

## **Introduction**

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# **C-Cube CL550 JPEG Image Coprocessor**

**Stephen Purcell**

**C-Cube Microsystems**

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C-Cube Microsystems  
Hot Chips Symposium  
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## **The Problem**

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**An 8.5" x 11" Color Picture is 25 MBytes**

**One Full - Color Frame is 1 MByte**

**One Second of Motion Video is 30 MBytes**

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## **Design Goal**

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**Symmetric Compression / Decompression**

**CCITT / ISO Int'l Standard**

**All Image types : Still and Motion**

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## **Performance**

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**In S/W 1 MByte Image                  Several Minutes**

**In H/W 1 MByte Image                  Several Seconds**

**CL550 1 MByte Image                  1/30th of a Second**

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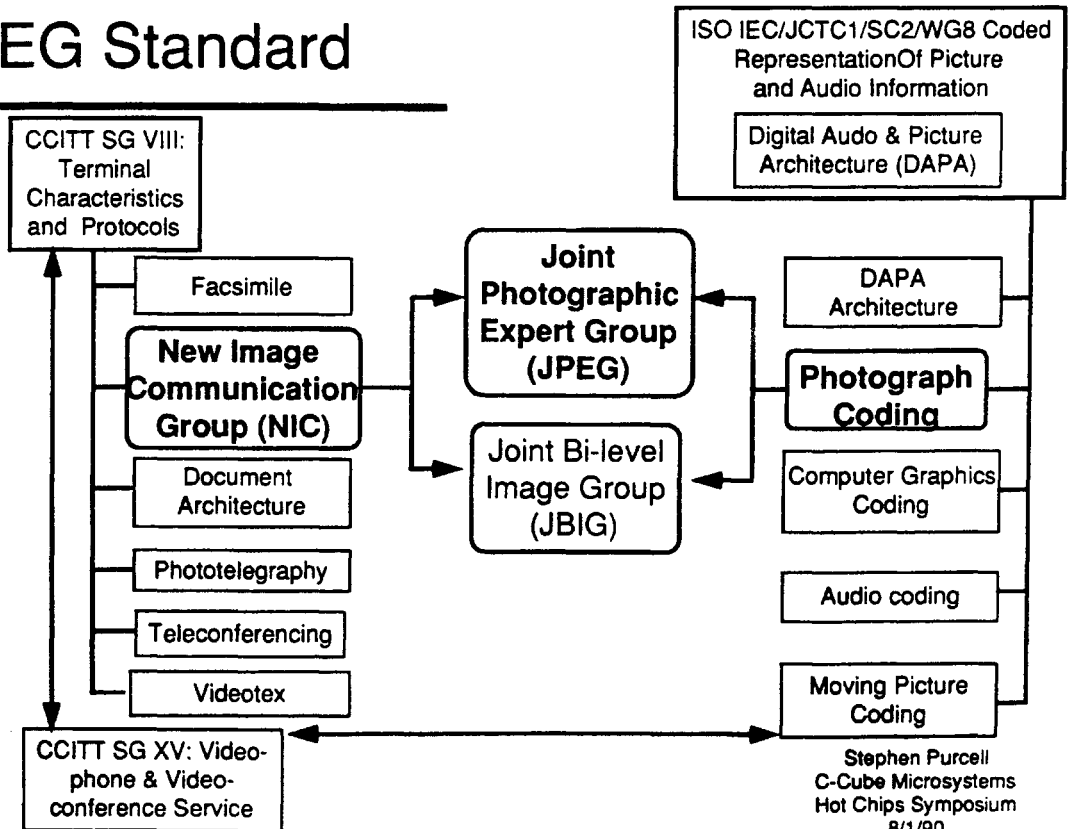
# CCITT / ISO Int'l Standards

