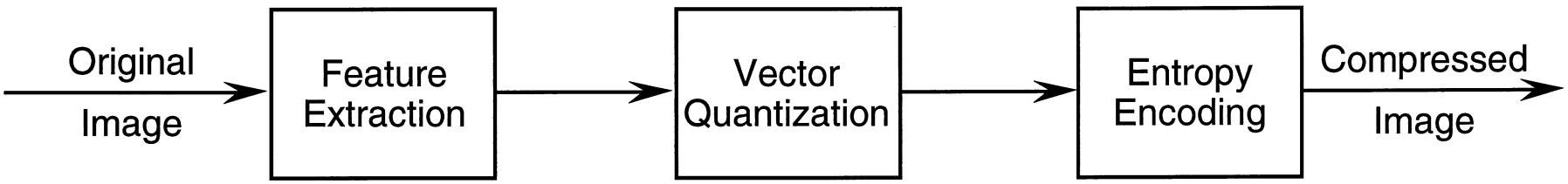
Key Elements of an Image Encoder

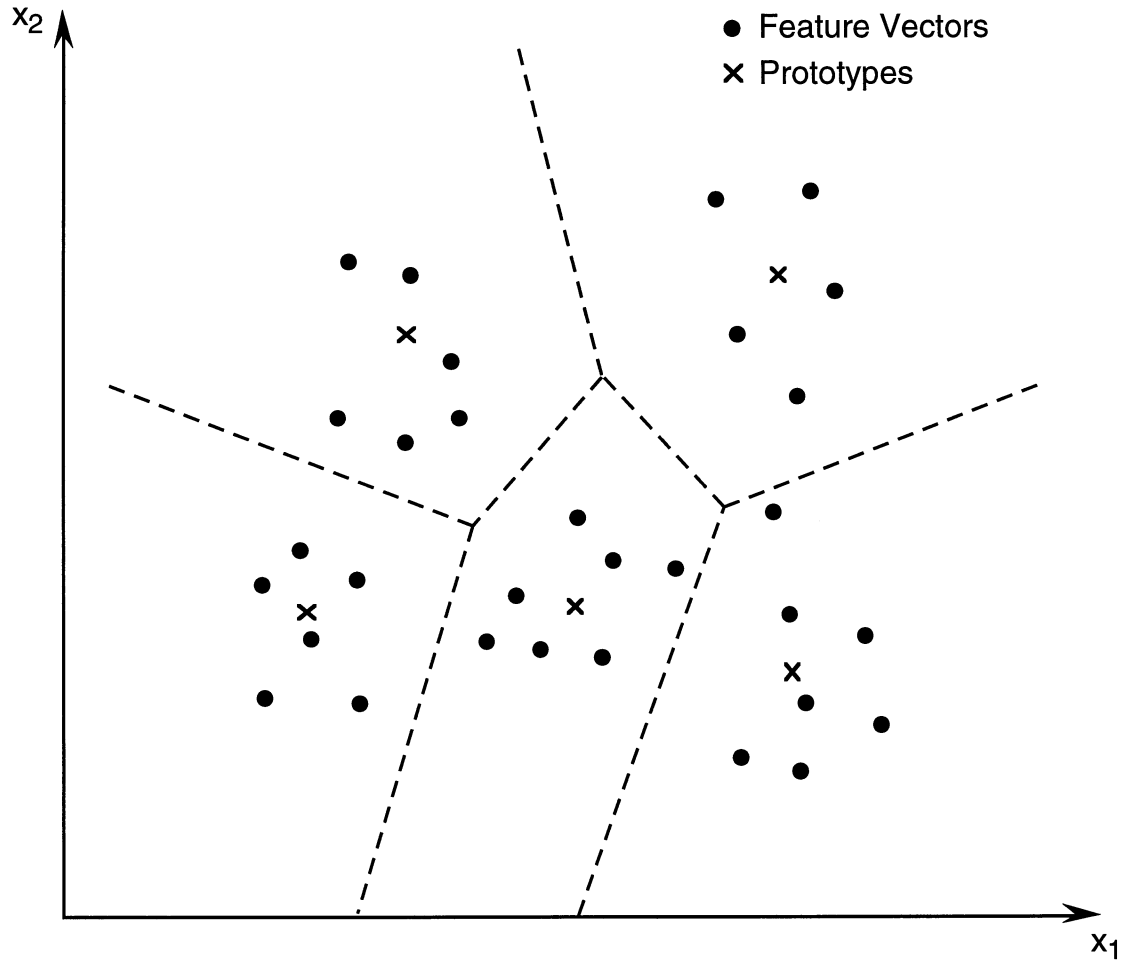


Vector Quantization (VQ)

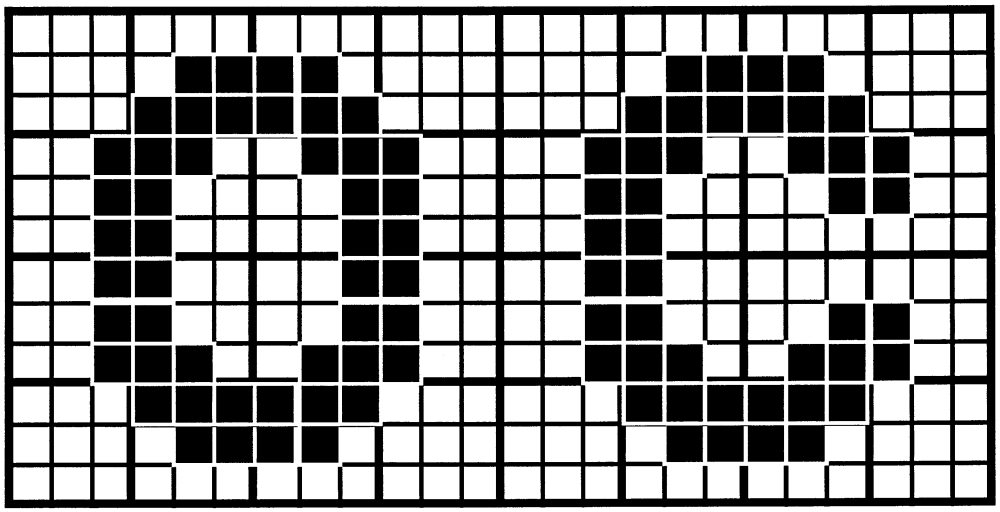
- **Basically a clustering step**
- **Partition feature space into cells**
- **All feature vectors within a single cell are represented by a single prototype vector**
- **Quantization is a many-to-one mapping $\Rightarrow$ not invertible; thus is inherently lossy**

Vector Quantization (cont.)

