
بسم الله الرحمن الرحيم
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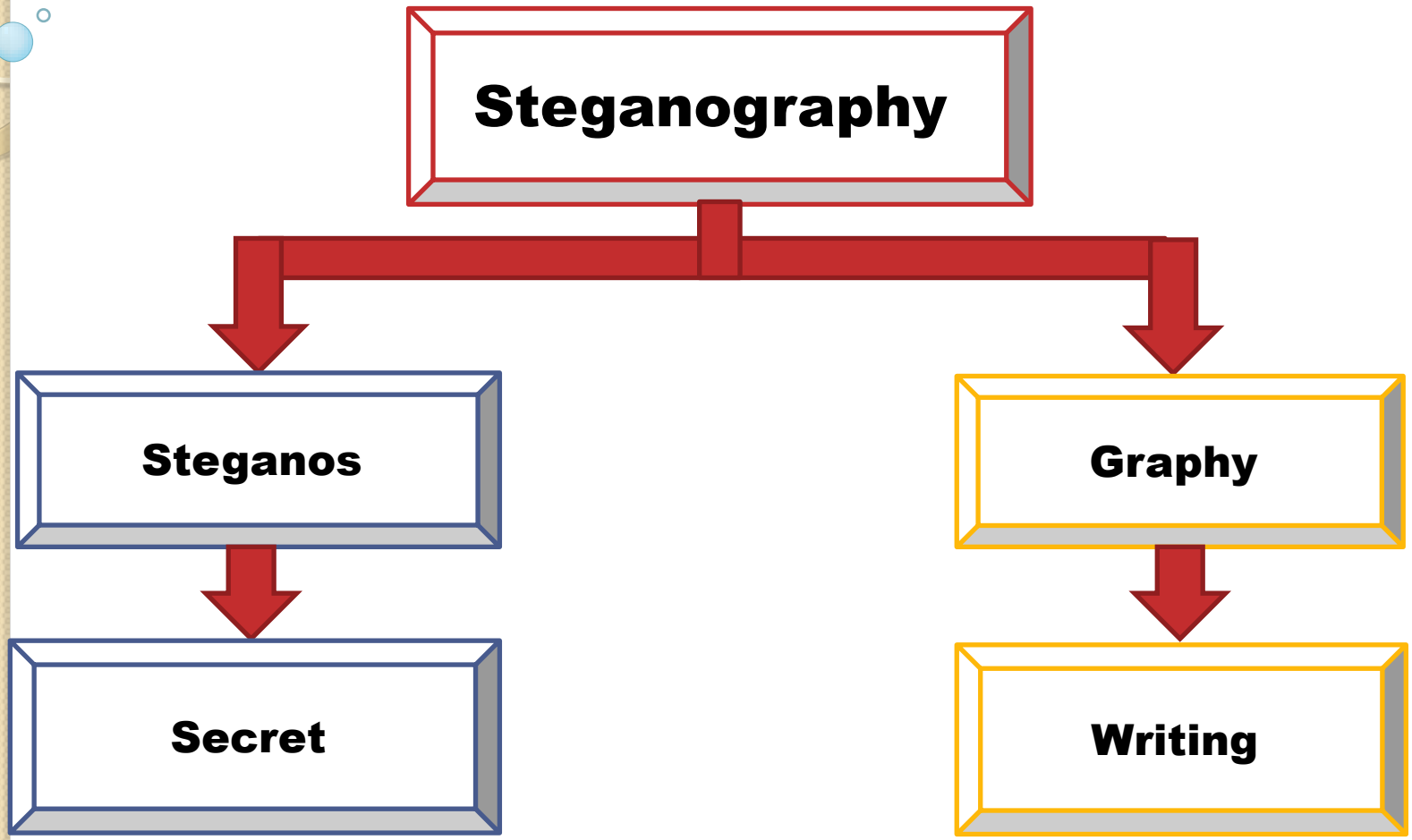
STEGANOGRAPHY IN IMAGES

