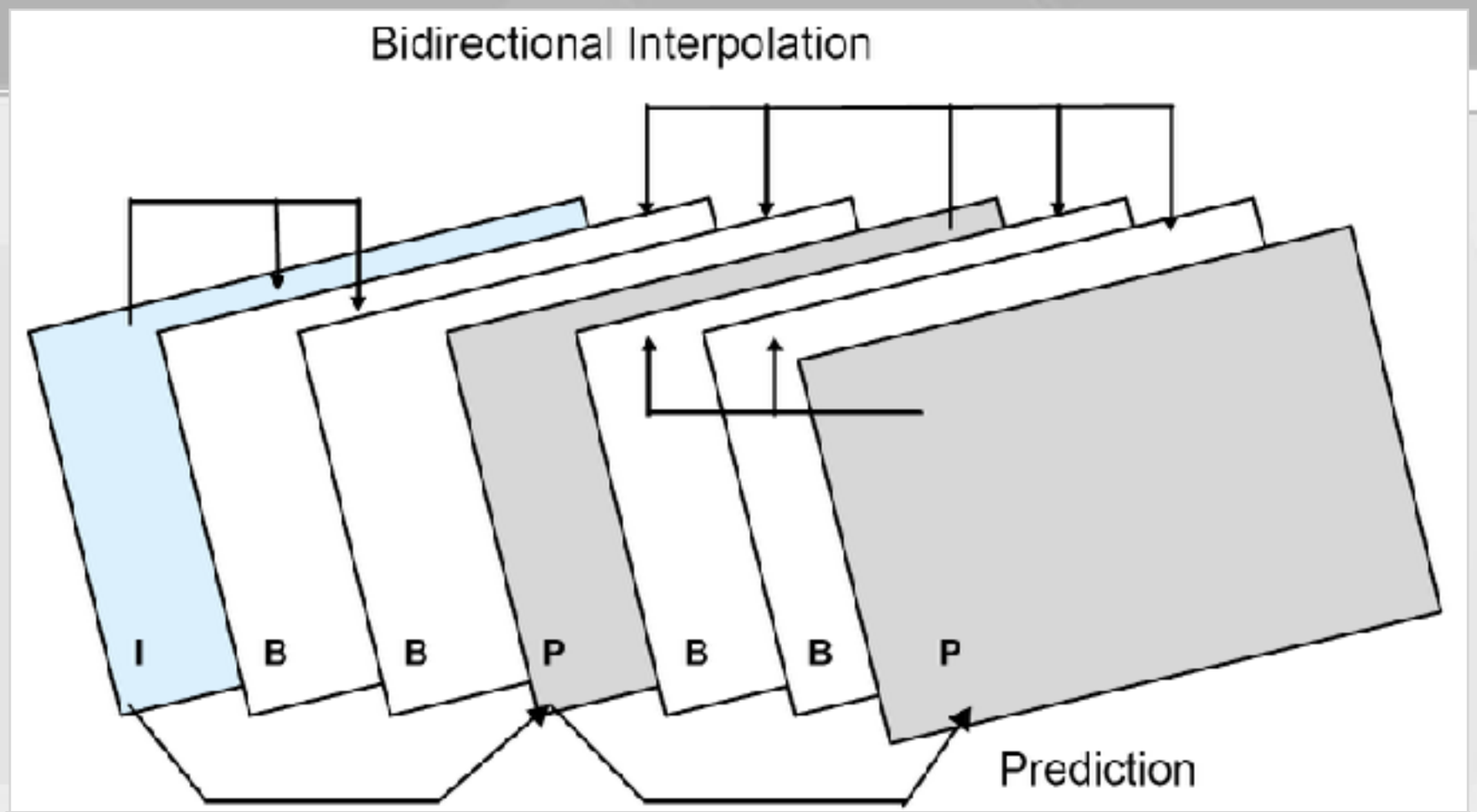
previous picture

=

new picture

MPEG: motion compression

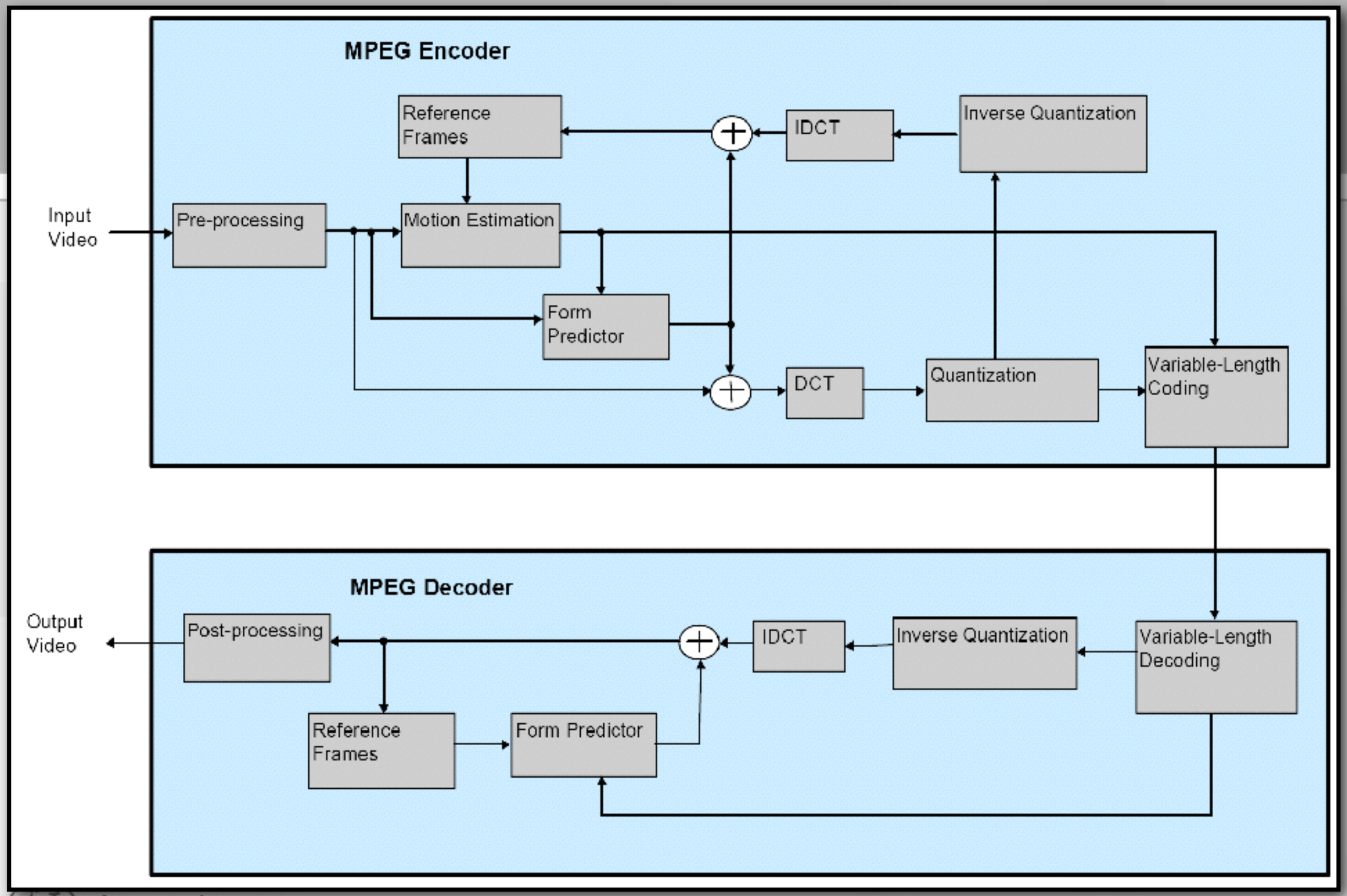
I = Intra-Frame
P = Predicted frame
B = Bi-directionally interpolated frame



Typical sequence: IBBPBBPBBI

Video signal: stream of picture, it is not necessary to send every picture

- **Whole picture is needed only when all the content is changed!**
- **Several pictures has to be buffered to memory to make prediction forward and backward**


MPEG Encoder
Reference Frames
IDCT
Inverse Quantization
Input Video
Pre-processing
Motion Estimation
Form Predictor
DCT
Quantization
Variable-Length Coding
MPEG Decoder
Output Video
Post-processing
IDCT
Inverse Quantization
Variable-Length Decoding
Reference Frames
Form Predictor

MPEG: other issues

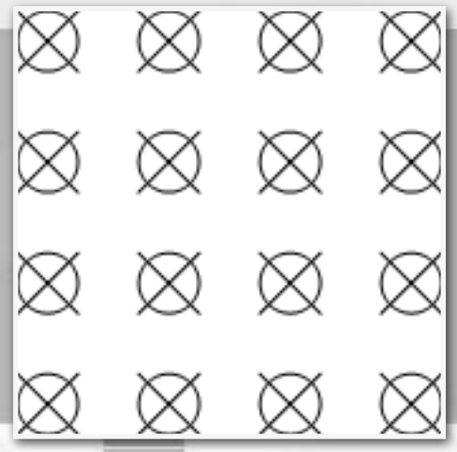
- Motion compensating
- Intra-frame transfer order