- **Illustration for 2-dimensional feature space**

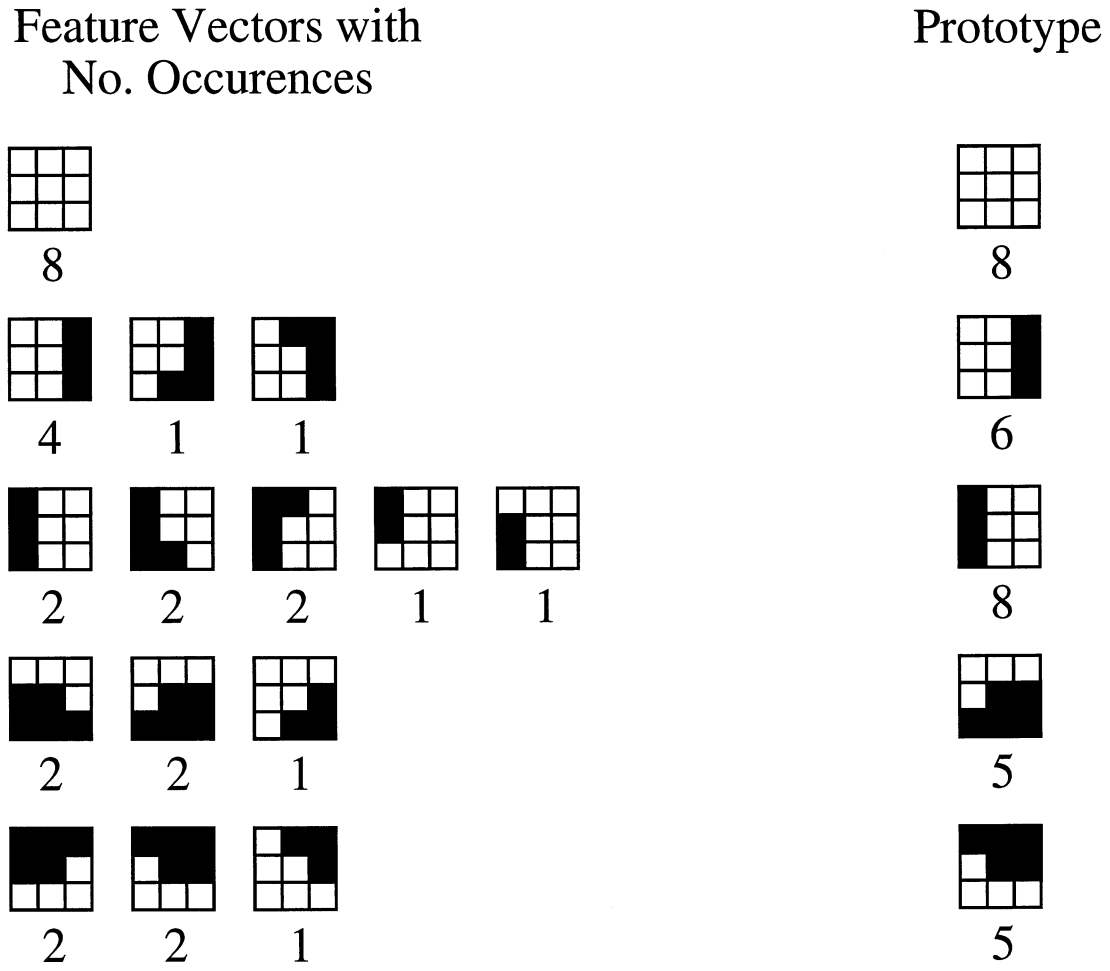


VQ Example



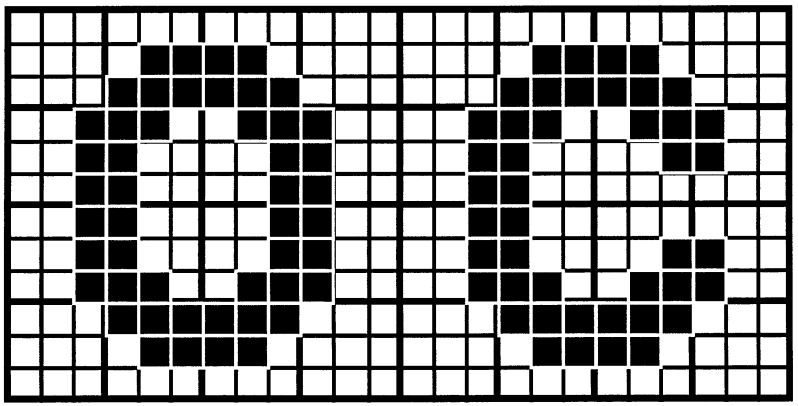
- **Features are 3X3 blocks of pixels**
- **Statistics:**
  - **$2^9 = 512$ different blocks are possible**
  - **only 32 different blocks actually occur**
  - **encode with 5 different prototypes**

VQ Example (cont.)

