CMPSCI 754 Multimedia Systems **Spring 2001**

Lecture : 2/13/01

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MPEG-2

Temporal Scalability

Suppose we have an original frame rate of 60 frames/sec. We could assign some of the frames to the base stream and others to enhancement stream. Thus a receiver with restricted bandwidth can receive only the base stream while another user with higher bandwidth can receive both the base stream and the enhancement stream to provide better video quality.
Thus in the above example we can have two frame rates i.e. 30 frames/sec and 60 frames/sec by,

```
 ___     ___     ___     ___     ___
|B|     |E|     |B|     |E|     |B|     ......
---     ---     ---     ---     ---
```

Note that the E frames can only have forward prediction i.e. prediction from previous E frames and B frames.

Chroma

SNR scalability(Signal-to-Noise Ratio)
In this, the Base stream has a coarser quantisation and therefore a higher signal to noise ratio while the enhancement stream has a finer quantisation i.e. a lower signal to noise ratio.
Thus the scaling is done along the noise.

Data Partitioning/Frequency Scaling

```
         8
   _____________              _____________
   |            |            |DC|   /     / |
   |            |            |--- /     /   |
   |            |      DCT   | B /     /    |
8  |            |     ----->  |  / E1 /      |
   |            |            | /     /      |
   |            |            |/    / E2     |
   |            |            |    /         |
   |            |            |   /          |
   -------------              -------------
      IMAGE
```

Here we divide the image into $8 * 8$ blocks and calculate their DCT coefficients. The coefficients are then divided into multiple streams. The Base stream will have the DC coefficient and some of the AC coefficients. There could also be multiple Enhancement streams consisting of higher AC coefficients.

Advantages

The advantages of these approaches are :

1. We can have multiple QOS levels.
2. It can also be used to increase resilience to packet loss by having the Base stream with a higher priority and during congestion dropping the low priority packets.
3. The resulting compression techniques are compatible with MPEG-1.
4. *Simulcast* i.e. the simultaneous transmission of a number of layers within a video is possible.

Disadvantages

The disadvantages of these approaches are :

1. It increases the complexity of encoding and decoding and may require specialised hardware to do it.
2. It decreases the compression efficiency as we cannot do backward prediction in the enhancement streams.

Wavelet

```
 ____________                ____________
|            |              |     |      |
|            |      wav     |LL   | HL   |     L : Low
|            |     ---->    |----------- |     H : High
|            |              |     |      |
|            |              |LH   | HH   |
|____________|              |____________|
```

In the wavelet based approach, the image is partitioned along the energy. This is done in a hierarchical fashion, where each of the four are further split into 4 smaller regions.
This has the advantage of removing some of the edginess of DCT boundaries as it can be done on the whole image.
The MPEG-2 committee could not replace DCT with wavelet due to backward compatibility issues.

MPEG-4

The MPEG-4 standard was developed with the objective of building a standard for lower bitrates meant for WANs and the internet. Another design objective was that it must be scalable from 10's of kbps to 10 Mbps.
It introduced a notion of *Object*. An image is considered to be a collection of objects where each object is encoded separately. Each stream is a hierarchical collection of objects.

```
              Stream
              /    \
             /      \
         Audio     Video
                    /   \
                   /     \
            Object1   Object2
             /    \     /   \
            /      \   /     \

 ___________________
|                   |
|   \|/             |       1. Background
|  --O--            |       2. House
|   /|\       _     |       3. Man
|            / \    |
|           /   \   |
|          /     \  |
|    O     | ___ |  |
|   /|\    | | | |  |
|   / \    | | | |  |
|___________________|
```

The background is encoded only once. The motion of the various objects can be specified. For e.g. We could say that the man is moving at 5 pixels/frame(say).

MPEG-7

MPEG-7 is a way of describing streaming media content.

Other Proprietary Encoders

1. Real Media
2. Windows Media
3. Quick Time

MP3 is just the audio part of MPEG.