Facsimile	Grp. 3 & 4	1984
Image	JPEG	1990
Motion	MPEG	1992

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# JPEG Standard



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## Image Quality

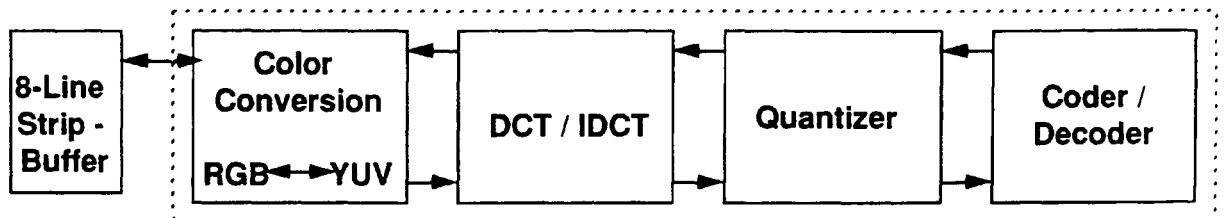
No Degradation on Screen Images at 10 : 1

No Degradation on Print Images at 25 : 1

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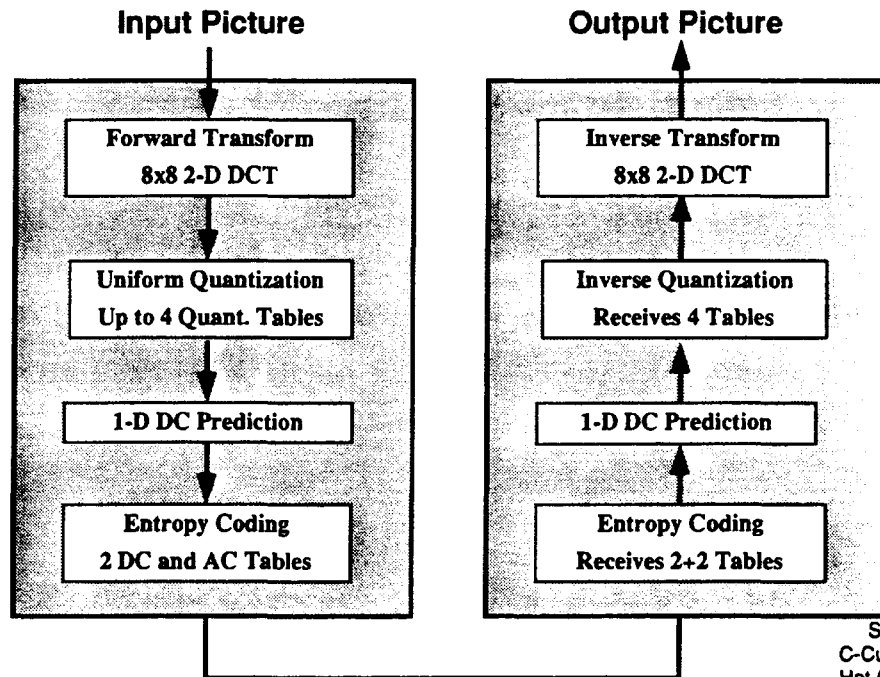
## JPEG Block Diagram



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## Baseline System



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## Y, Cb, Cr Color Space

Y	=	0.299	0.587	0.114	R
Cb	=	-0.169	-0.332	0.500	G
Cv	=	0.500	0.419	-0.081	B

**Luminance, Chrominance better than RGB or CMY**

**Less correlation between components ==> better coding**

**Human eye is more sensitive to luma than chroma**

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## **Discrete Cosine Transform**

