The Use of Steganography and Steganalysis Trends in Computer Forensics

Dinesh Reddy

Assistant Professor of Cybersecurity

Our Lady of the Lake University

Agenda

- History of Data Hiding
- Use of Steganography Methods in Computer Forensics
  - Image: LSB Method, Masking and filtering, Transformations
  - Text: Line-Shift Coding, Word-Shift Coding
  - Audio: LSB coding, Echo Hiding
  - Video steganography
- Use of Steganalysis in Computer Forensics
  - Invisible Secrets, S-Tools

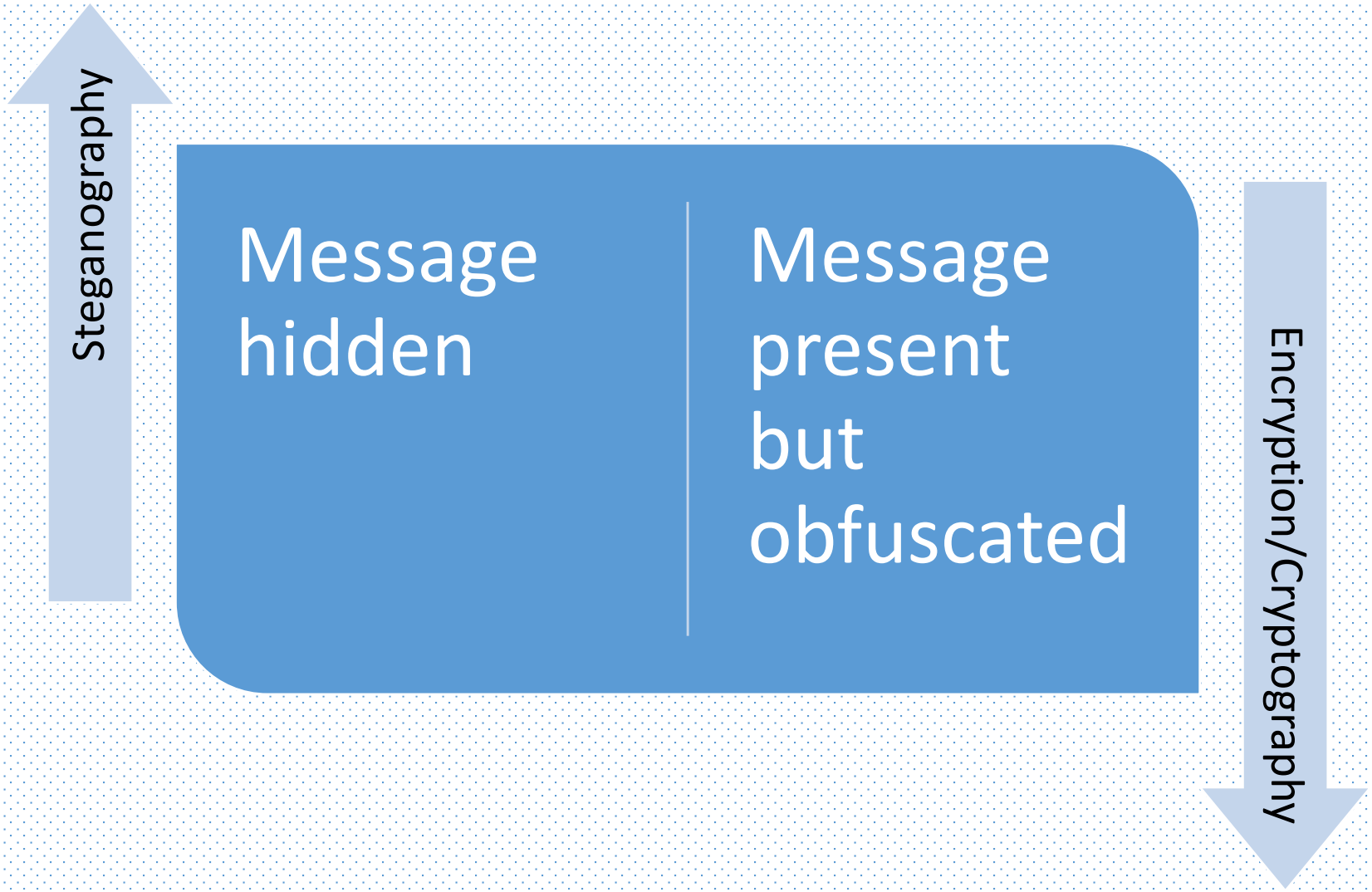
History of Data Hiding

- Ancient Chinese wrapped notes in wax and swallowed them for transport
- In ancient Greece, message written on slave's shaved head, then hair allowed to grow back
- During World War II, French Resistance sent messages written on the backs of couriers using invisible ink

