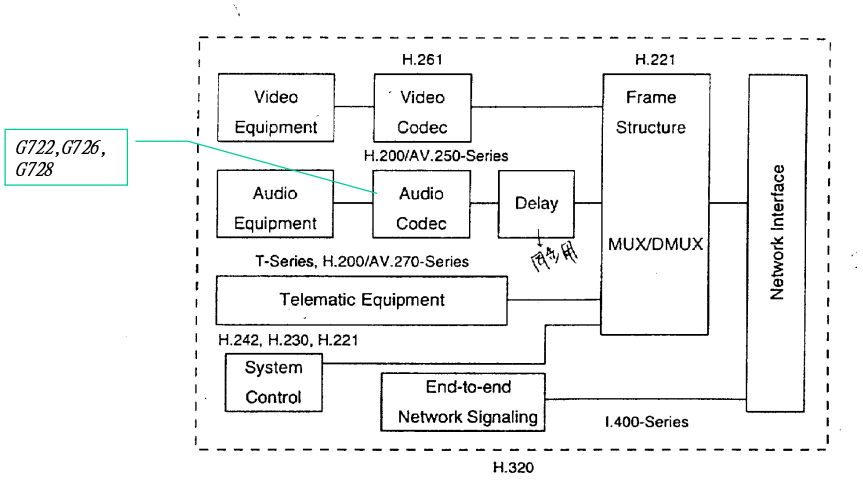
# Introduction to H.261

- *H.261*
  - Video Codec for Audiovisual Services at pX64 kbps , where p is in the range 1 to 30, suitable to ISDN
  - Part of Recommendation H.320
  - For real-time visual communication services,
    - video conferencing
    - video phone
- *H.263, H.263+*
  - Video Coding for Low Bitrate Communication no more than 64 kbps
  - Part of Recommendation H.324
  - shot for video phone, mobile video phone





# Recommendation H.320



# The H.261 Video Coding Standard

- CIR(Common intermediate Format)
  NTSC:525lines,30fps
  others:625lines,25fps
  CIF整合上述兩者:352×288,30fps
- 畫面爲4:3
- Y:352×288,Cb:176 × 144,Cr:176 × 144
- QCIF





# Source Format

- Picture formats supported：

| *Picture format* | *Luminance pixels* | *Luminance lines* | *H.261 support* | *Uncompressed bitrate(Mbps)* | | | |
|---|---|---|---|---|---|---|---|
| | | | | *10 frames/sec* | | *30 frames/sec* | |
| | | | | *Mono* | *Color* | *Mono* | *Color* |
| *QCIF* | *176* | *144* | *Yes* | *2.0* | *3.0* | *6.1* | *9.1* |
| *CIF* | *352* | *288* | *Optional* | *8.1* | *12.2* | *24.3* | *36.5* |

+ *compression ratios approximate to 100 to 3000*



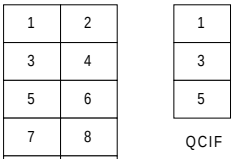
## Video Hierarchy Layer

- The hierarchy has four layers：
  - **Picture layer**：corresponds to one video frame
  - **Group of block layer** ： corresponds to 1/12 of CIF picture or 1/3 of QCIF
  - **Marco block layer** ： corresponds to 16x16 pixels of luminance and the two spatially corresponding 8x8 chrominance components
  - **Blocks layer**： corresponds to 8x8 pixels



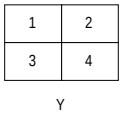


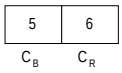
## Blocks Arrangement




Arrangement of GOBs in a picture



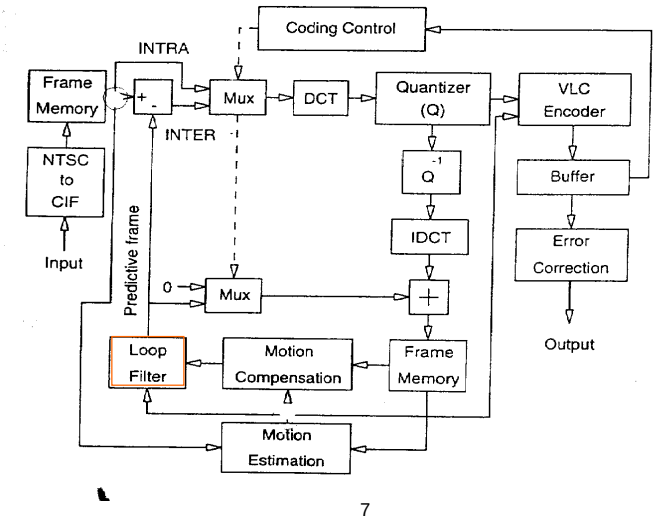




Arrangement of blocks in a macroblock

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |

Arrangement of macroblocks in a GOB

# Encoding System








# 架構特點

- Macro block:4:2:0
- 只有I-picture,P-picture
- 在low bit rate時，有skip的機制
- loop filter
  y[i]=0.1248y[i-1]+0.7495y[i]+0.1248y[i+1]
- error check--parity check
- data stream
  pictures--GOPs--MB--YCbCr

## Coding Algorithms

- Main function：
  - motion Compensation(optional)
  - transformer
    - discrete cosine transform(DCT)
  - quantization
    - the quatization is a single variable instead of a matrix of 64 terms and can only be changed every 11 macroblocks.
- DPCM loop operates on each MB.



