Image Compression

Overview

- **Reduce amount of data required to store or transmit an image**
- **Early storage/transmission requirements**
  - **original "standard" digital image**
    - » **512 x 512 pixels x 1 byte/pixel $\cong$ 0.25 Mbytes**
  - **In 1960's, this was a lot of data; today it is not.**
  - **Do we still need image compression?**

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Overview (cont.)

- **Contemporary storage/transmission requirements**
  - **workstation color image**
    - » **1024 x 1024 pixels x 3 bytes/pixel $\cong$ 3.0 Mbytes**
  - **desktop publishing**
    - » **four color image (cyan, magenta, yellow, black)**
   - » **8.5 x 11 in^2 sampled at 600 dots/in $\cong$ 134 Mbytes**

Overview (cont.)

– remote sensing - hyperspectral dataset

  » 1 terrain irradiance measurement in each of 200 10 nm wide spectral bands

  » 12 bits/sample

  » 25 x 25 m² footprint on ground

  » 10 x 10 km² area $\cong$ 4800 Mbytes

Image Compression System
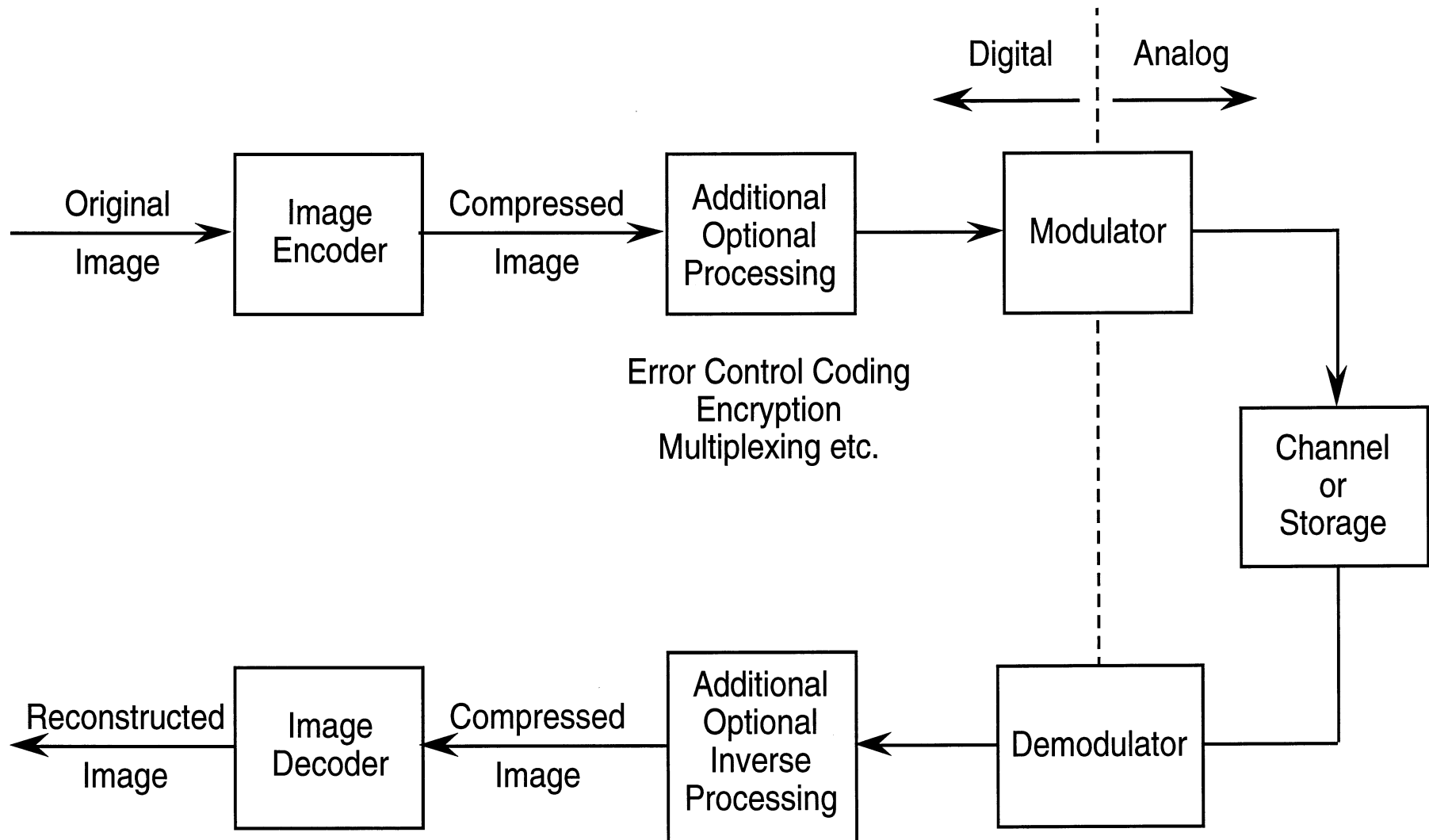
Image Compression Factors