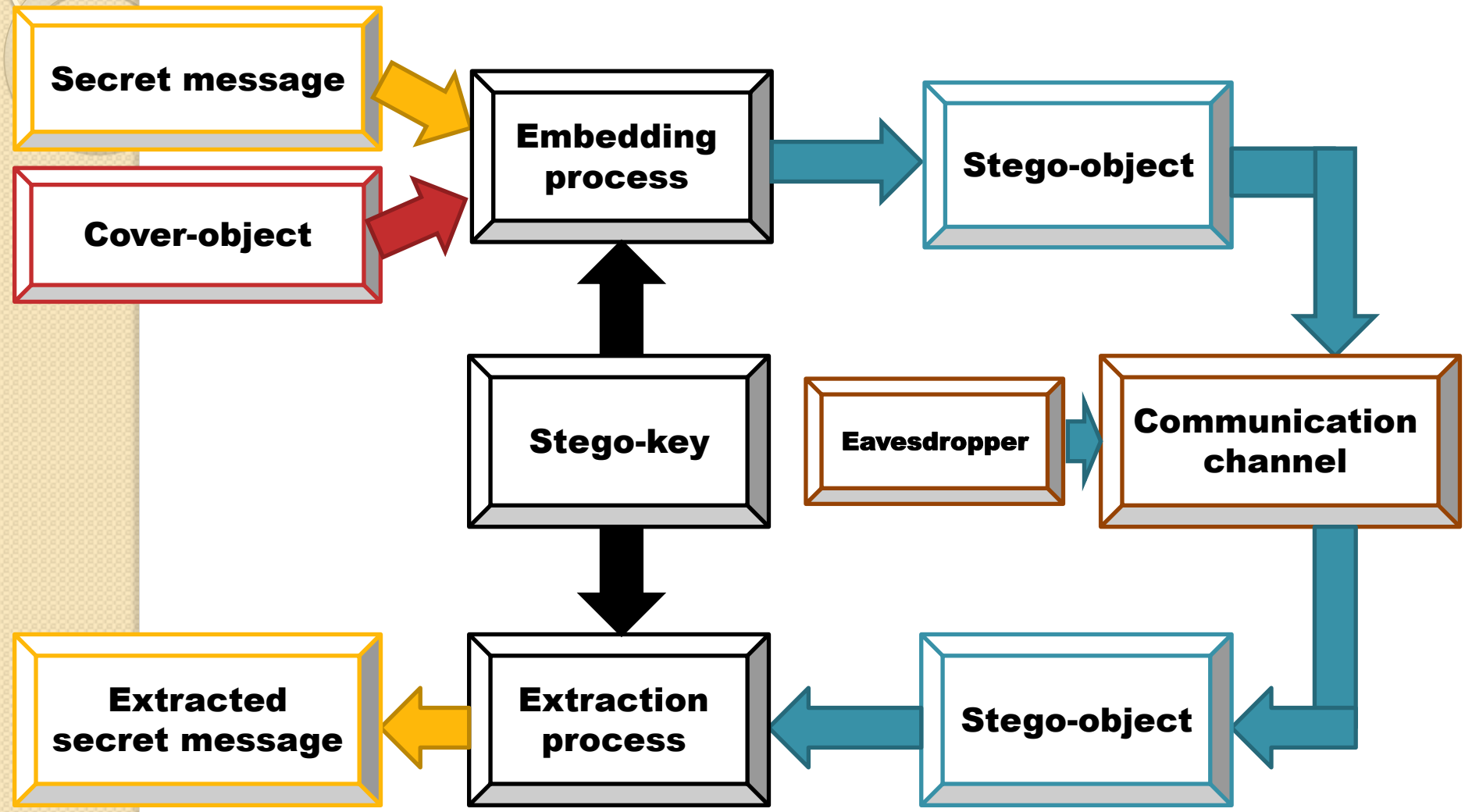
STEGANOGRAPHY



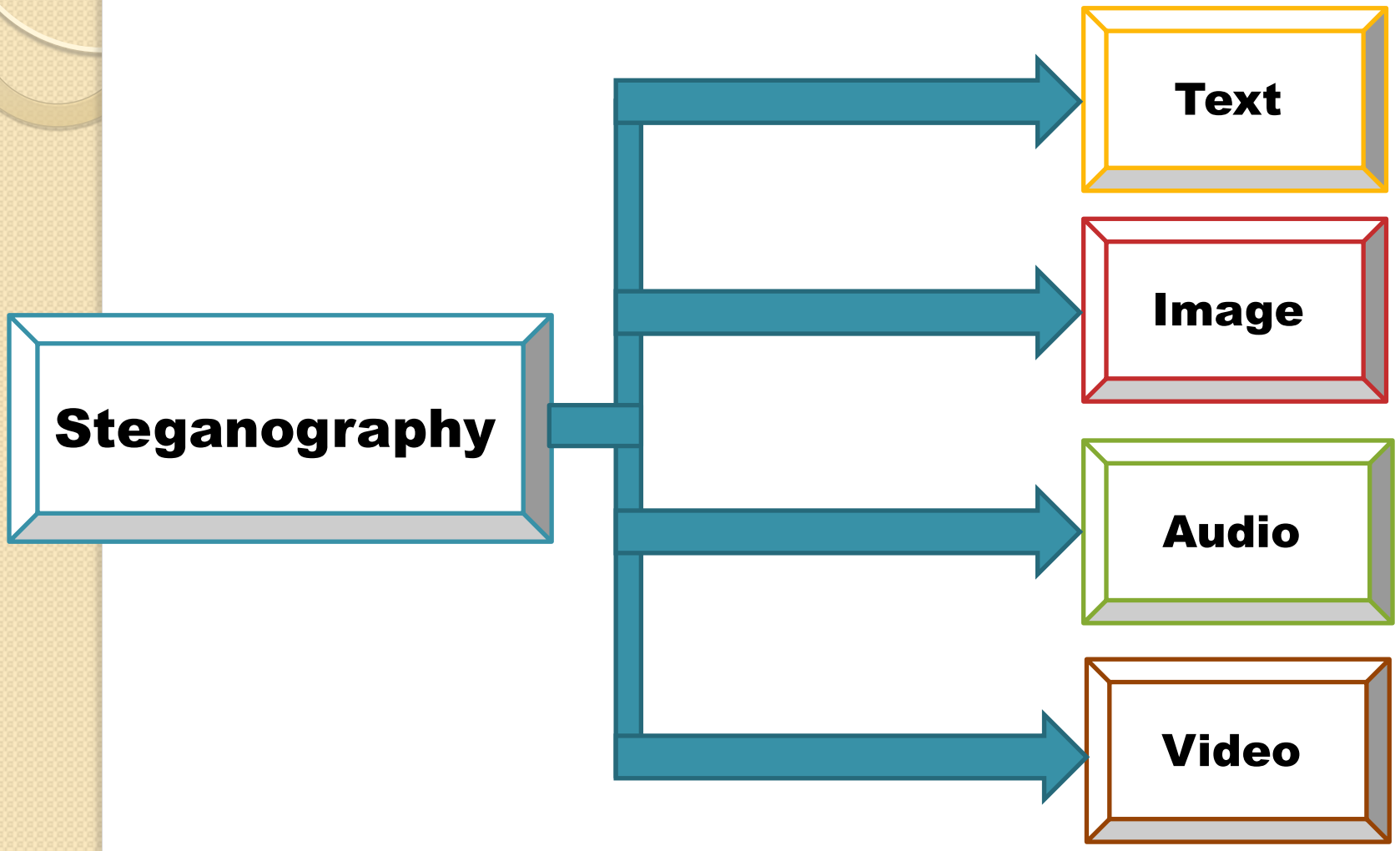
EXAMPLES IN HISTORY

- Tattoos on shaved heads.
- Wax-covered tablets.
- Invisible Inks - milk, fruit juice.

