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**A VIDEO COMPRESSION CHIP SET**

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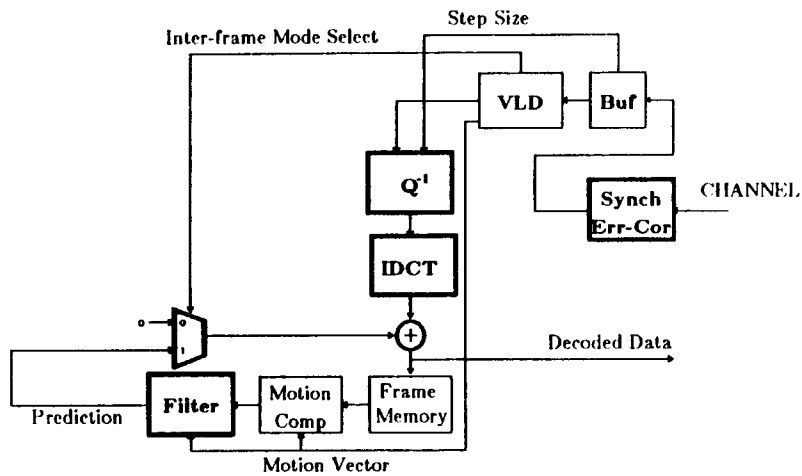
**A VIDEO COMPRESSION CHIP SET****Peter A. Ruetz****LSI LOGIC Corporation  
DSP Division  
Milpitas, CA 95035****OUTLINE**

- **APPLICATIONS/GOALS**
- **VIDEO COMPRESSION**
- **IMAGE COMPRESSION**
- **THE PROCESSORS**
  - **L64720 MOTION ESTIMATION**
  - **L64730 DCT PROCESSOR**
  - **L64740 QUANTIZATION**
  - **L64715 BCH ENCODER/DECODER**
- **SUMMARY**



A VIDEO COMPRESSION CHIP SET

VIDEO DECODER (CCITT)



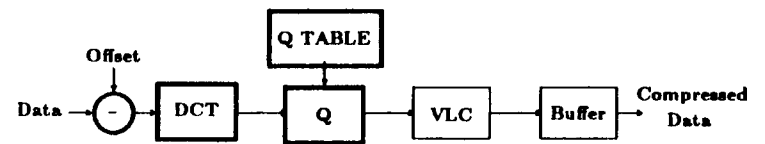
- SUBSET OF ENCODER
- INV Q, IDCT, FILTER MUST TRACK

A VIDEO COMPRESSION CHIP SET

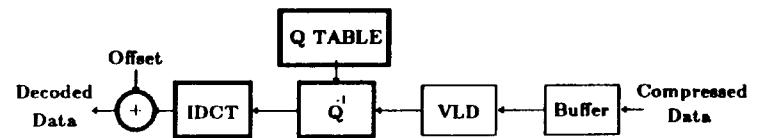
IMAGE COMPRESSION

- JPEG IMAGE COMPRESSION
  - Similar to Video Compression
  - in Intra Mode
  - Images May be Very Large

• JPEG ENCODER



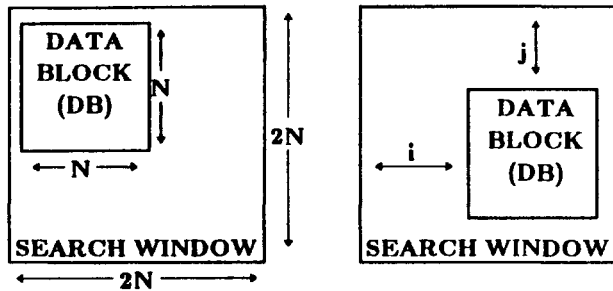
• JPEG DECODER



### L64720 - MOTION ESTIMATION

- COMPUTES FOR ALL  $N^2 (i,j)$ :

$$- \text{error}(i,j) = \sum_{y=0}^{N-1} \sum_{x=0}^{N-1} \text{abs} \{ \text{SW}(x+i,y+j) - \text{DB}(x,y) \}$$



- 8-BIT INPUT DATA
- 56 $\mu$ Sec EXECUTION TIME ( $N=16$ )
- OUTPUT:  $\text{error}(i,j)$ , min error,  $\text{error}(0,0)$