- **Redundancy**

  - pixels do not take on all values with equal probability

  - value of any given pixel is not independent of that of other pixels in the image
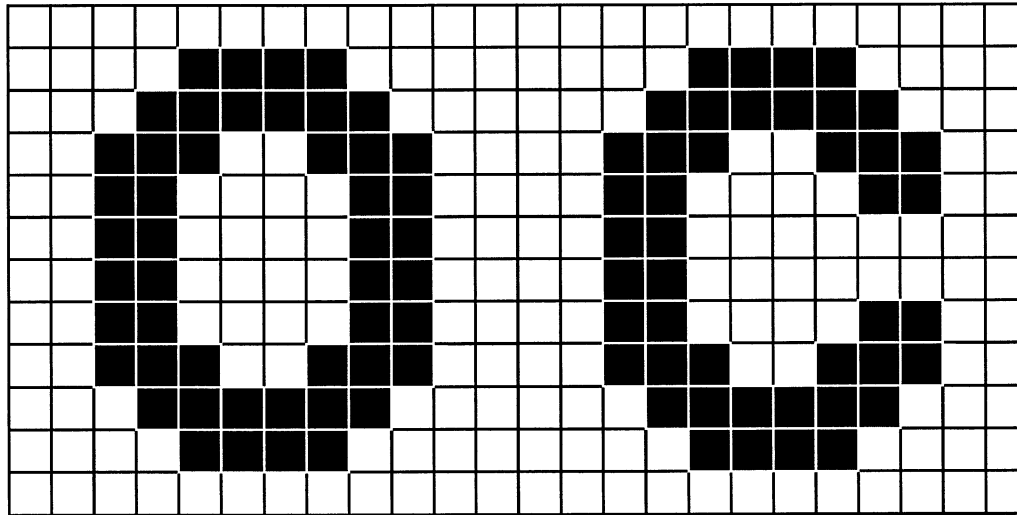
Image Compression Factors

- **Irrelevancy**

  - **Not all information in the image is required for intended application**

  - **Under typical viewing conditions, can remove some information without introducing a perceptible change in the image**

    » **inability to detect:**

      - **small changes in luminance over large areas**

      - **larger changes in luminance over very small areas**

    » **masking due to detail in the image**

Image Compression Factors (cont.)

- **Irrelevancy (cont.)**

    - degradation may be observable, but not objectionable, e.g. teleconferencing

    - degradation may not interfere with performance of task, e.g. object recognition

35mm Slides - Effect of Quantization

Two Major Types of Compression Algorithms

- **Lossless**
  - reconstructed image is identical to original image
  - can only exploit redundancy

- **Lossy**
  - reconstructed image is not identical to original image
  - can exploit both redundancy and irrelevancy

Key Elements of an Image Encoder

Original Image → **Feature Extraction** → **Vector Quantization** → **Entropy Encoding** → Compressed Image