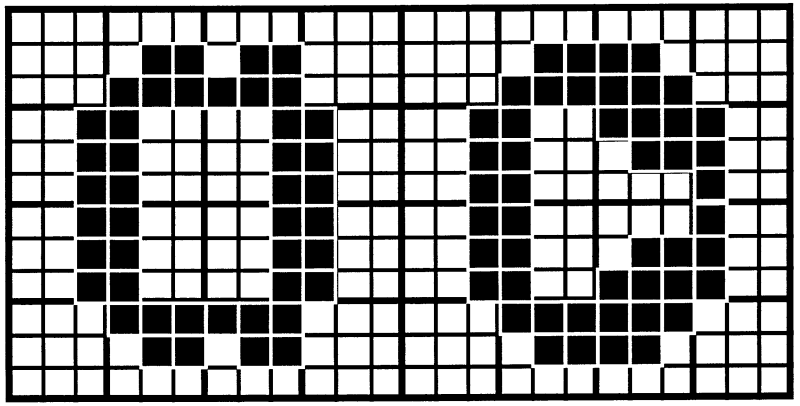


VQ Example (cont.)

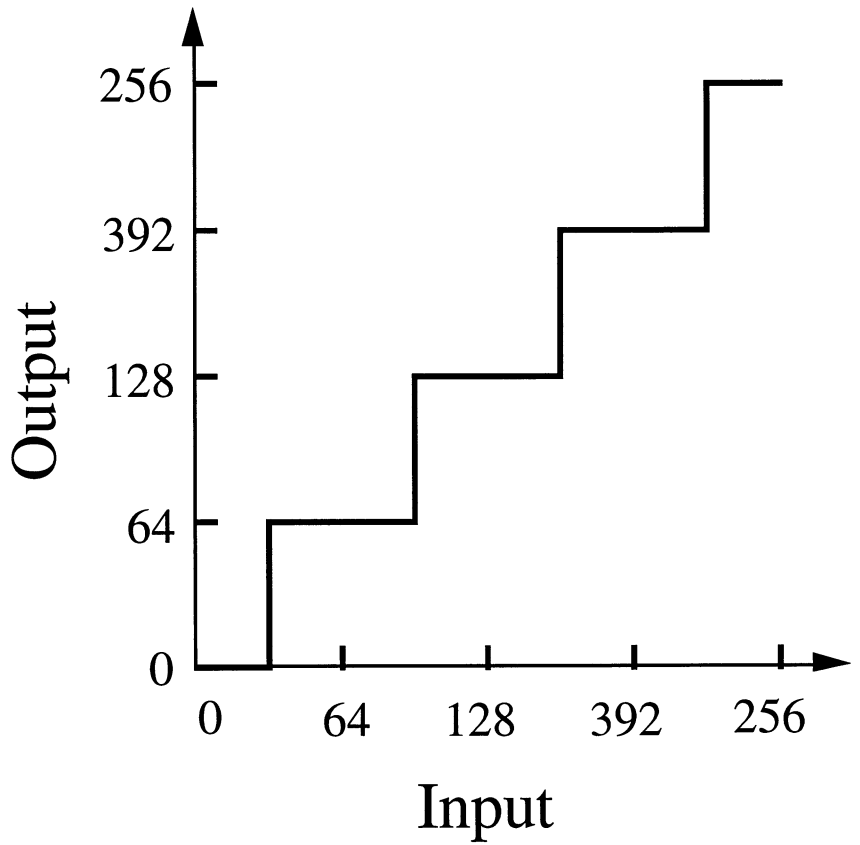
Original Image



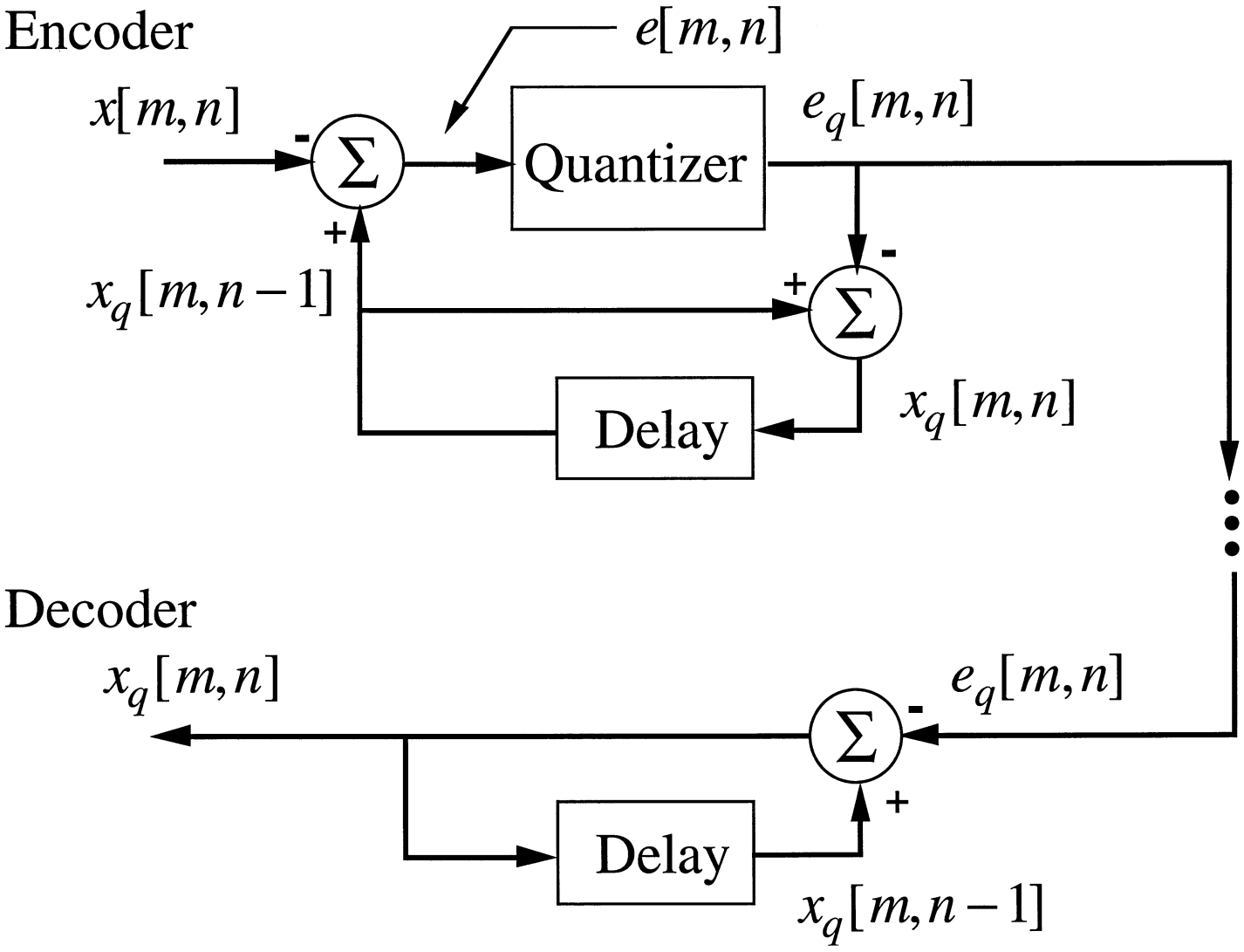
Decoded Image



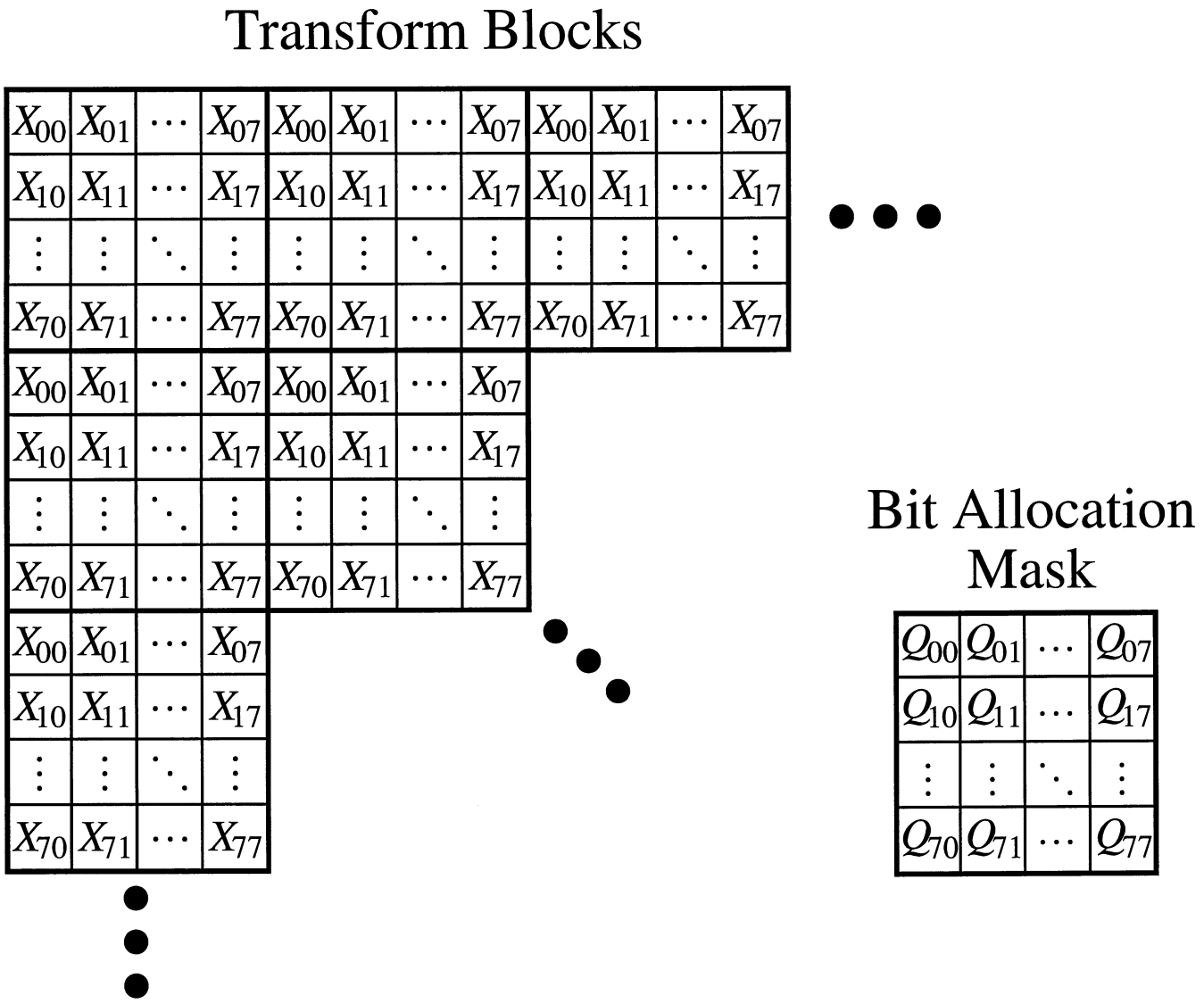
Scalar Quantization



Scalar Quantization in DPCM



Block DCT Quantization



Block DCT Quantization (cont.)

- **Transform coefficients are independently quantized as scalars**
- **Each element of bit allocation mask is an integer between 0 and 255 specifying quantizer step size for corresponding transform coefficient**
- **Scaled and quantized transform coefficients**

$$X_{kl}^{SQ} = \lfloor X_{kl} / Q_{kl} + 0.5 \rfloor$$

- **Reconstructed transform coefficients**

$$X_{kl}^{Q} = X_{kl} Q_{kl}$$