Color video coding

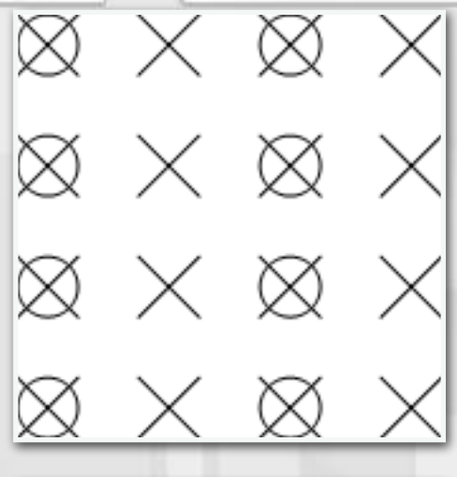
- 抽样和编码整个模拟（彩色）视频信号
  - –例如，复合编码
- 对亮度和色度分别编码
  - –例如，组件编码
  - –亮度比色度更重要，可根据应用场合采用4:2:2, 4:2:0, 4:4:4等不同的编码比率

YUV 420等格式的说明

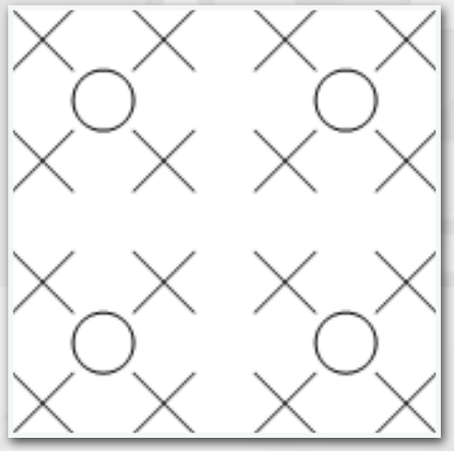
- YUV 的优点是色度通道的采样率可比 Y 亮度通道的低，同时不会明显降低视觉质量
- A:B:C表示法可用来描述 YUV 的采样频率比例
  - –4:4:4 每像素32位 表示色度频道没有下采样
  - –4:2:2 每像素16位 表示 2:1 的水平下采样，没有垂直下采样。对于每两个 U 样例或 V 样例，每个扫描行都包含四个 Y 样例
  - –4:2:0 每像素16位或12位 表示 2:1 的水平下采样，2:1 的垂直下采样
  - –4:1:1 表示 4:1 的水平下采样，没有垂直下采样。对于每个 U 样例或 V 样例，每个扫描行都包含四个 Y 样例，不太常用