**Real, orthogonal transform  
related to Discrete Fourier Transform**

**Spatial ==> Frequency  
Frequency dependent Quantization**

**Correlated ==> Uncorrelated  
Independent entropy coding of coefficients**

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## **Quantization**

**Uniform Quantization of transform coefficients**

**More low frequency buckets; less high frequency**

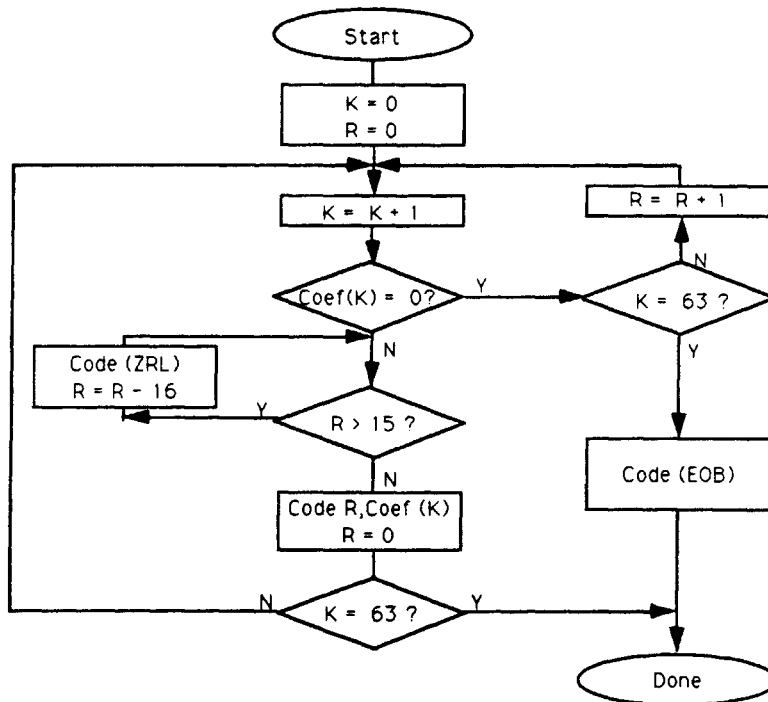
**Human eye resolves better at low frequency**

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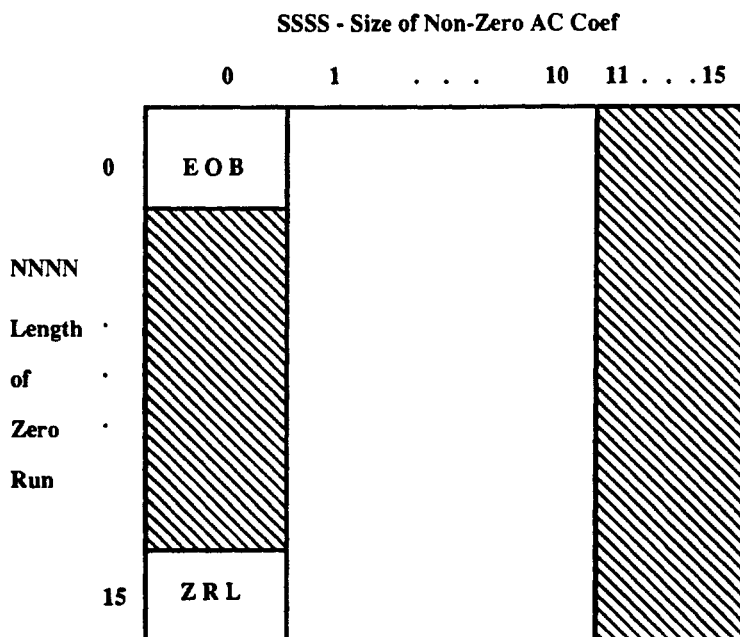
## AC Coefficient Coding



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## 2-D Value Array for AC Coef VLCs



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## **Where is the compression ?**

**Chroma subsampling (2x, lossy)**

**Transform (1x, lossless)**

**Quantization (5x, lossy)**

**Entropy Coding (2x, lossless)**

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## **CL550 JPEG Image Compression Processor**

