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the center for education and research in information assurance and security

Using Forms for Information Embedding in Electrophotographic Documents

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Protect and Prevent

- Fingerprint and Trace
- Authentication
- Forgery/Alterations

Extrinsic Signature Embedding

- Generate extrinsic signature by modulating the amplitude of the laser beam intensity
- Signature could carry information such as the printer reference number or a time stamp.
- Embedded information does not affect perceived document quality, but is still detectable from the scanned document

Goals

- Embed information at the printer mechanism level in document forms (such as borders or frames) of electrophotographic documents using laser beam intensity modulation
- Provide a content-independent embedding tool for extrinsic signature embedding
- Increase embedding capacity through the use of error-correcting coding techniques

Embedding Signal Design

- Adjust codeword parameters waveform, amplitude, frequency, length
- Amplitude of embedding signal is bounded by edge raggedness
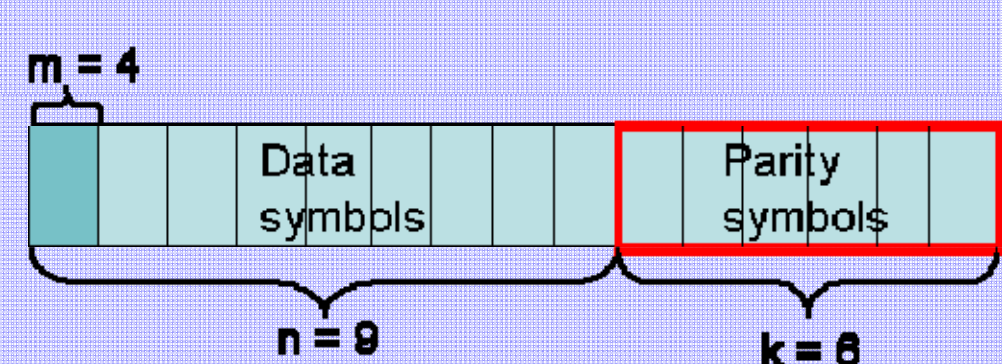- Frequency and codeword length are bounded by the printer mechanism
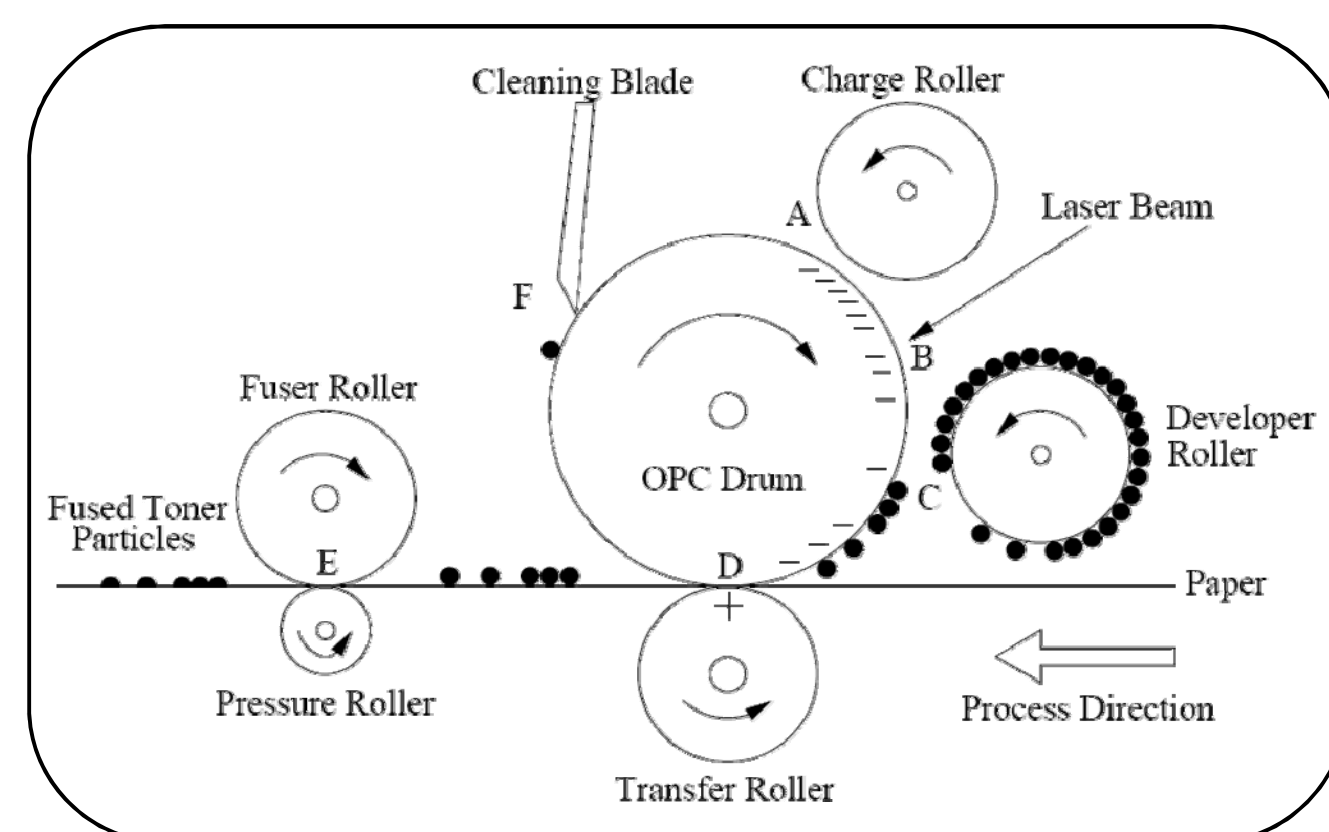
$$M = \{u_1, u_2 ... u_l\}$$