### LARGER SEARCH WINDOWS

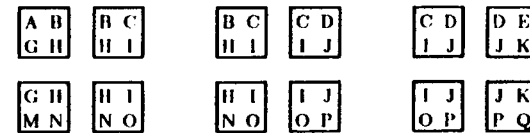
□ =  $N \times N$  Block of Data



SEARCH WINDOW OVER ORIGINAL IMAGE



DESIRED 3N x 3N SEARCH WINDOWS

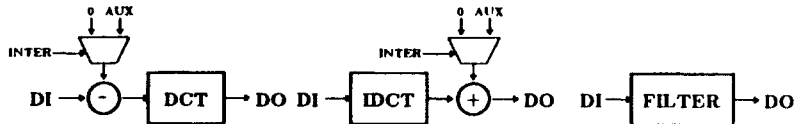


2N x 2N SEARCH WINDOWS FOR EACH PROCESSOR

- EACH PROC COMPUTES SOME ERRORS
- SAME DATA BLOCK FOR EACH PROC

### L64730 - DCT, IDCT, FILTER

- 8 X 8 DATA BLOCK
- THREE OPERATING MODES

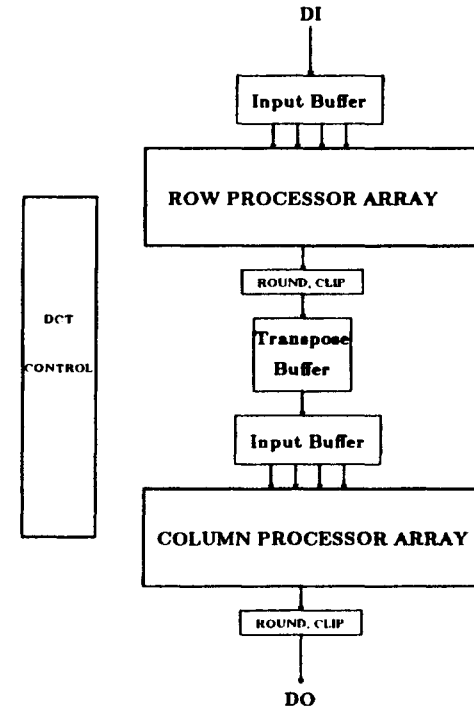


- 12-BIT I/O
- CONFORMS TO H.261 ERROR SPECS
- SUSTAINED PIXEL RATES TO 40 MHz
- HANDLES INTER MODE PREDICTION
- COMPUTES:

$$BD(u,v) = \frac{1}{32} C(u)C(v) \sum_{x=0}^7 \sum_{y=0}^7 bd(x,y) \cos \left[ \frac{\pi u(2x+1)}{16} \right] \cos \left[ \frac{\pi v(2y+1)}{16} \right]$$

$$bd(x,y) = 2 \sum_{u=0}^7 \sum_{v=0}^7 C(u)C(v) BD(u,v) \cos \left[ \frac{\pi u(2x+1)}{16} \right] \cos \left[ \frac{\pi v(2y+1)}{16} \right]$$

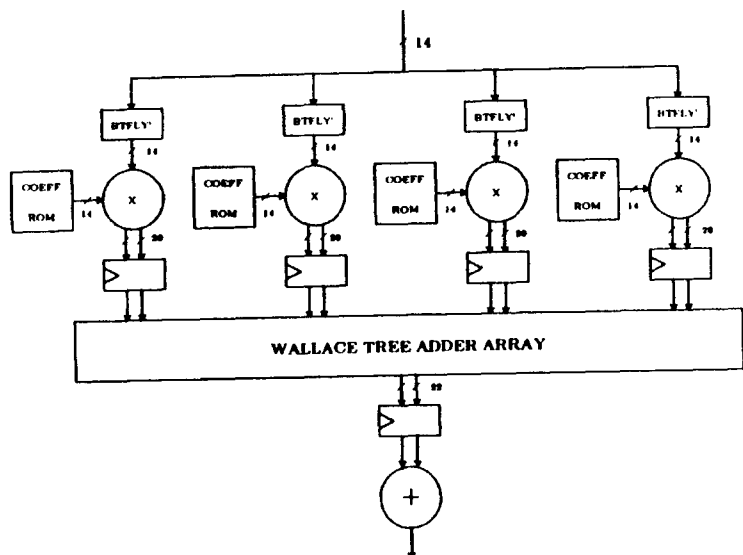
### L64730 - DCT, IDCT, FILTER



- INTERNAL CONTROLLER
- SEPARABLE PROCESSOR
- STREAM DATA I/O

**VIDEO COMPRESSION - THE PROCESSORS**

**L64730 - DCT, IDCT, FILTER**



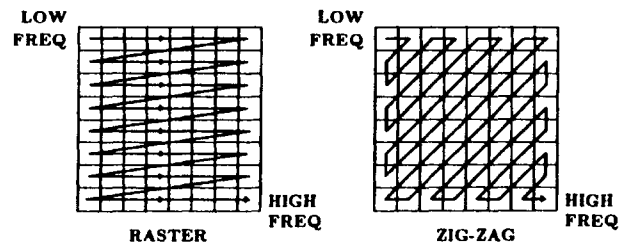
- **1-STAGE FAST TRANSFORM**
  - 4 Mults
- **ROUND CARRY SAVE FORMAT**
  - "Eat Away" Low Mult Bits
  - Has Upredictable Error Props