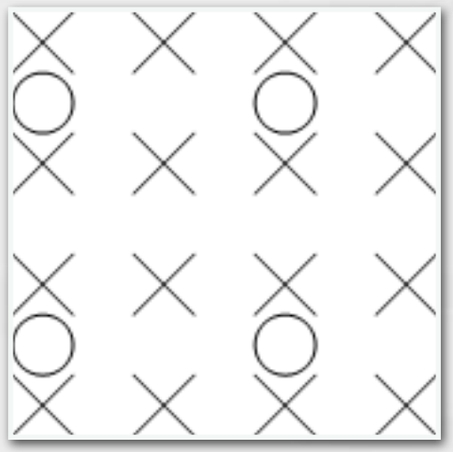
YUV444



YUV422

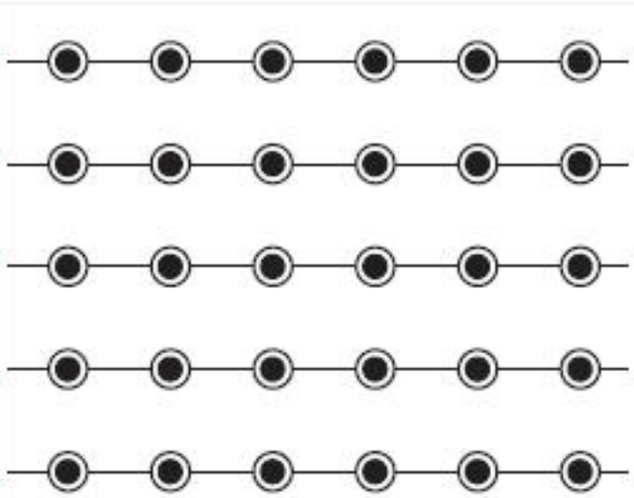


YUV420
MPEG-1

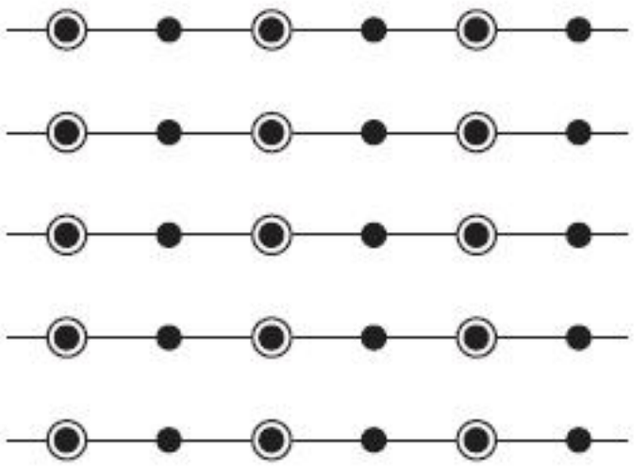


YUV420
MPEG-2

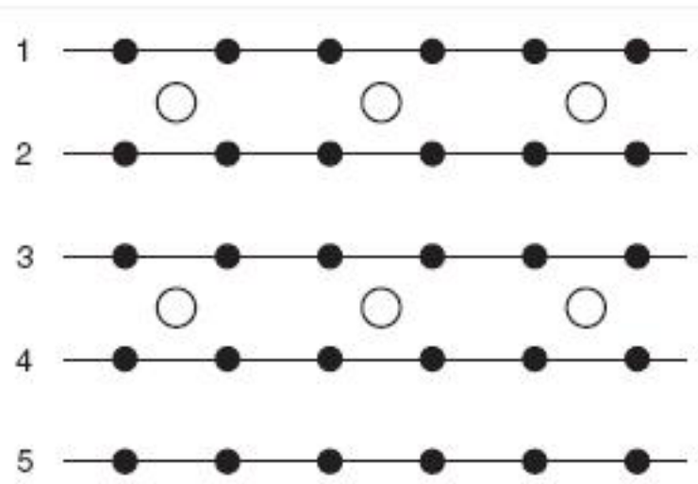
YUV4:4:4采样



YUV4:2:2采样



YUV4:2:0采样



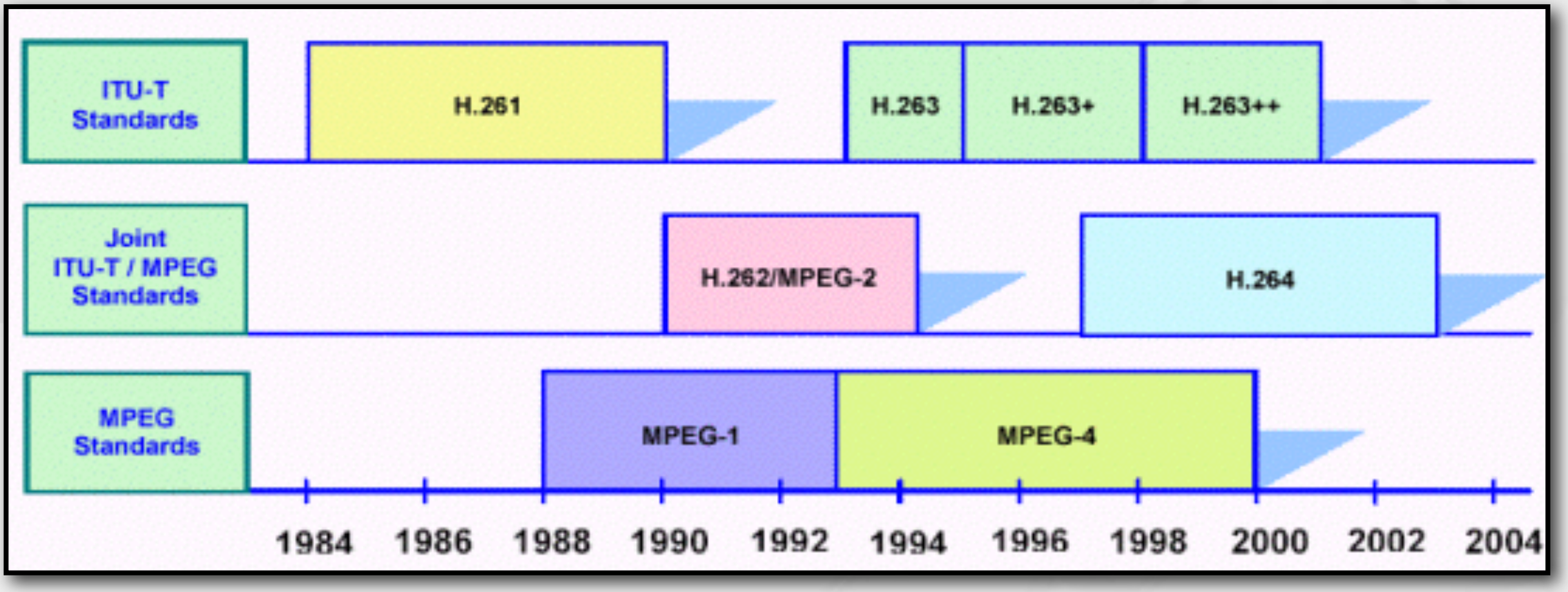
黑点表示采样该像素点的Y分量，以空心圆圈表示采用该像素点的UV分量

Overview of H.264