$$C = \{c_1, c_2 ... c_L\}$$

$$S[y] = \sum_{i=0}^{L} A W_{c_i}[y - iT] + V_o$$

Communications systems approach

- Message carrier: embedding signal
- Communication channel: document form
- Coding methods:

Reed Solomon

$m = 4$

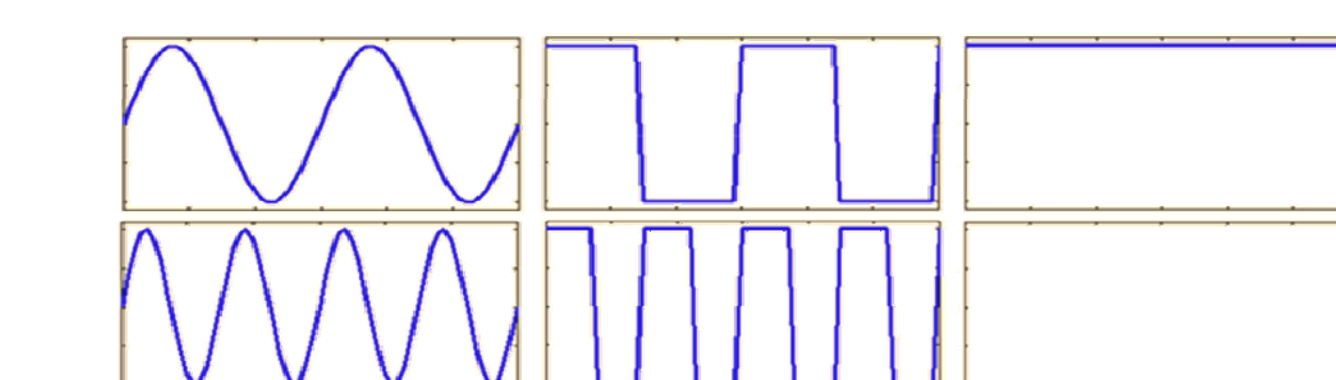| Data symbols	Parity symbols

$n = 9$ $k = 6$

- Block encoder
- Systematic
- Error correcting capacity 3
- Code rate 0.6

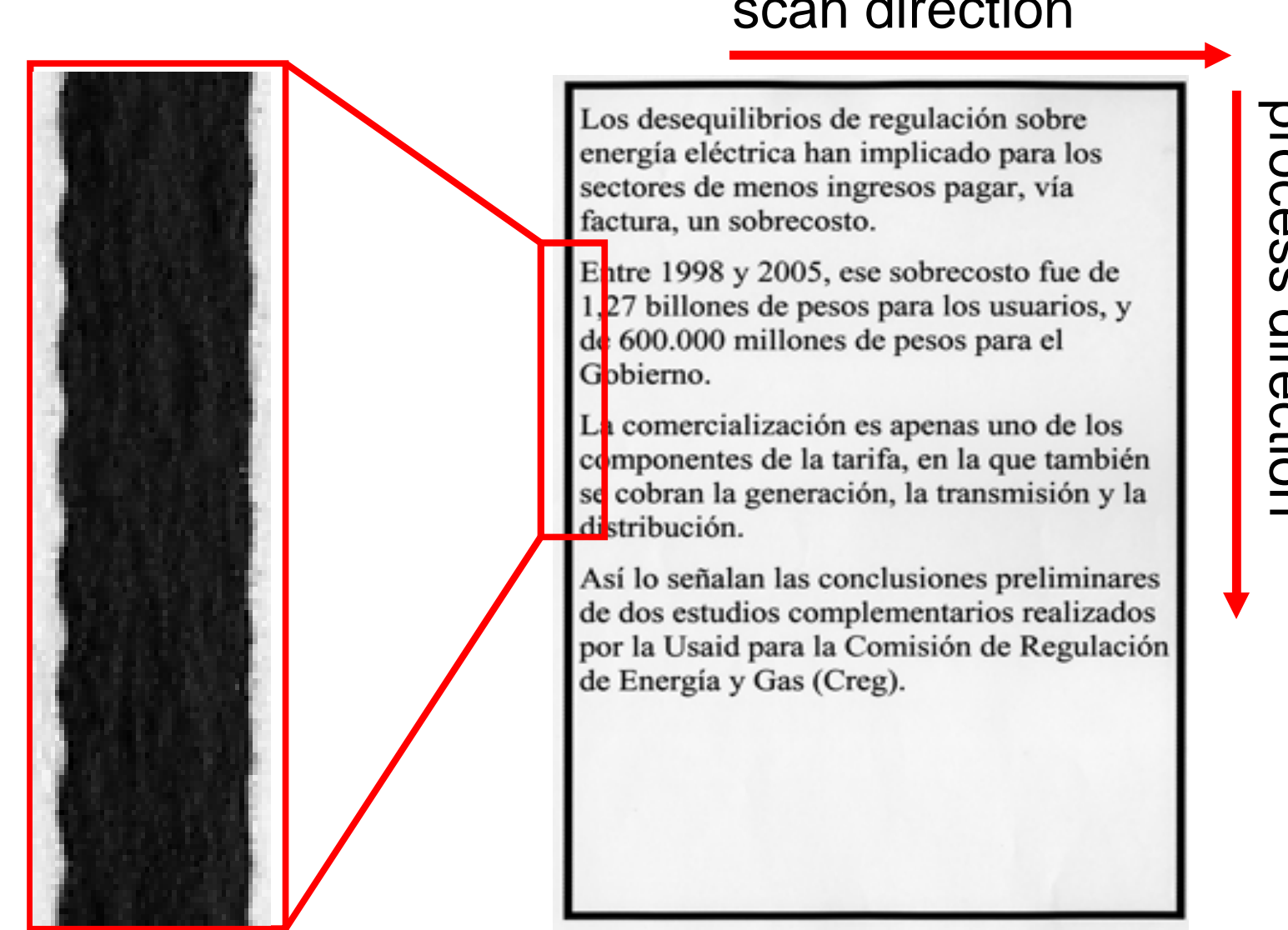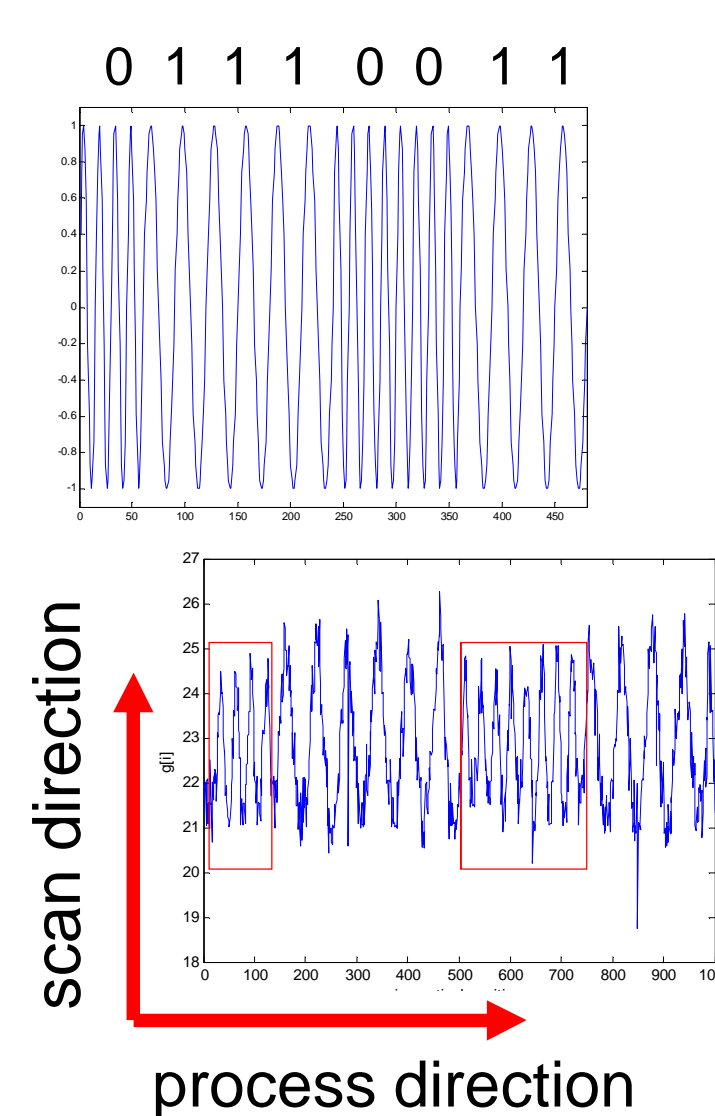Convolutional code