BASIC STEGANOGRAPHY MODEL



TYPES OF STEGANOGRAPHY



REQUIREMENTS OF STEGANOGRAPHY

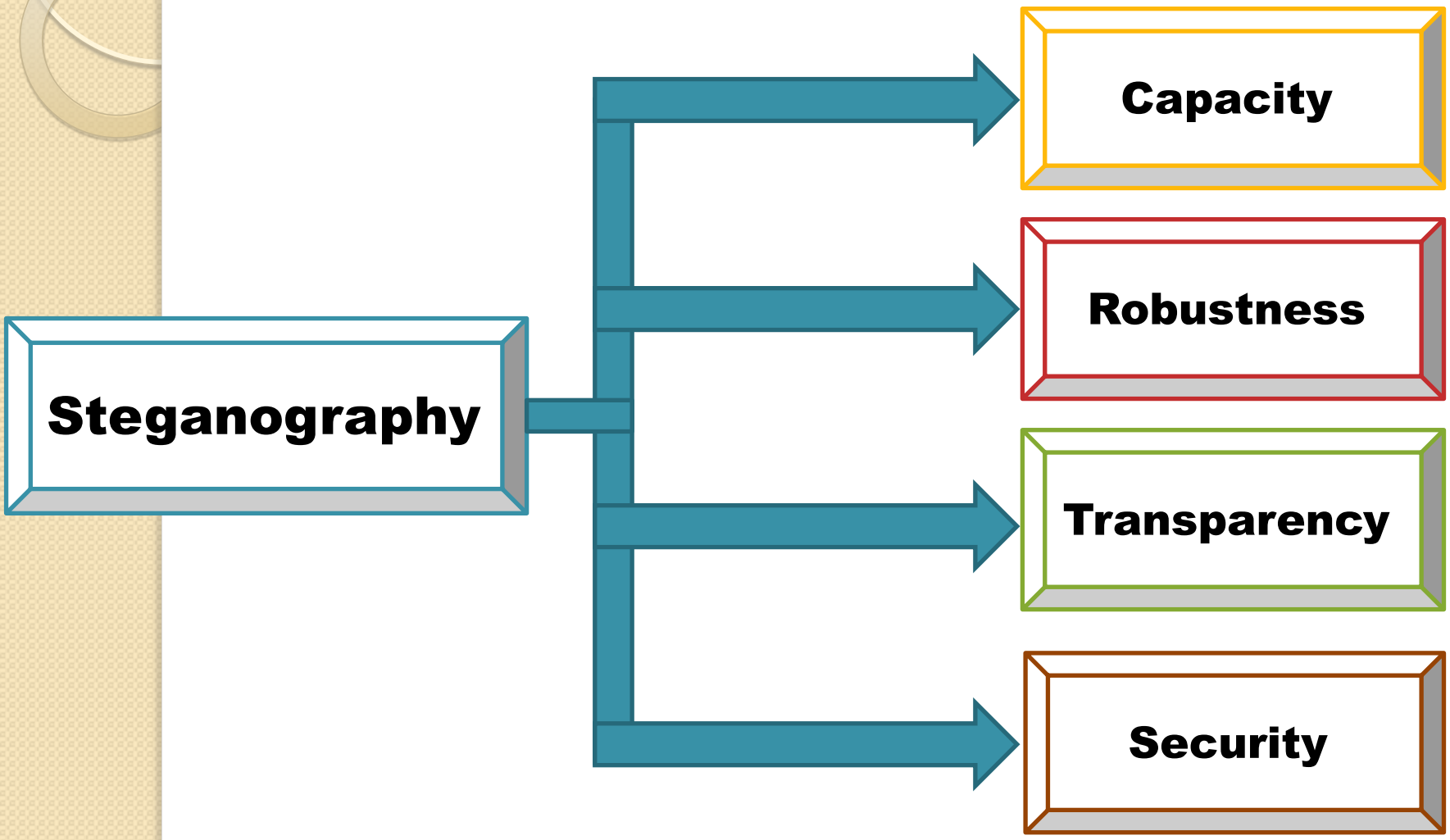
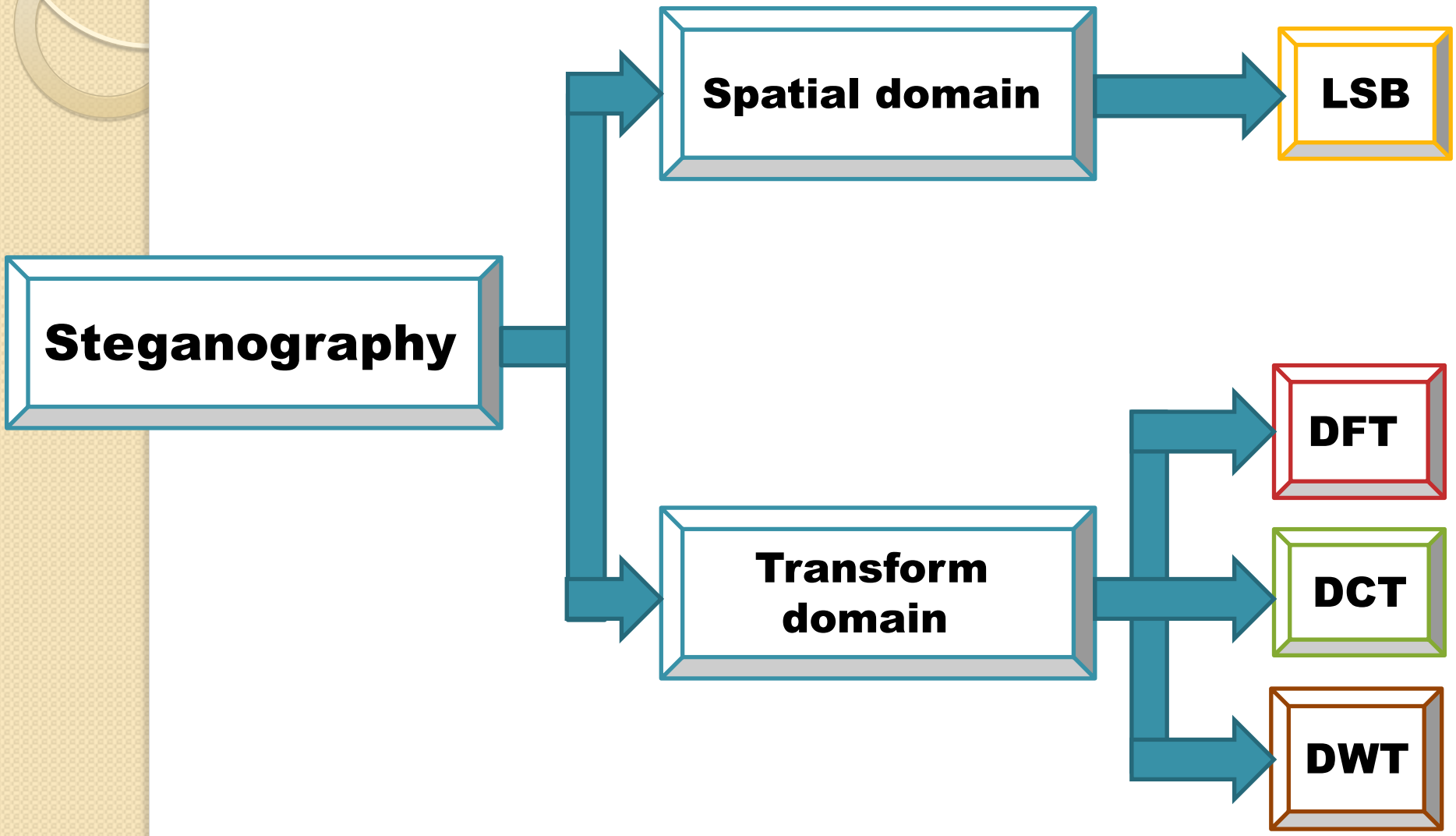


IMAGE STEGANOGRAPHY TECHNIQUES



LSB TECHNIQUE

- Most popular and simpler technique that is used to hide data in cover images.
- Replaces least significant bits of the cover image with the bits of the secret message.
- Has low robustness against attacks such as lossy compression and image manipulation.

TRANSFORMATION TECHNIQUE

- Replaces significant bits of the cover image with the bits of the secret message.
- They stay imperceptible to the human sensitive system.
- More robust than LSB technique against attacks such as lossy compression and image manipulation.

DIGITAL IMAGE

A digital or electronic image is one that has been produced with a computer or camera. The digital camera takes a visual image and translates it into a series of mathematical values. Any two-dimensional image such as a photograph, printed page, or any other type of picture placed on a scanner and its surface captured. The scanner then digitizes the image and displays it electronically on the monitor. Digital images are made up of pixels.

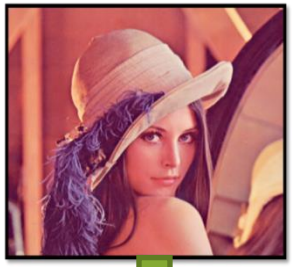
GRAYSCALE IMAGE (8-BIT)

21	100	140	25	30
50	90	70	56	78
99	43	85	65	32
87	99	54	10	16
197	15	9	16	155

Pixel → 197

11000101

COLOR IMAGE (RGB) IMAGE (24-BIT)



10	15	20	92
28	9	32	65
56	70	173	82
200	180	43	198

100	90	60	204
60	85	21	54
45	15	30	10
9	134	178	193

16	25	30	201
127	132	17	19
23	45	180	96
65	37	110	190

Pixel → 198 193 190

11000110 11000001 10111110

R G B

COVER IMAGE

(512*512*3)

R

(512*512)

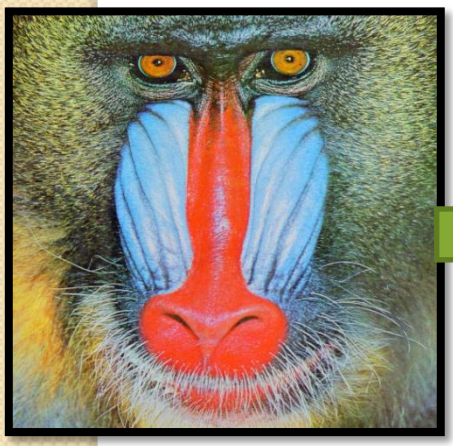
G

(512*512)