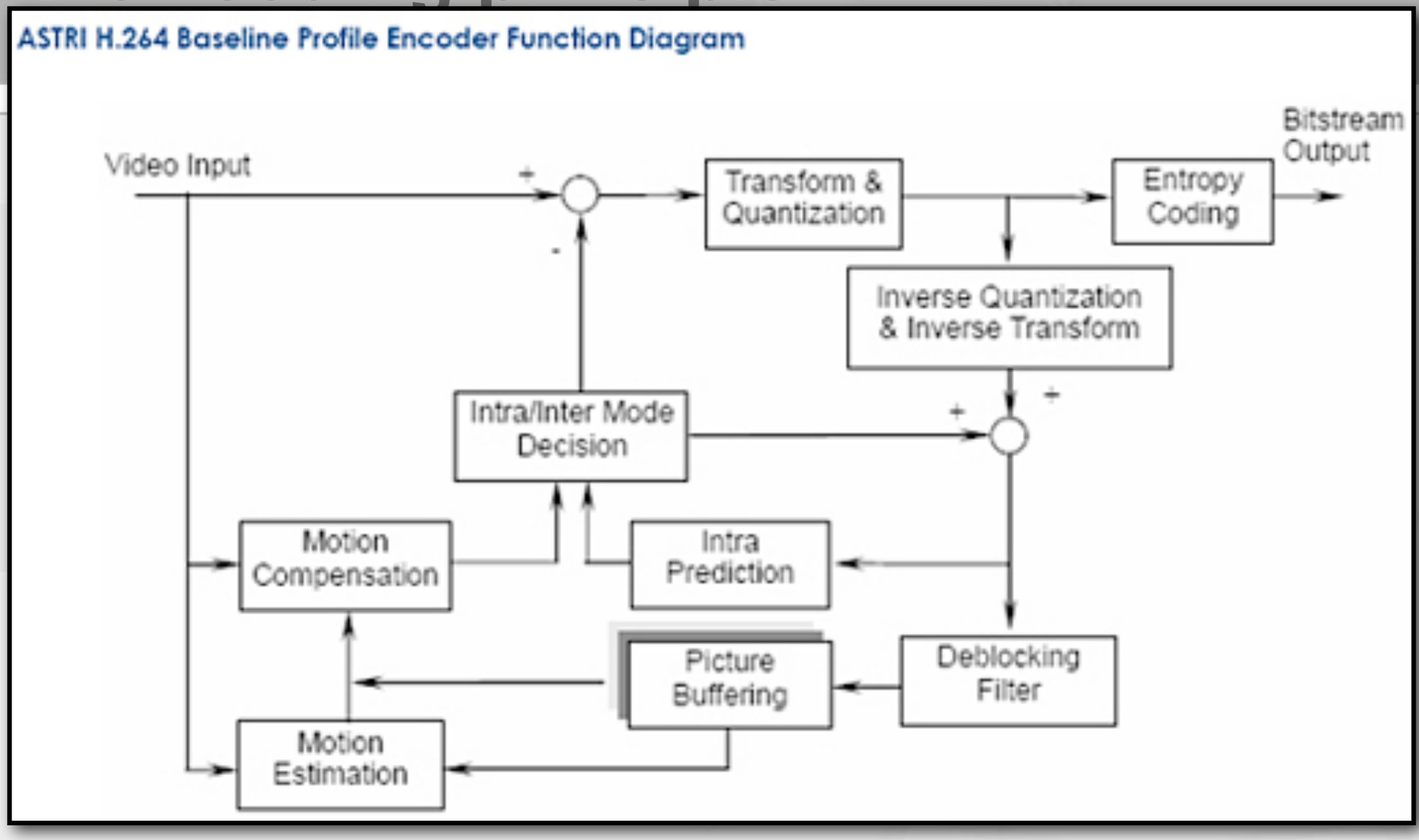
- JVT（Joint Video Team）
  - –founded on December 2001, Pattaya Thailand.
  - –video coding specialists from ITU-T and ISO, the two international standards organizations
  - –goal: define a new video coding standards to achieve high compression rate, high image quality, good network adaptive coding frame.