**Single chip compression/decompression**

**Adjustable compression ratio 8:1 to 100:1**

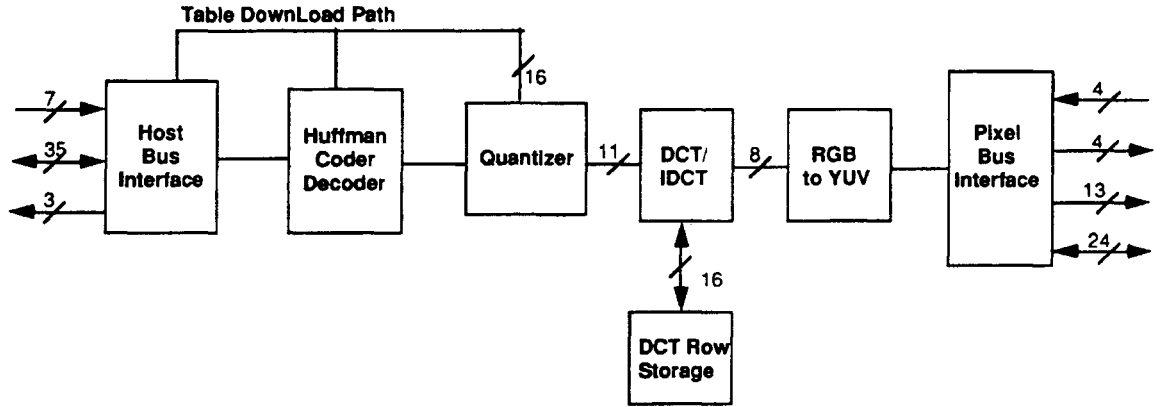
**24-bit RGB and YUV color formats**

**Real-time CCIR 601 Video bandwidth (14M pixels/sec)**

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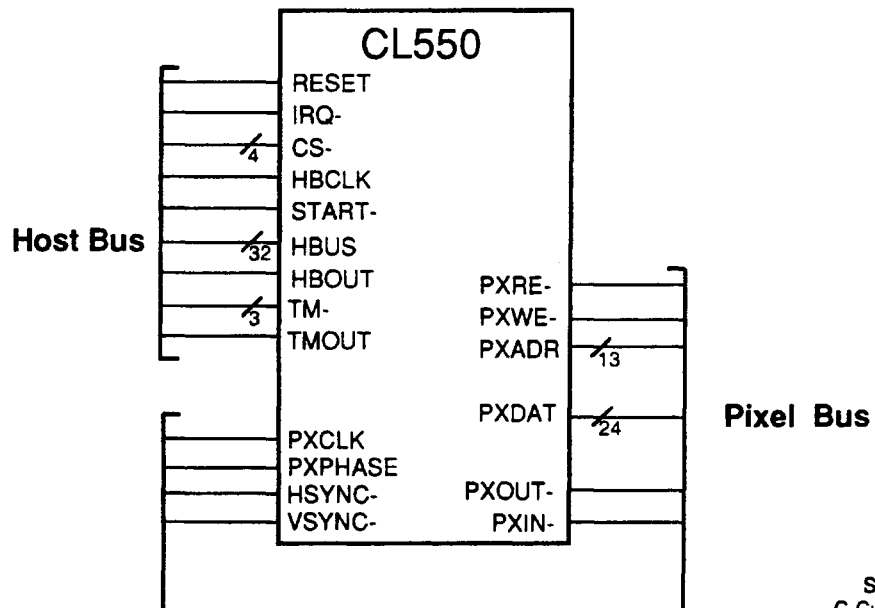
# Chip Block Diagram