B

(512*512)

SECRET IMAGE



Different sizes
(32*32*3)

(32*32)

R

(32*32)

G

(32*32)

B

RED LAYER (COVER IMAGE)

R
(512*512)

$$\begin{bmatrix} 198 & 206 & 182 \\ 170 & 173 & 186 \\ 134 & 178 & 188 \end{bmatrix}$$

(3*3)

Decimal

$$\begin{bmatrix} 198 \\ 206 \\ 182 \\ 170 \\ 173 \\ 186 \\ 134 \\ 178 \\ 188 \end{bmatrix}$$

Binary

$$\begin{bmatrix} 11000110 \\ 11001110 \\ 10110110 \\ 10101010 \\ 10101101 \\ 10111010 \\ 10000110 \\ 10110010 \\ 10111100 \end{bmatrix}$$

RED LAYER (SECRET IMAGE)

R
(32*32)

132
131

(1*2)

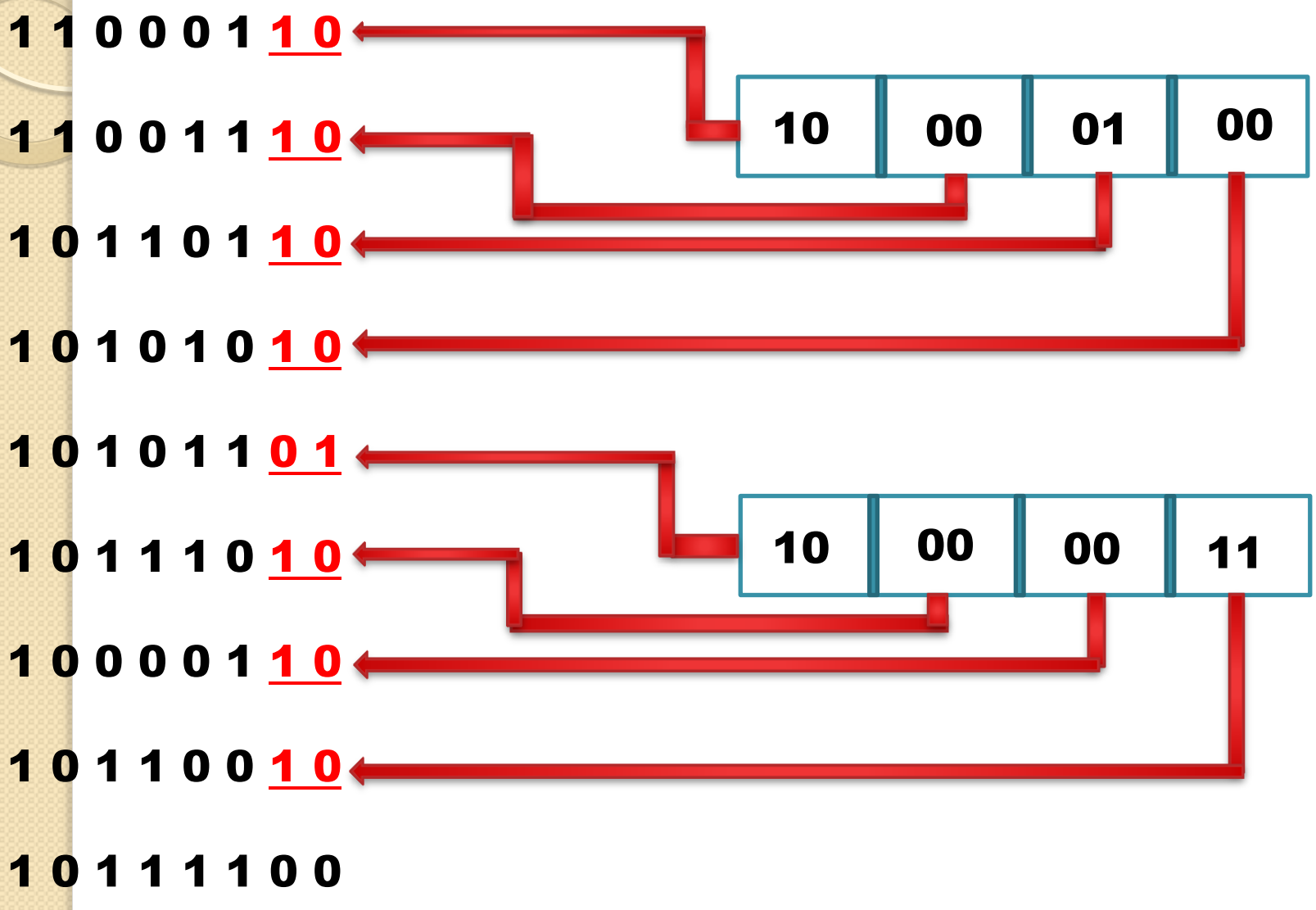
Decimal

132
131

Binary

10000100
10000011

EMBEDDING PROCESS



RED LAYER (STEGO IMAGE)

198
204
181
168
174
184
132
179
188

198 204 181
168 174 184
132 179 188

(3*3)