- H.264: A new video compression standard
  - –accepted by ITU-T
  - –accepted by ISO
    - called AVC (Advanced Video Coding) standard
    - as the 10th part of MPEG-4

Major history of digital video standard



H.264 coding principle



H.264的主要技术特点

1. 4类DCT整数变换以及相应的量化方法

2. 7种宏块预测模式
   - 16×16, 16×8, 8×16, 8×8, 8×4, 4×8, 4×4
   - 运动估计和补偿更加精确

3. 多参考帧
4. 帧内预测
5. 改进的去块效应滤波器（Deblocking filter）
6. 增强的熵编码方法
   - UVLC（Universal VLC）、CAVLC（Context adaptive VLC）和CABAC

7. 1/4像素插值
8. 宏块级逐行、隔行自适应编码MBAFF

Advantages and shortages of H.264

- ☑ High compression rate
  - –In the same image quality, H.264 can be compressed as size of
    - • 36% of MPEG-2， 61% of MPEG-4 ， 51% of H.263
  - –Low bit stream, high quality

- ☑ High error correctness rate
  - –H.264 provides necessary tools to solve the error coding problem in unstable network environments

- ☑ Network adaptation
  - –H.264 provides Network Adaptation Layer so as to make files of H.264c can be easily transferred in different network environments.

- ☐ High computation price
  - –In the same image quality, H.264 is twice of MPEG-2 in computation complexity.

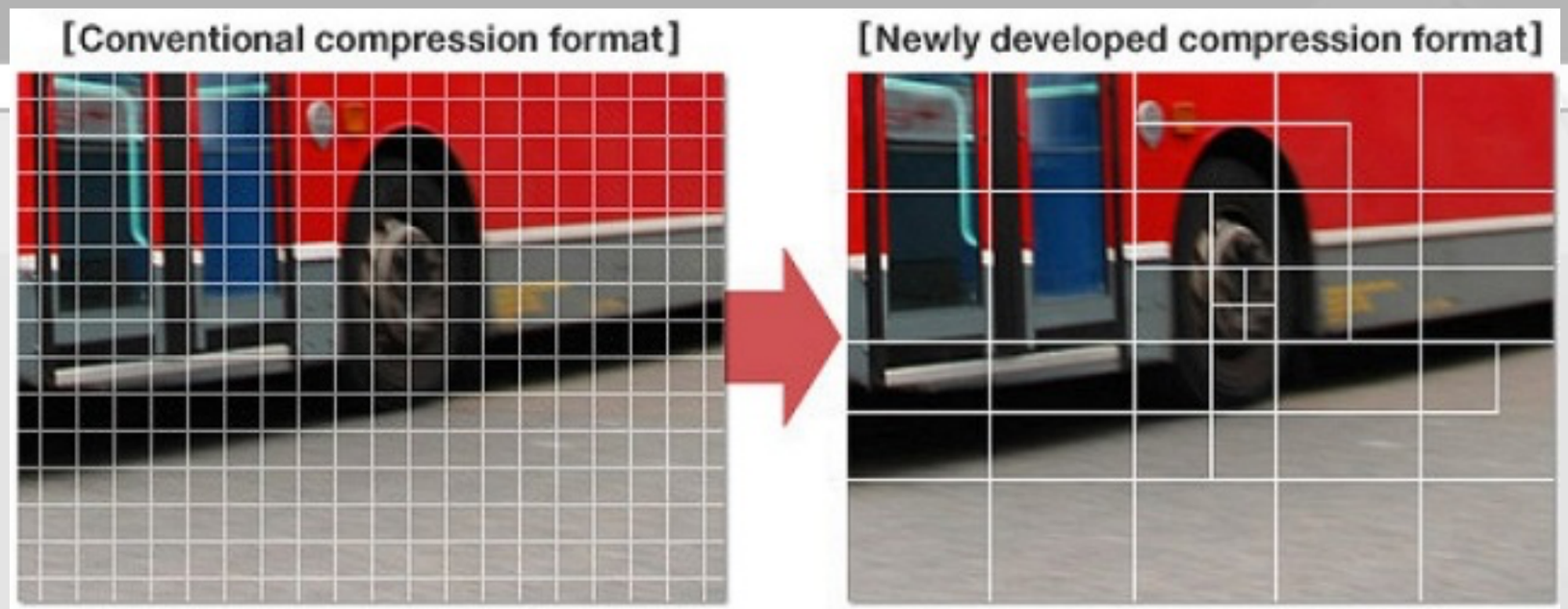
Applications of H.264

- H.264 standards added a NAL（Network Abstraction Layer）
  - –to face the network connection and interface problem in the real applications.
- video communication
  - –In real-time communication, POLYCOM、TANDBERG、VCON、SONY etc. claimed their own H.264 based TV-meeting products.
- digital TV broadcasting
  - –MPEG has already finished defining the MPEG-2 compatible standard on H.264 stream coding content
- video storage-and-play-back
  - –For High resolution DVD（HD DVD）application, H.264/MPEG-4 AVC solution.