**VIDEO COMPRESSION - THE PROCESSORS**

**L64740 - QUANTIZATION PROCESSOR**

FUNCTION	JPEG	CCITT
QUANTIZATION STEP SIZE	FREQ DEPEND	FIXED
ZIG-ZAG RUN CODING	YES	YES
CLIP QUANT COEFF	NO	8-BITS
DPCM FOR DC COEFF	YES	NO
VAR THRESHOLD	NO	OPTIONAL

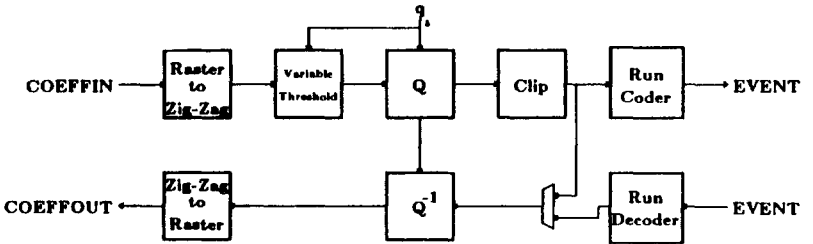
- **TWO QUANTIZATION TABLES**
- **CAN CASCADE WITH DCT, IDCT**
- **12-BIT DCT COEFFICIENTS**



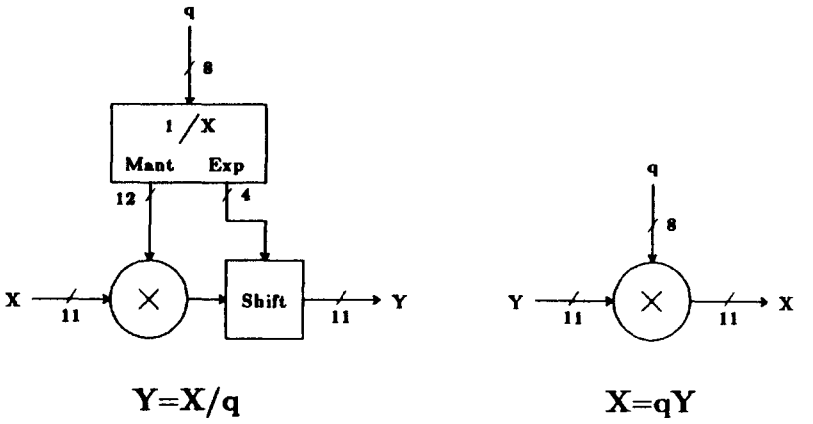
VIDEO COMPRESSION - THE PROCESSORS

L64740 - QUANTIZATION PROCESSOR

• CCITT MODE



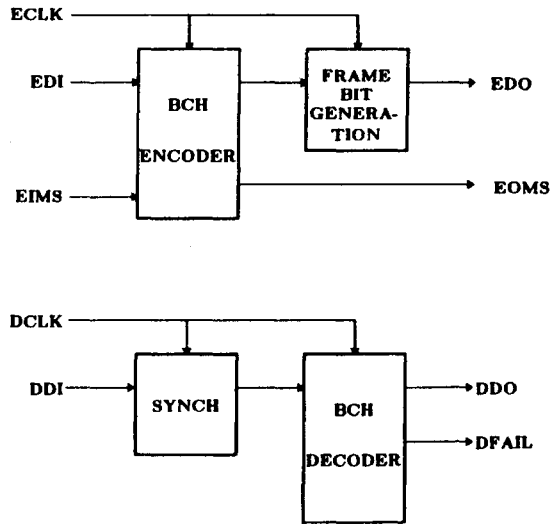
• QUANTIZATION



VIDEO COMPRESSION - THE PROCESSORS

L64715 - BCH CODEC

- BCH (511,493) ENCODER/DECODER
- CORRECTS TWO ERRORS
- PERFORMS FRAMING AND SYNCHRONIZATION
- 20 MBIT/SEC FULL DUPLEX
- DETECTS DECODING FAILURE



VIDEO COMPRESSION - THE PROCESSORS

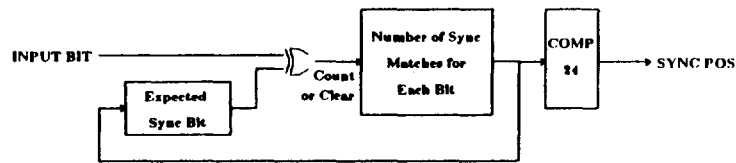
SYNCHRONIZATION

• INFORMATION

- Sync Pattern (1-bit/Block)
- Error Count (511-bits/Block)

• TRADE OFF HARDWARE, SYNC TIME

- Search 256-Positions in Parallel
- Use Error Count for Stability



A VIDEO COMPRESSION CHIP SET

SUMMARY

• CHIP SET DEVELOPED FOR:

- VIDEO COMPRESSION
- IMAGE COMPRESSION

• PIPELINED OR "CO-PROCESSOR" MODES

• BLOCK ORIENTED DATA I/O

• BUILDING BLOCK PROCESSORS