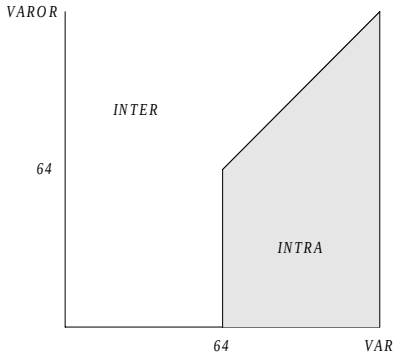


## INTRA/INTER Decision

$$DIF = original\_pel - MC\_pel$$

$$VAR = (\sum DIF^2)/256$$

$$VAROR = [\sum (original - mean)^2]/256$$



## Motion Compensation

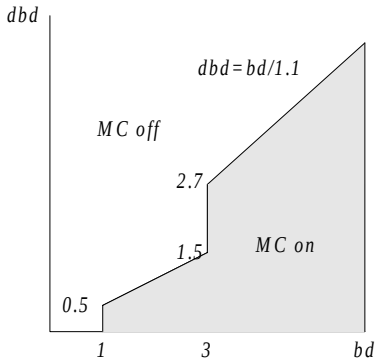
- Performed on Macro Block(16x16)
- Motion estimation on luminance only
- Motion vector
  - ±15 pixel for each direction for luminance
  - chrominance motion vectors are half of MB's
  - all pixels referenced by it are within the coded picture area
  - MVD is obtained from the macroblock vector by subtracting the vector of the preceding macroblock





## MC On/Off Decision

$$bd = \frac{\sum |block\ \ difference|}{256},\quad dbd = \frac{\sum |displaced\ \ block\ \ difference|}{256}$$



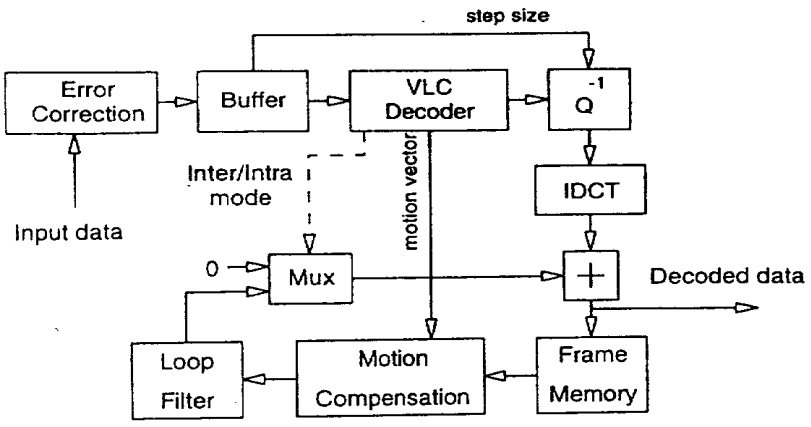
## Transmission Coder

- Video data buffering
  - number of bits created by coding single picture
    - operating with CIF : < 256k bits
    - operating with QCIF : < 64k bits
- Error correcting code
  - BCH(511,493) forward error correction code
  - generator polynomial
    - generate the correction parity bits
  - error correction framing





## Decoding System



## Implementation Issues:IDCT準度

要求DCT+IDCT後和原圖比較：

- For any pixel,peak error<1.0,
  average error<0.015,
  mean square error<0.06
- over all average error<0.0015
  mean square <0.02
- zeros in,zeros out





## Implementation Issues:
## 特殊要求

- At least one intraframe coded macroblock for every 132 interframe coded macroblocks.
- In practice,perform intraframe coding on a few macroblocks in every picture using a rotational scheme

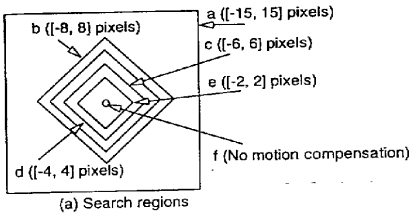


# Implementation Issues: motion estimation

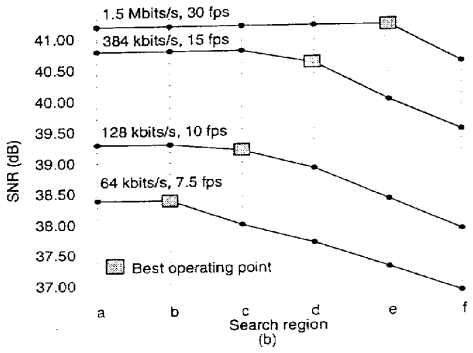
- 佔了60%的系統load
- 解決方法：search range↓
- high frame rate ⇒smaller search range
  low frame rate⇒bigger search range
- for videoconferencing:use smaller,dimand-shaped search region.








(a) Search regions




(b)

# H.261和MPEG的不同

| MPEG | H.261 |
|---|---|
| Uses CIF, SIF, or higher spatial resolutions. | Uses QCIF or CIF spatial resolutions. |
| Variable image aspect ratio (defined in the header). | Fixed 4:3 aspect ratio. |
| Uses groups of pictures. | No notion of GOPs. |
| I, P, and B macroblocks. | No B macroblocks. |
| Typical bit rates are around 1.1 Mbits/s. | Typical bit rates are around 384 kbits/s. Max. bit rate is 2 Mbits/s. |
| No restrictions on skipped pictures. | Only 1, 2, or 3 skipped pictures allowed. |
| Sub-pixel accurate motion vectors. | Pixel accurate motion vectors. |
| Typical motion vector range is +/- 15 pixels. | Typical motion vector range is +/- 7 pixels. |
| The end-to-end coding delay is not critical. | Used mostly in interactive applications. End-to-end delay is very critical. |





# H.263

- Based on ITU-T Recommendation H.261
- Compressing the moving picture component of audiovisual services at low bitrates ≤ 64Kbps
- Design for GSTN(General Switched Telephone Network) or mobile channel
- Part of Recommendation H.324
  - For low bitrate multimedia communication



# Recommendation H.324