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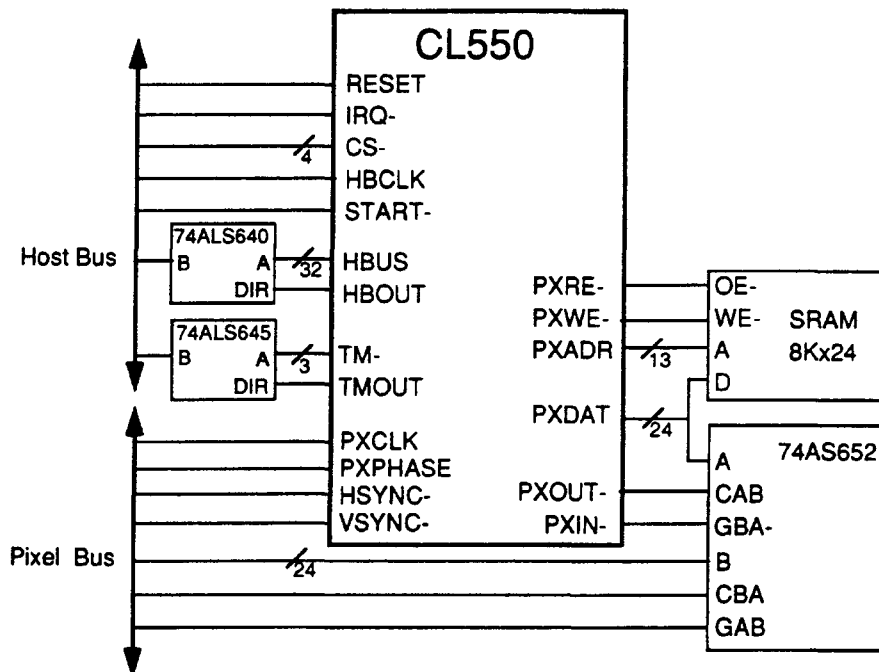
# CL550 Pins



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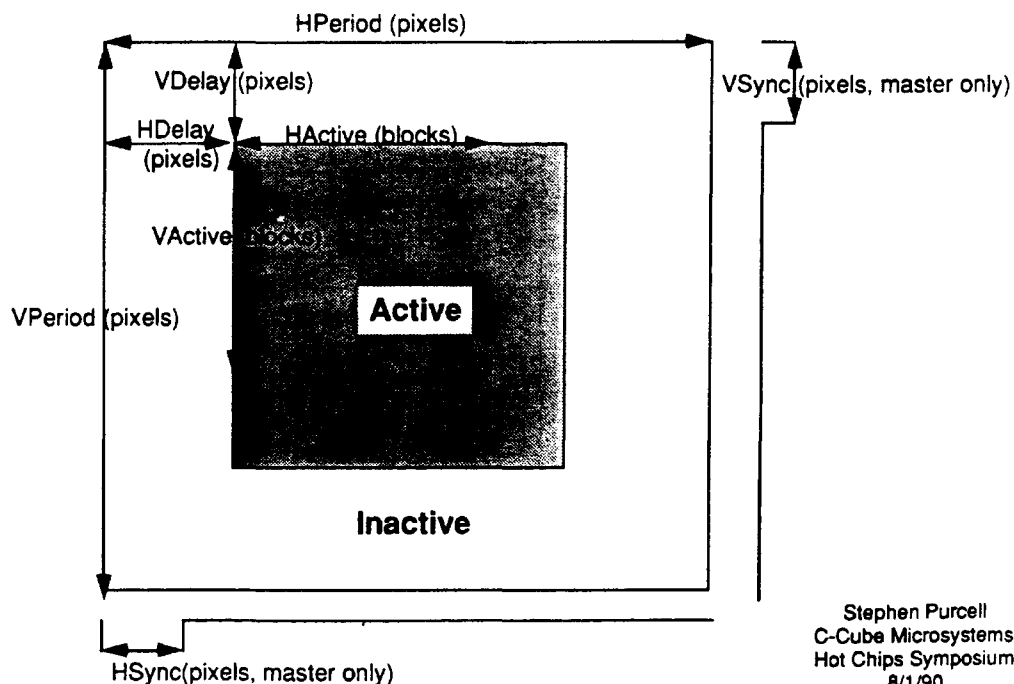
## Sample Circuit



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## CL550 Pixel Windowing



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