H.265

- High Efficiency Video Coding (HEVC), also known as H.265 and MPEG-H Part 2
- 应用于：
  - 高清晰度(Higher Definition)：数字视频的应用格式从720 P向1080 P全面升级，在一些视频应用领域甚至出现了4K x 2K、8K x 4K的数字视频格式;
  - 高帧率(Higher frame rate)：数字视频帧率从30 fps向60fps、120fps甚至240fps的应用场景升级;
  - 高压缩率(Higher Compression rate)：传输带宽和存储空间一直是视频应用中最为关键的资源，因此，在有限的空间和管道中获得最佳的视频体验一直是用户的不懈追求。

H.265



H.264(JM 16.2), 4112kbps, 33.19dB HEVC(HM3.0), 1927kbps, 33.14dB

Summary of video coding

- Resolution
- Coding rate
- Motion coding
- Transfer performance

VR + image/video/audio

- Image
  - –stereo ~
  - –360 Panorama
  - –360 + stereo
- Video
  - –stereo ~
  - –360 Panorama
  - –360 + stereo
- Audio
  - –stereo
  - –surrounded ~

车猫网 360度立体视频

http://v.youku.com/v_show/id_XMTY2NTczOTY1Mg==.html?from=s1.8-1-1.2&spm=a2h0k.8191407.0.0

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2.4. HTML and XML

结构化文档概览

Overview of HTML

- Hypertext Markup Language
  - Developed by Tim Berners-Lee
    - lightweight markup language vs. complex SGML.
  - Based on pure text format

- Rich abilities to display multimedia information.
  - Later added tags to support image and videos.

- HTML 3.2 => HTML 4.0 => HTML 5.0
  - Different browser has their own display effects.

Overview of all HTML elements

Reference: http://htmlhelp.com/reference/wilbur/overview.html

Head →

Body →

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
    <title>Apple中国</title>
    <meta http-equiv="content-type" content="text/html;
charset=gb2312">
    ...
</head>

<body>
<!-- Tag for Activity Group: General, Activity: Apple China -
Homepage -->
...
</body>
</html>
```

http://www.apple.com.cn/

Overview of HTML - Head elements

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN" "http://www.w3.org/TR/html4/loose.dtd">
<html>
<head>
    <title>Apple中国</title>
    <meta http-equiv="content-type" content="text/html; charset=gb2312">
    ...
    <link rel="home" href="http://www.apple.com/">
    ...
    <script src="http://images.apple.com/global/scripts/lib/prototype.js" type="text/javascript" charset="utf-8">
    </script>
    ...

    <style type="text/css" media="all">
    ...
    #billboard { width: 1100px; margin: 0 auto 15px; overflow: hidden; position: relative; }
    #ticker { margin-bottom: 15px; }
    #homefooter { margin: 60px auto 50px; }
    ...
    </style>
</head>
```

- TITLE - Document title
- ISINDEX - Primitive search
- META - Meta-information

- LINK - Site structure
- BASE - Document location
- SCRIPT - Inline script
- STYLE - Style information

Overview of HTML - Body elements

```
<html>
<head> ... </head>
<body>
    <H1> Hello, world </H1>
    <P> Digital Asset management is cool! </P>

</body>
</html>
```

- **Block level elements**
  - –Headings: H1 => H6
  - –Lists: UL, OL, DIR, MENU, LI, DL, DT, DD
  - –Text Containers: P, PRE, BLOCKQUOTE, ADDRESS
  - –others: DIV, CENTER, FORM, HR, TABLE

Overview of HTML - Body elements

```
<html>
<head> ... </head>
<body>
    <H1> Text-level elements </H1>
    <A href="http://www.google.com"> GOOGLE  <IMG src=" ... ">  </A>

</body>
</html>
```

- **Text-level elements**
  - –Logical markup: EM ...
  - –Special markup: A, IMG, APPLET ...
  - –Physical markup: B, ...
  - –Forms: INPUT ...
  - –Tables: CAPTION, TR, TH, TD

About CSS

叠样式表 (Cascading Style Sheets)

- http://www.w3school.com.cn/css/css_intro.asp

- 样式定义如何显示 HTML 元素
- 样式通常存储在样式表中（*.css）
- 把样式添加到 HTML 4.0 中，是为了解决内容与表现分离的问题
- 外部样式表可以极大提高工作效率
- 外部样式表通常存储在 CSS 文件中
- 多个样式定义可层叠为一个

HTML 5.0

- 学习参考： http://www.w3school.com.cn/html5/index.asp
- 实例解释： http://directguo.com/html5
  - http://html5-slide-template.googlecode.com/svn/trunk/html5-slide-template.html#slide1

- 一套Web富客户端开发的工业标准
  - 许多新特性：内建的视频、音频标记，元素拖放功能
  - 最新的 Safari、Chrome、Firefox 以及 Opera 支持某些 HTML5 特性，Internet Explorer 也已经逐步支持