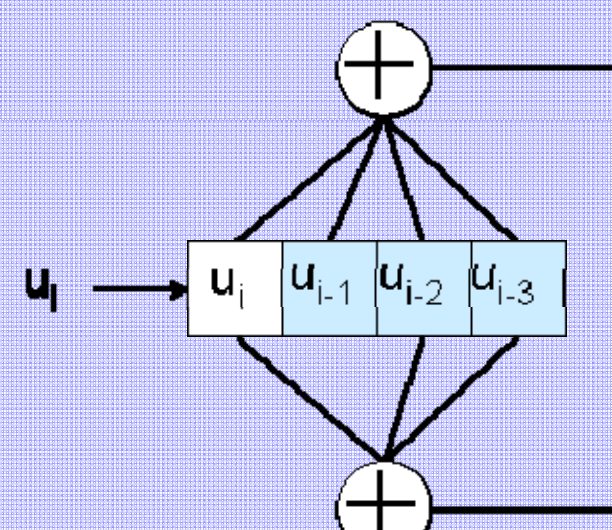
- Sequential encoder
- Non-systematic
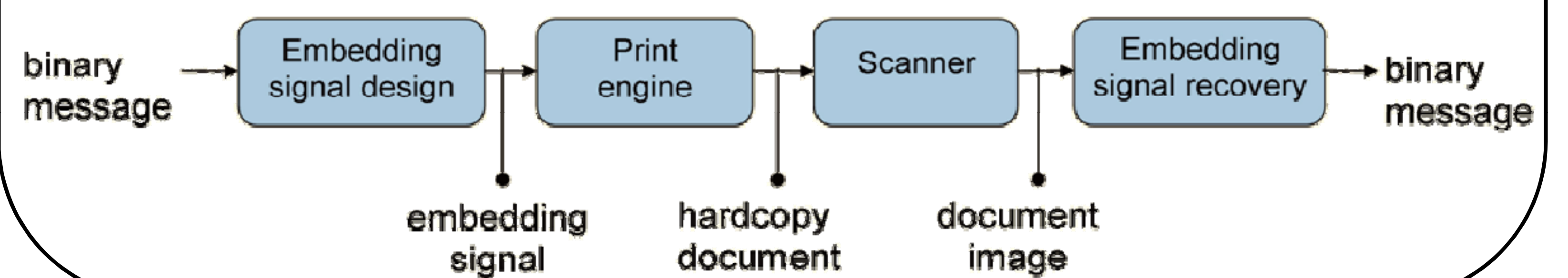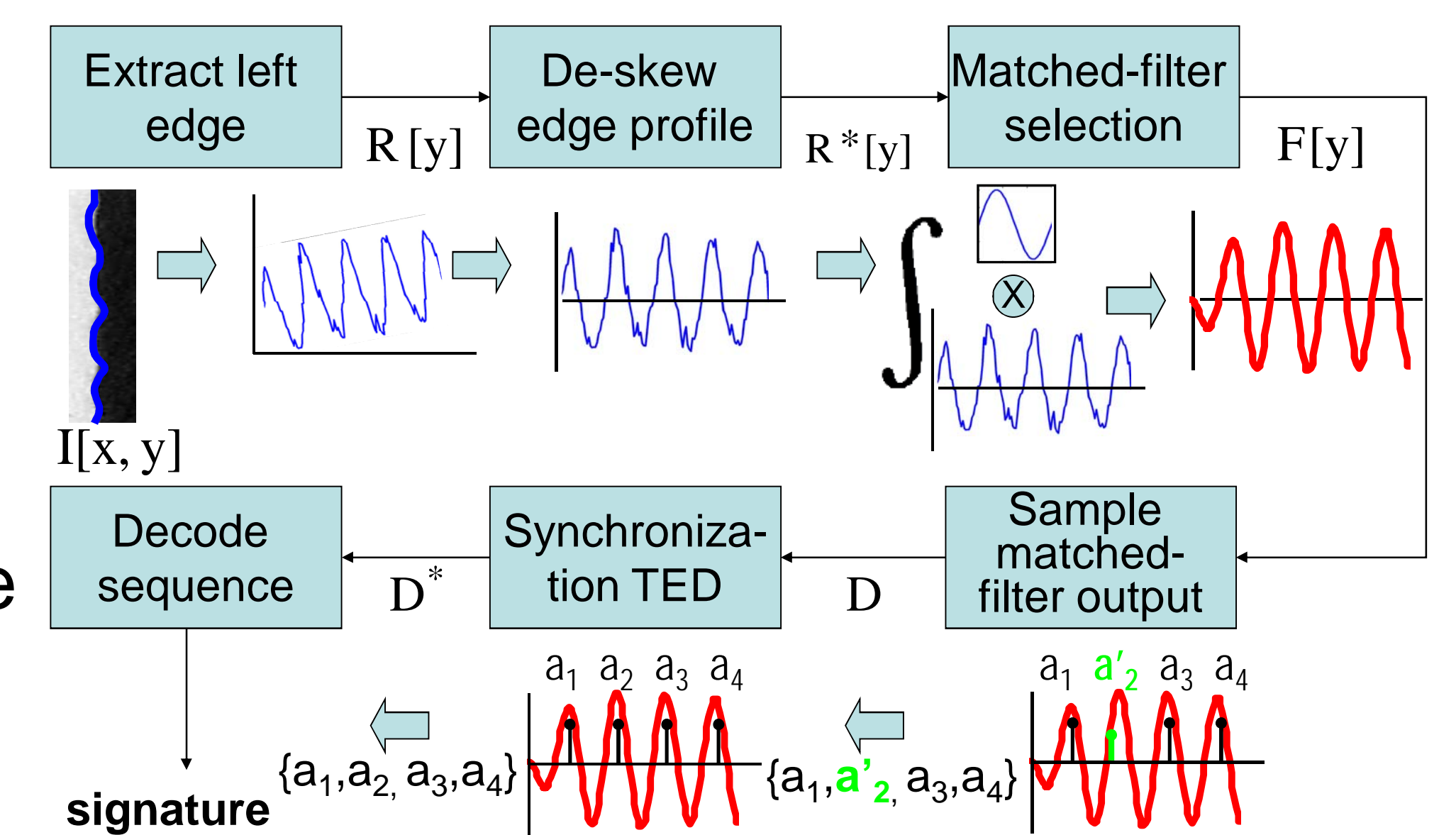- Error correcting capacity 2
- Code rate 0.5