R
(Cover image)
After
embedding

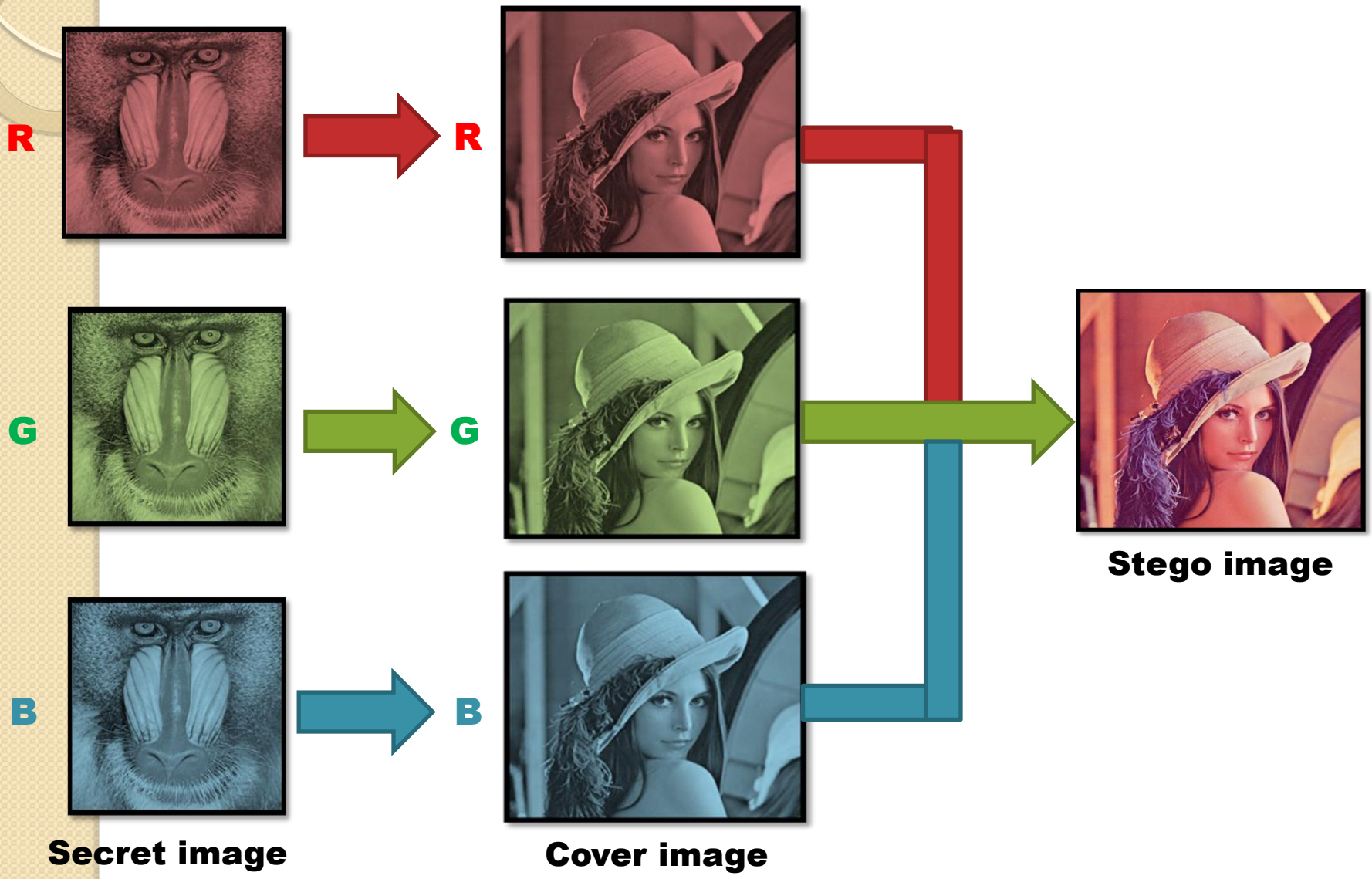
198 206 182
170 173 186
134 178 188

(3*3)

R
(Cover image)
Before
embedding

R
(Stego image)

STEGO IMAGE (TRANSMITTER)



STEGO IMAGE (RECIEVER)

(512*512*3)

R

(512*512)

G

(512*512)

B

(512*512)

RED LAYER (STEGO IMAGE)

R
(512*512)

$$\begin{bmatrix} 198 & 204 & 181 \\ 168 & 174 & 184 \\ 132 & 179 & 188 \end{bmatrix}$$

(3*3)

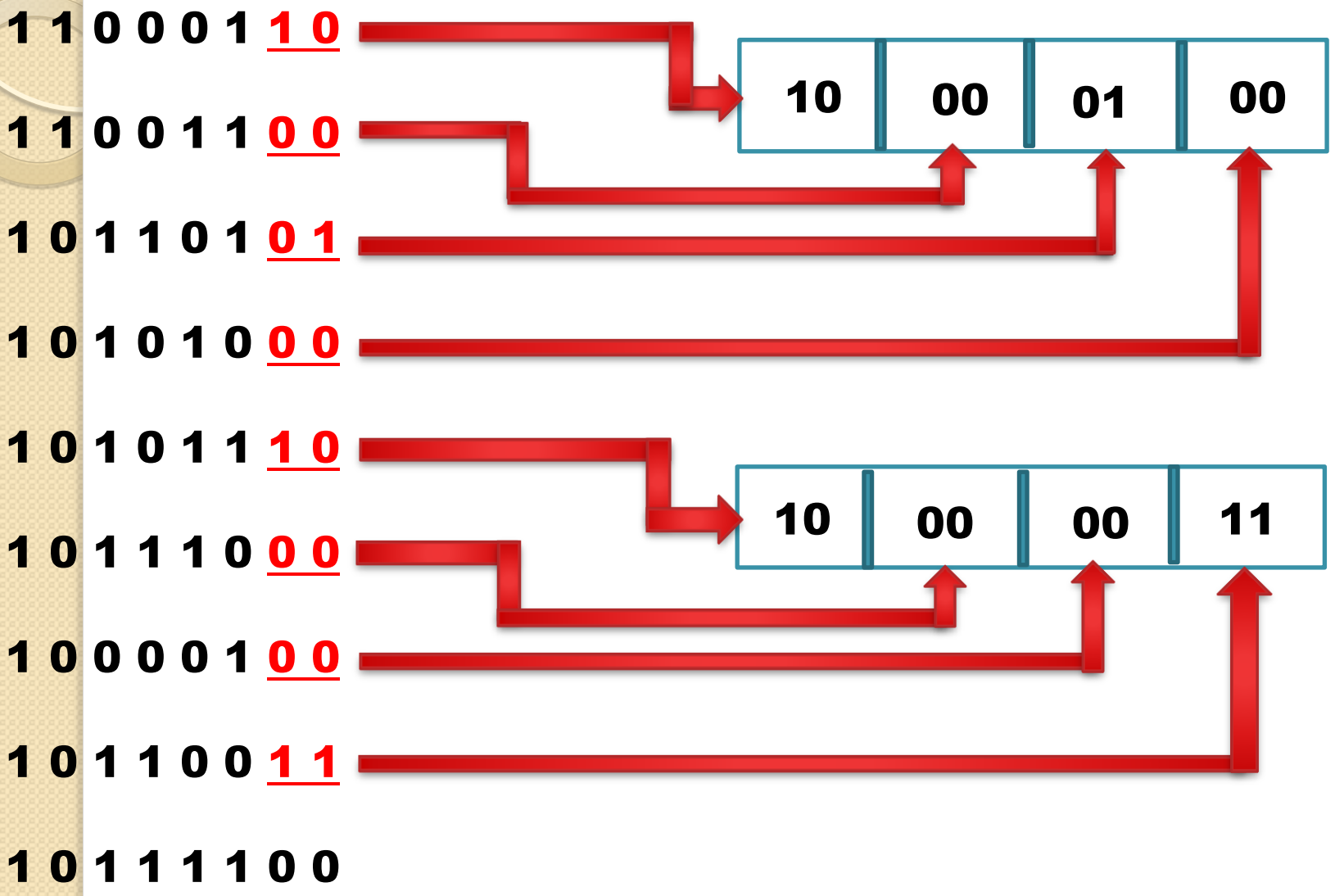
Decimal

$$\begin{bmatrix} 198 \\ 204 \\ 181 \\ 168 \\ 174 \\ 184 \\ 132 \\ 179 \\ 188 \end{bmatrix}$$

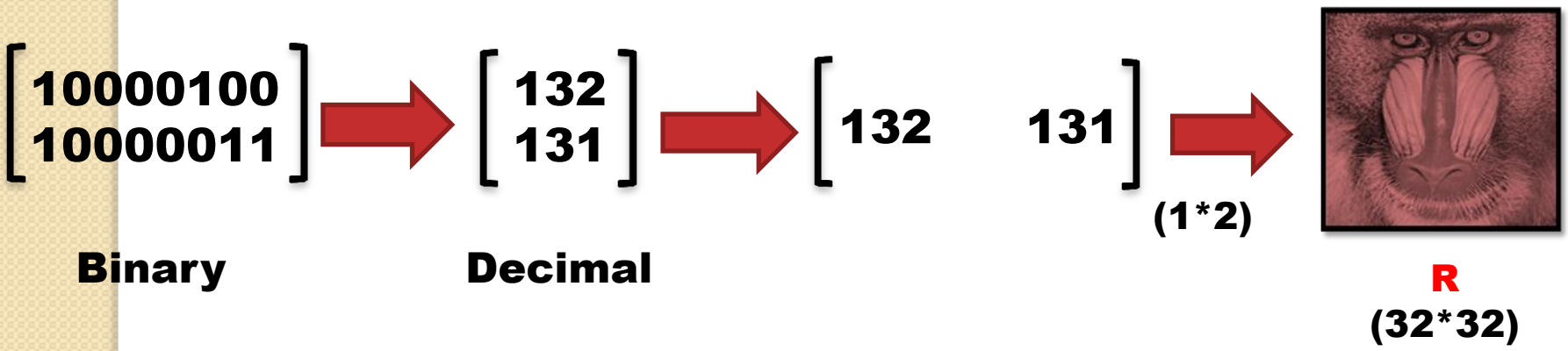
Binary

$$\begin{bmatrix} 11000110 \\ 11001100 \\ 10110101 \\ 10101001 \\ 10101101 \\ 10111000 \\ 10000100 \\ 10110011 \\ 10111100 \end{bmatrix}$$