Interesting demos

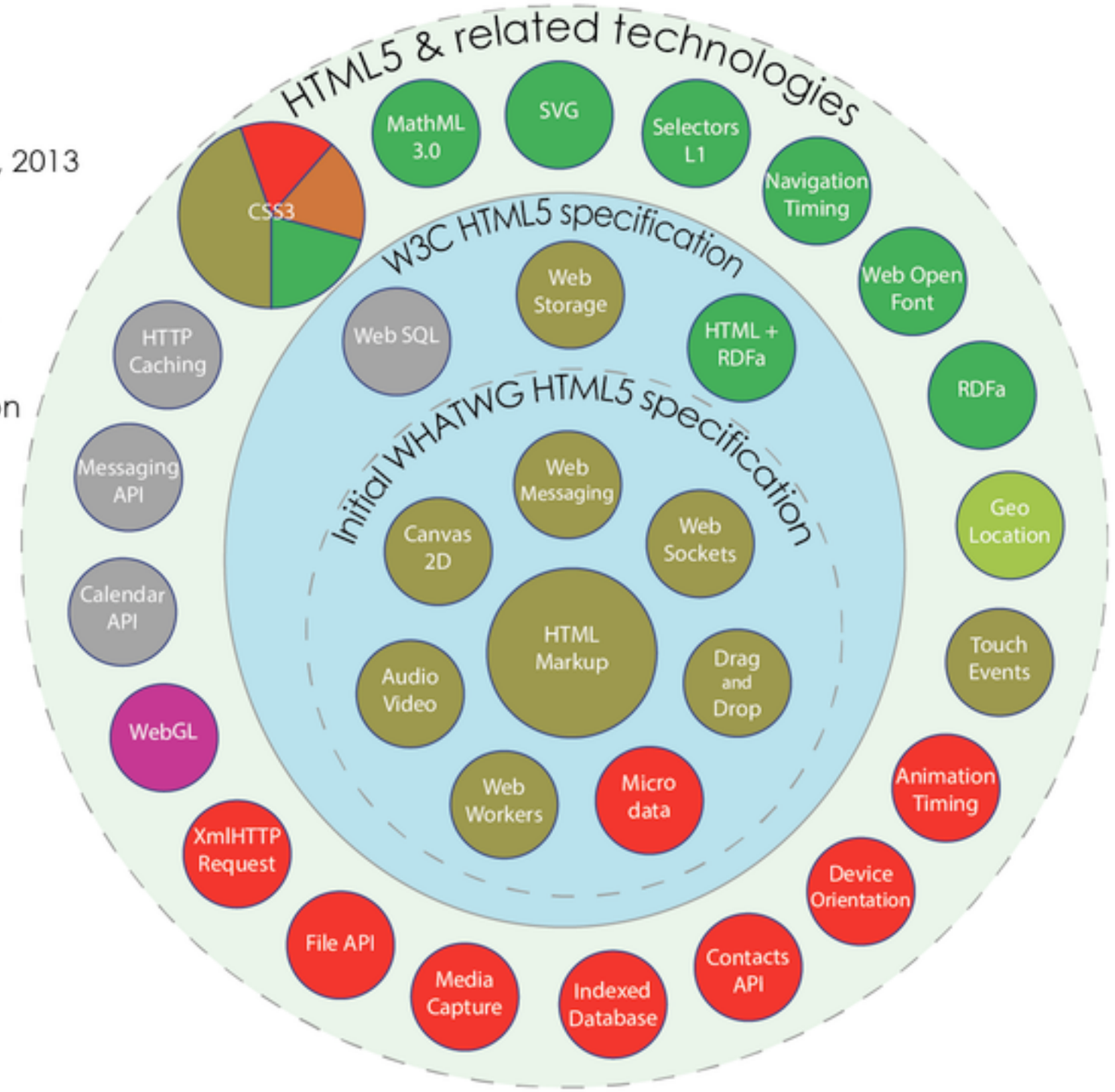
- http://www.cnblogs.com/chu888chu888/archive/2012/02/29/2374841.html

- html5 Slides
- Impress (http://impress.github.io/impress.js)

HTML5

Taxonomy & Status on January 20, 2013

- W3C Recommendation
- Proposed Recommendation
- Candidate Recommendation
- Last Call
- Working Draft
- Non-W3C Specifications
- Deprecated



by Sergey Mavrody CC BY · SA

About JavaScript

- http://www.cad.zju.edu.cn/home/zhx/DAM/2015/doku.php?id=js

- JavaScript

About Python

- http://www.cad.zju.edu.cn/home/zhx/DAM/2015/doku.php?id=python
- 网页服务：
  - Flask …
- 科学计算：
  - numpy and scipy …
- 图像处理：
  - Image and opencv …
- 还有很多其他库：
  - virtualenv 构建虚拟环境
  - pip 安装python扩展包
  - …

Alternative solutions

- LaTeX
- Markdown
- …

举个栗子

- HTML逆向解析——我的实验微信公众号:

- 欢迎关注、实验