Carrier	Bit '1'	Bit '0'
	$W_1[n]$	$W_0[n]$
sine	$sine[2\pi n f/R]$	$sine[4\pi n f/R]$
square	$square[2\pi n f/R]$	$square[4\pi n f/R]$
constant amp.	$Arect(n/T)$	$-Arect(n/T)$

0 1 1 1 0 0 1 1

Los desequilibrios de regulación sobre energía eléctrica han implicado para los sectores de menos ingresos pagar, vía factura, un sobrecosto.

Entre 1998 y 2005, ese sobrecosto fue de 1.27 billones de pesos para los usuarios, y de 600.000 millones de pesos para el Gobierno.

La comercialización es apenas uno de los componentes de la tarifa, en la que también se cobran la generación, la transmisión y la distribución.

Así lo señalan las conclusiones preliminares de dos estudios complementarios realizados por la Usaid para la Comisión de Regulación de Energía y Gas (Creg).

scan direction / process direction

Embedding Signal Recovery

- The border/form is segmented from the scanned document and the edge profile is extracted
- Matched-filter operators "match" the codeword waveform

Remarks

- There exists a trade-off between edge raggedness cause by the embedding signal amplitude and the detection rates
- The embedding capacity increases when coding strategies are used
- The error rate is reduced by using error-correcting code schemes

Code	Carrier	Code word length (scanlines)	Capacity (bits/inch)	Error rate (10^{-3})
none	sine (20,40)	30	20	12.5
none	square (20,40)	30	20	8.33
none	sine (50,100)	48	12	13.33
none	square (50,100)	48	12	13.33
RS	constant	32	75	8.33
CC	constant	16	75	3.88

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