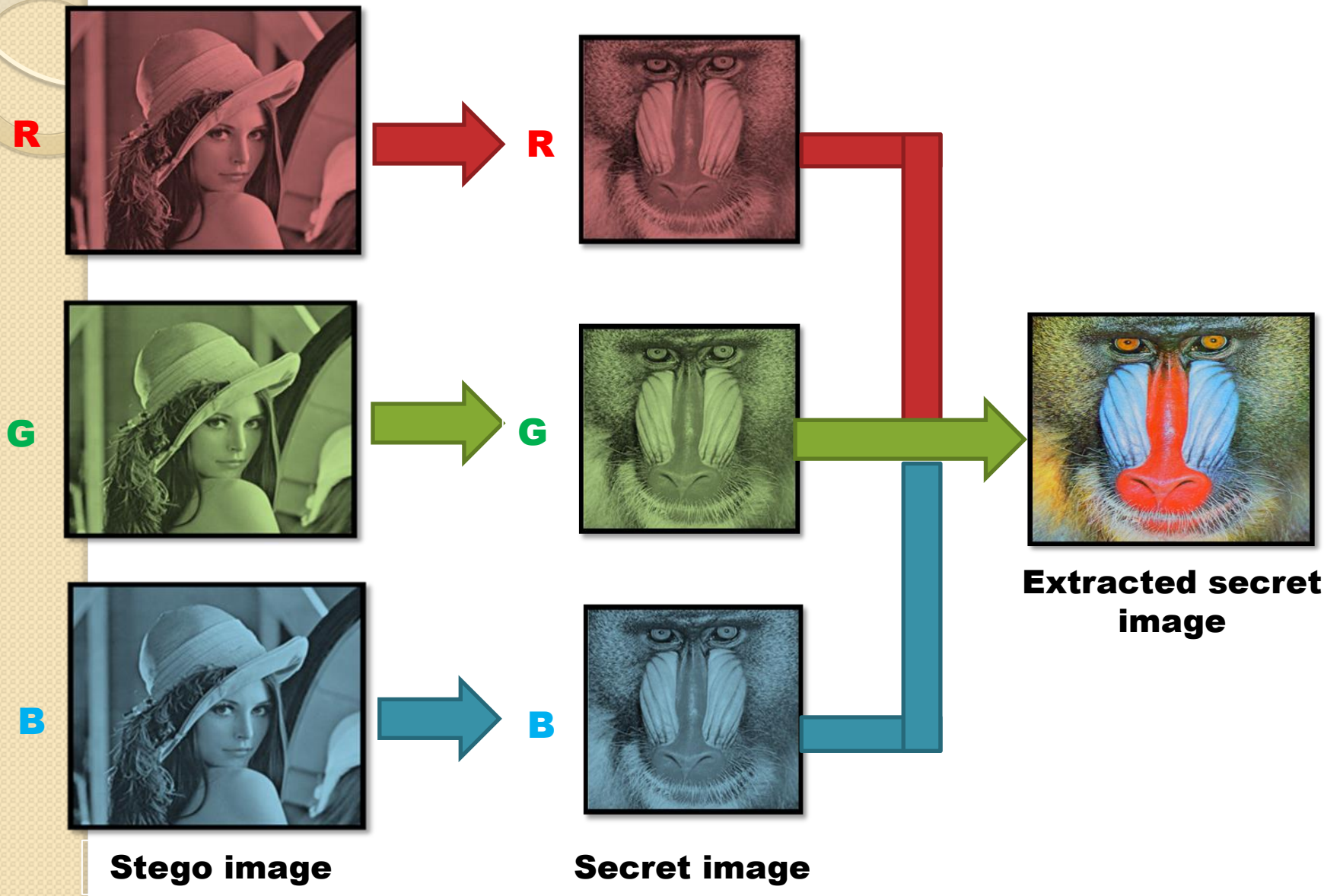
EXTRACTION PROCESS



RED LAYER (EXTRACTED SECRET IMAGE)



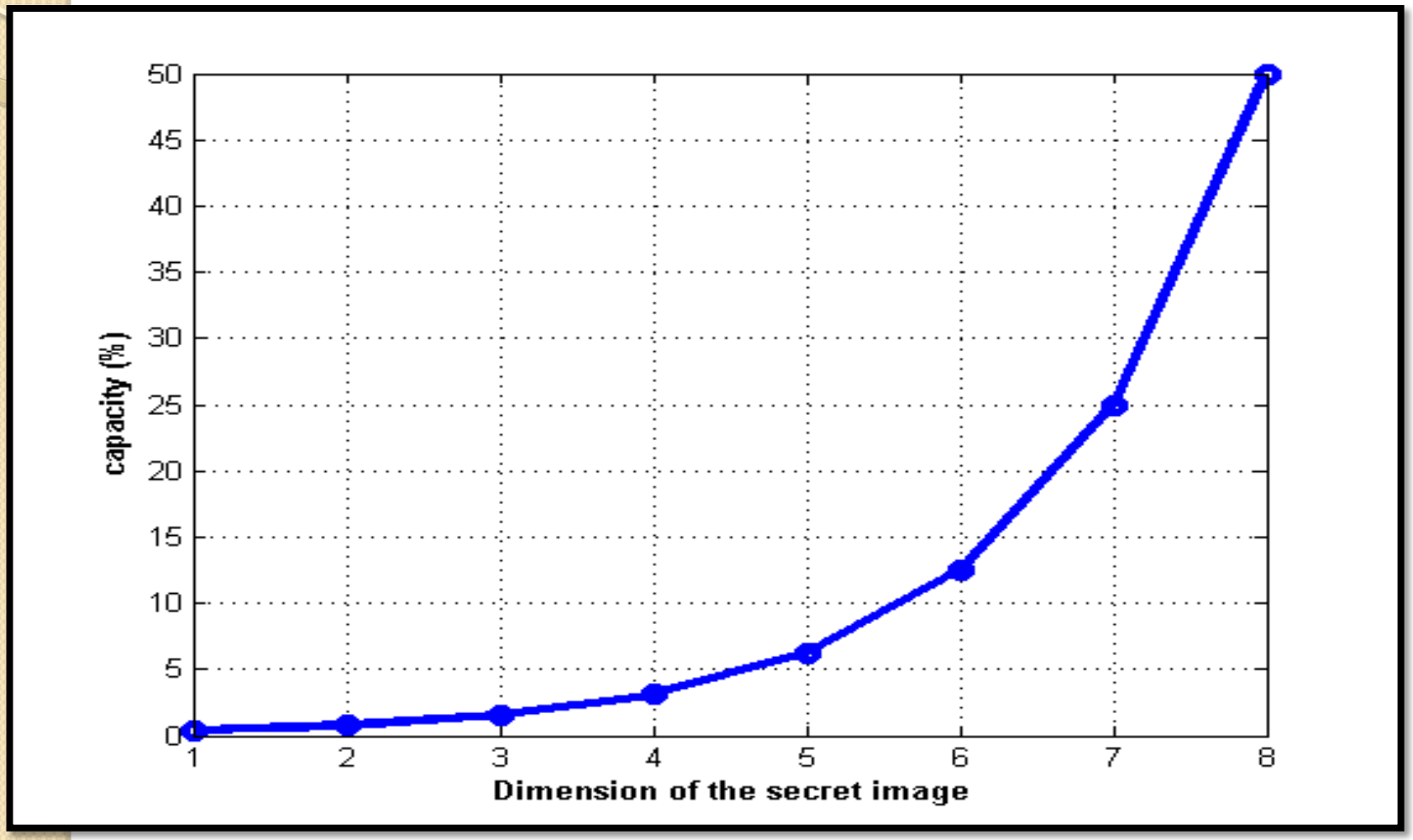
EXTRACTED SECRET IMAGE



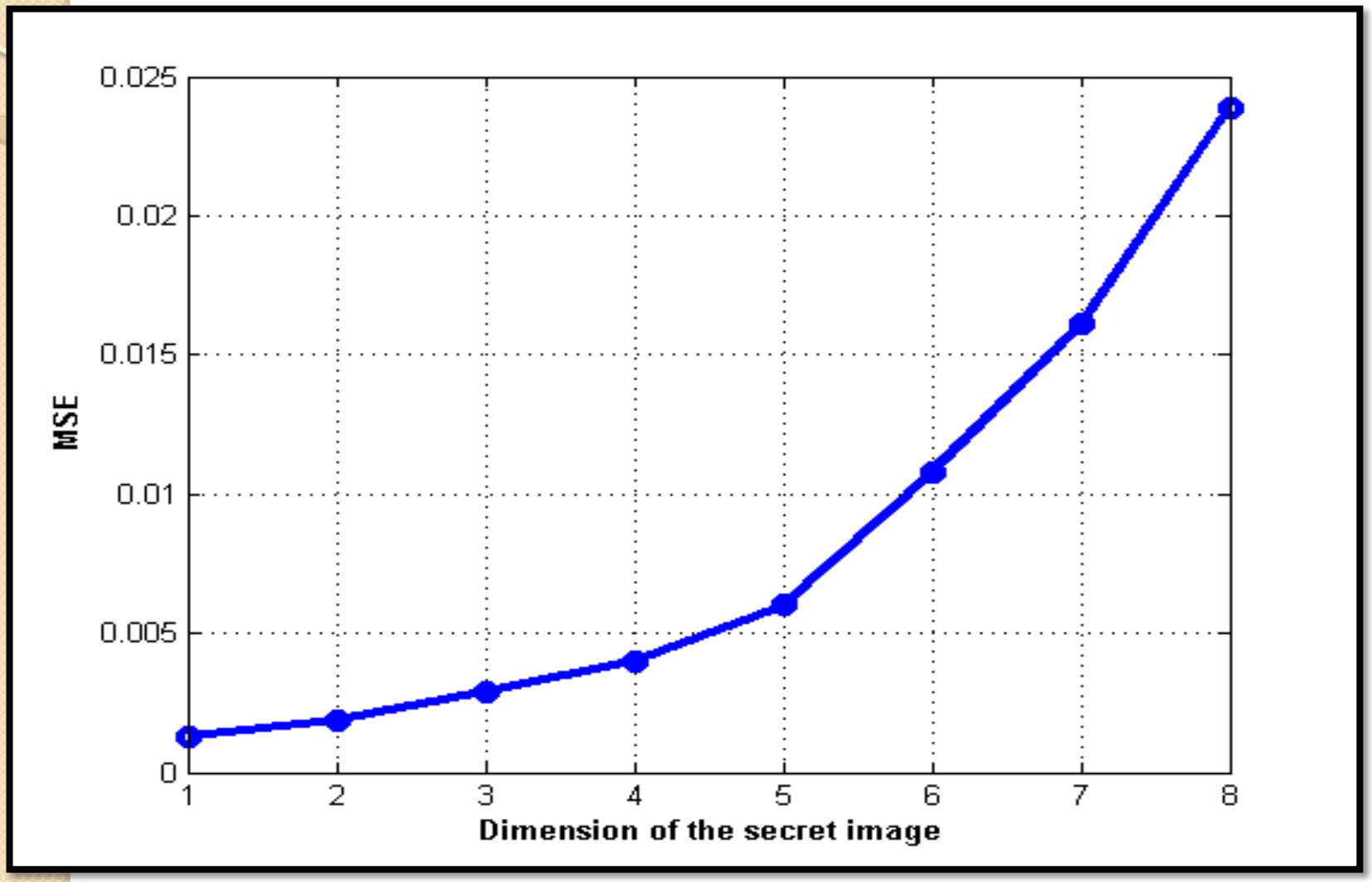
CAPACITY, MSE, PSNR, COR AND SNR TESTS FOR STEGO AND EXTRACTED SECRET IMAGES

		Stego image				Extracted secret image			
Dimension of the secret image	Capacity (%)	MSE	PSNR (dB)	Cor	SNR (dB)	MSE	PSNR (dB)	Cor	SNR (dB)
32*32	0.39	0.0013	76.9592	0.9999	71.8218	0.1908	55.3260	1	49.7788
32*64	0.78	0.0019	75.4008	0.9999	70.2633	0.1909	55.3223	1	49.7994
64*64	1.56	0.0029	73.5358	0.9999	68.3984	0.1882	55.3839	1	49.8902
64*128	3.125	0.0040	72.1446	0.9999	67.0071	0.1909	55.3233	1	49.8477
128*128	6.25	0.0060	70.3495	0.9999	65.2121	0.1900	55.3423	1	49.8939
128*256	12.5	0.0108	67.8312	0.9998	62.6937	0.1908	55.3240	1	49.8924
256*256	25	0.0161	66.0573	0.9998	60.9199	0.1899	55.3458	1	49.9502
256*512	50	0.0239	64.3453	0.9998	59.2078	0.1824	55.5207	1	50.1478

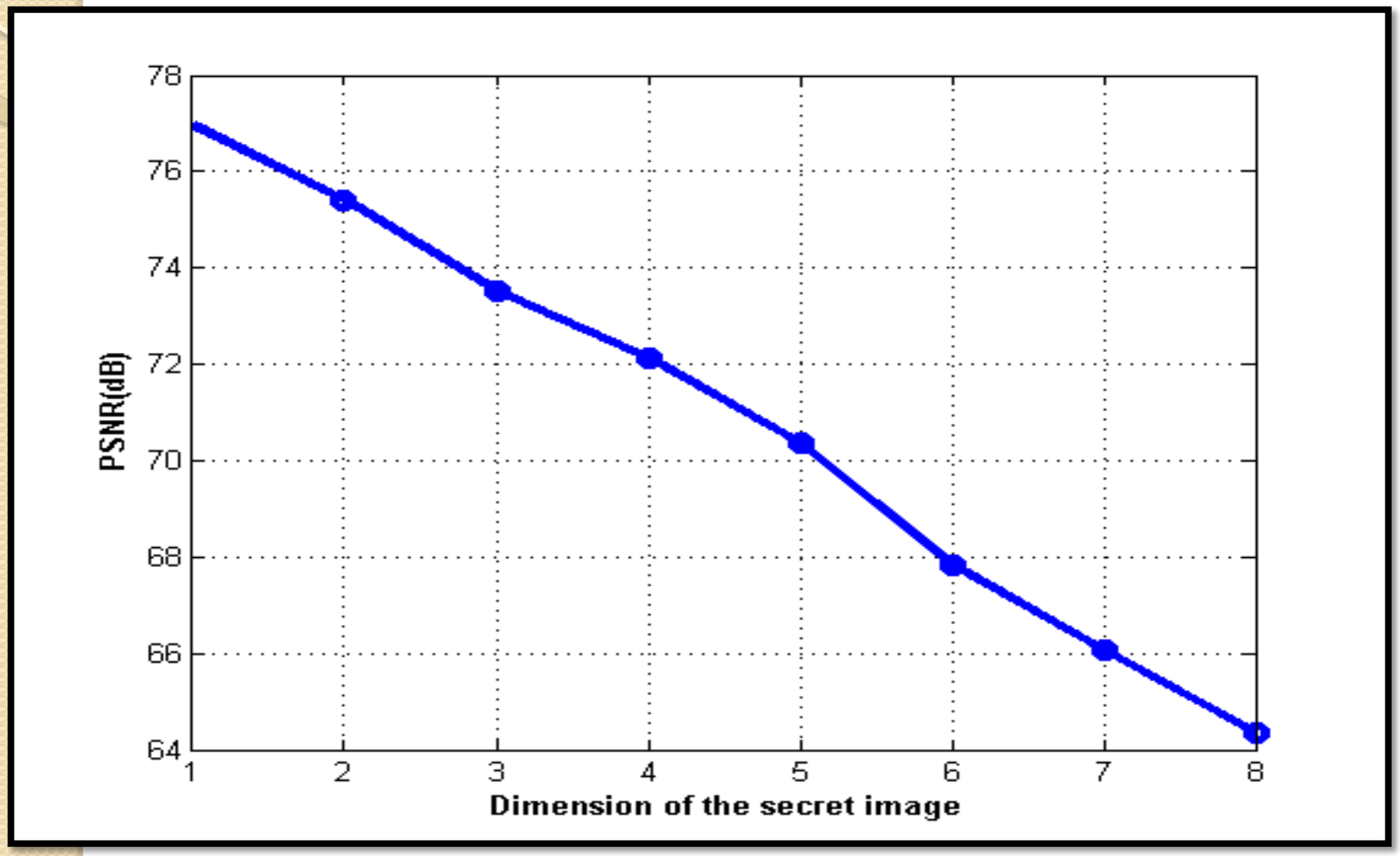
CAPAITY TEST FOR THE STEGO IMAGE



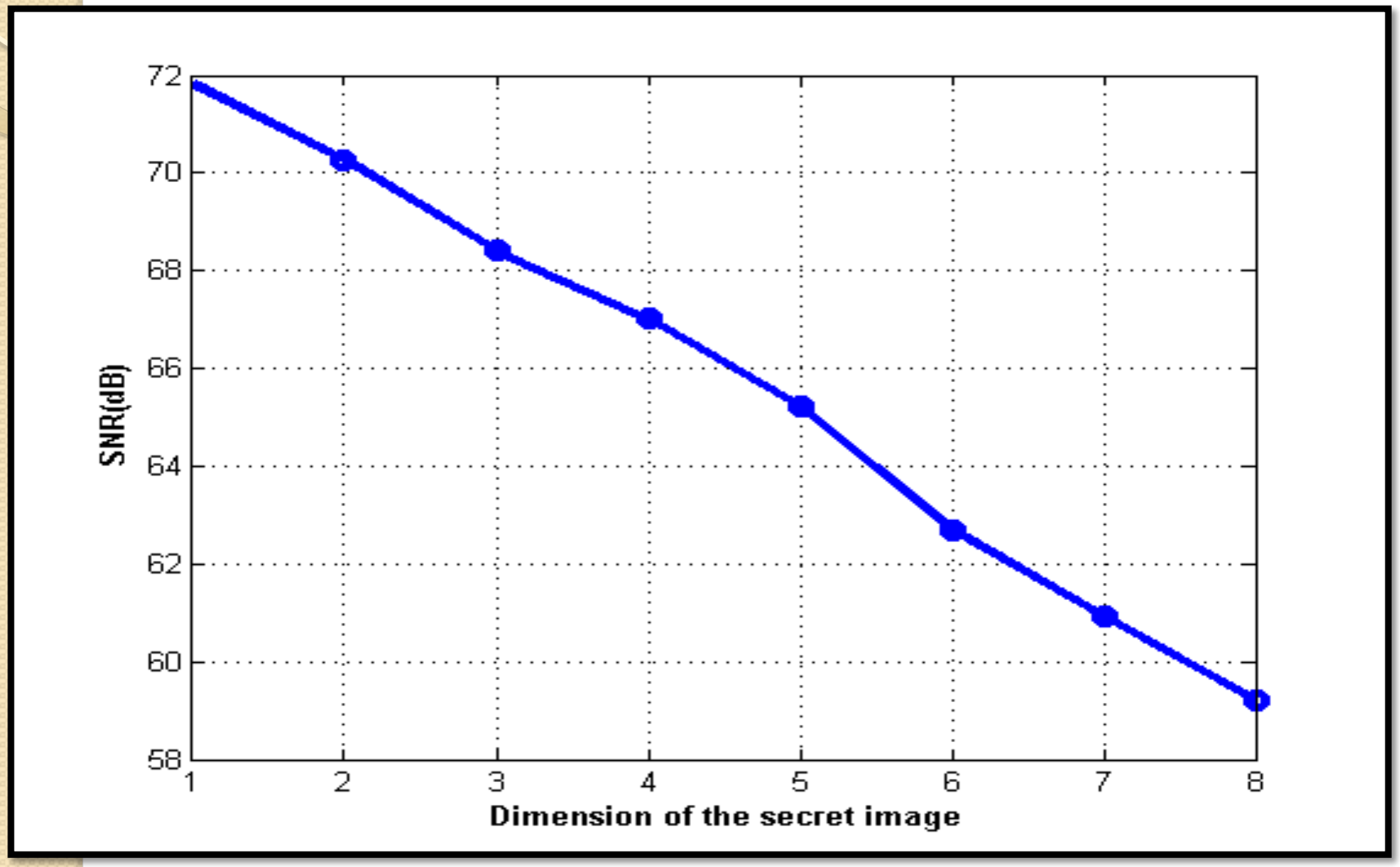
MSE TEST FOR THE STEGO IMAGE



PSNR TEST FOR THE STEGO IMAGE



SNR TEST FOR THE STEGO IMAGE



CONCLUSIONS

- When the capacity increases, the MSE of the stego image increases.
- When the capacity increases, the PSNR and SNR of the stego image are decreased.
- The correlation of the stego image is close to one (0.9999), this means that the stego image is very similar to the cover image.
- The correlation of the extracted secret image is one, this means that there is no difference between the secret image and the extracted secret image.