Steganography

- The art and science of writing hidden messages
- Goal is to hide information so that even if it is intercepted, it is not clear that information is hidden there
- Most common method is to hide messages in pictures using the least significant bit (LSB) method

Steganography Vs Encryption



Basic Steganography Terms

- Payload
- Carrier
- Channel

LSB Method

- The LSB method depends on the fact that computers store things in bits and bytes.
- Colored pixels in a computer stored in bits
- Consider 11111111 = 255 in decimal
- Change last digit to 0
- 11111110 = 254 in decimal (Minimal deviation as compared to original value which was 255)
- So, the last bit or least significant bit is used to hide data

LSB Method

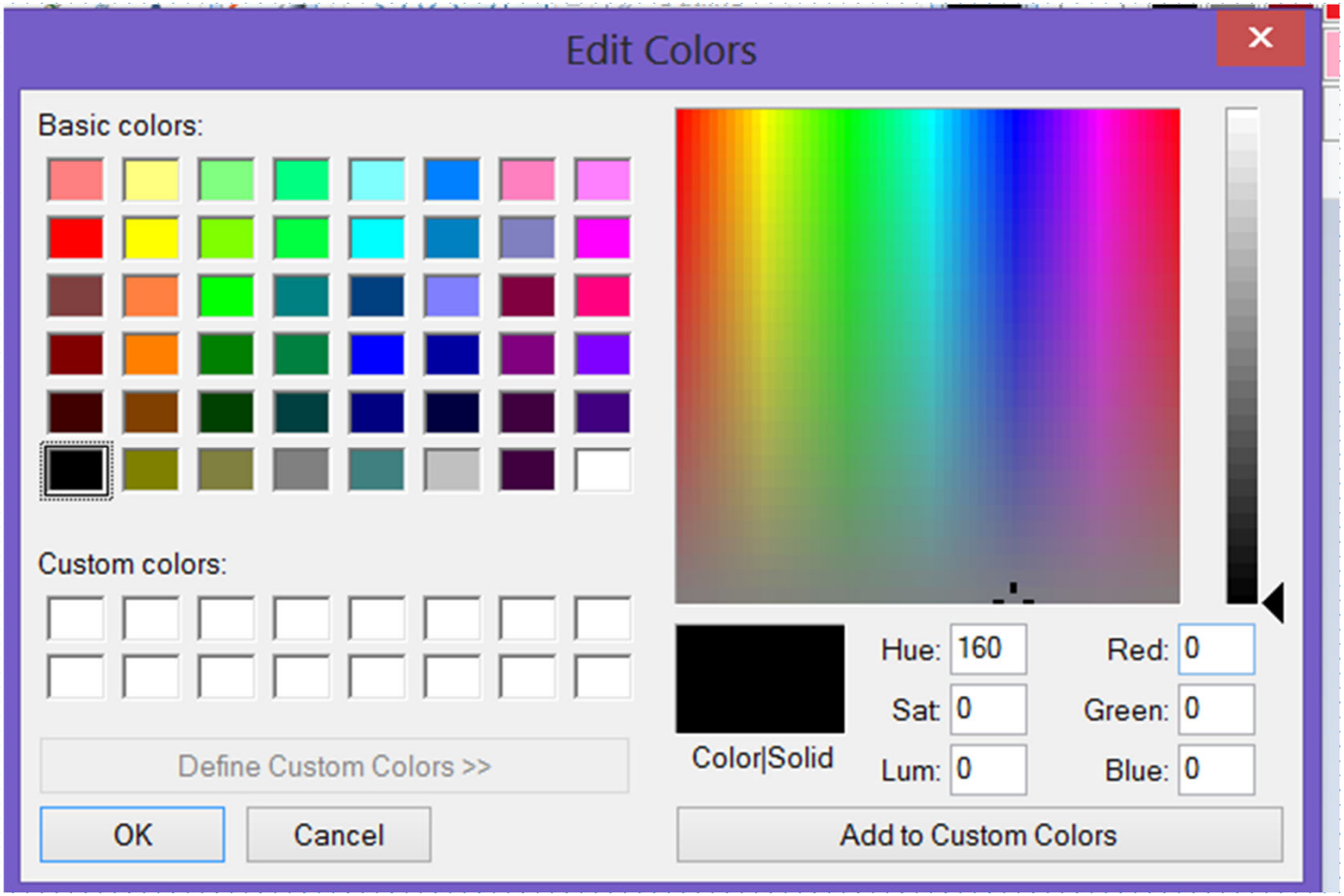
- MSB ……LSB

- 11111111 = 255
- 11111110 = 254
- 01111111 = **128 (Changing MSB will significantly change the image revealing that image is modified)**

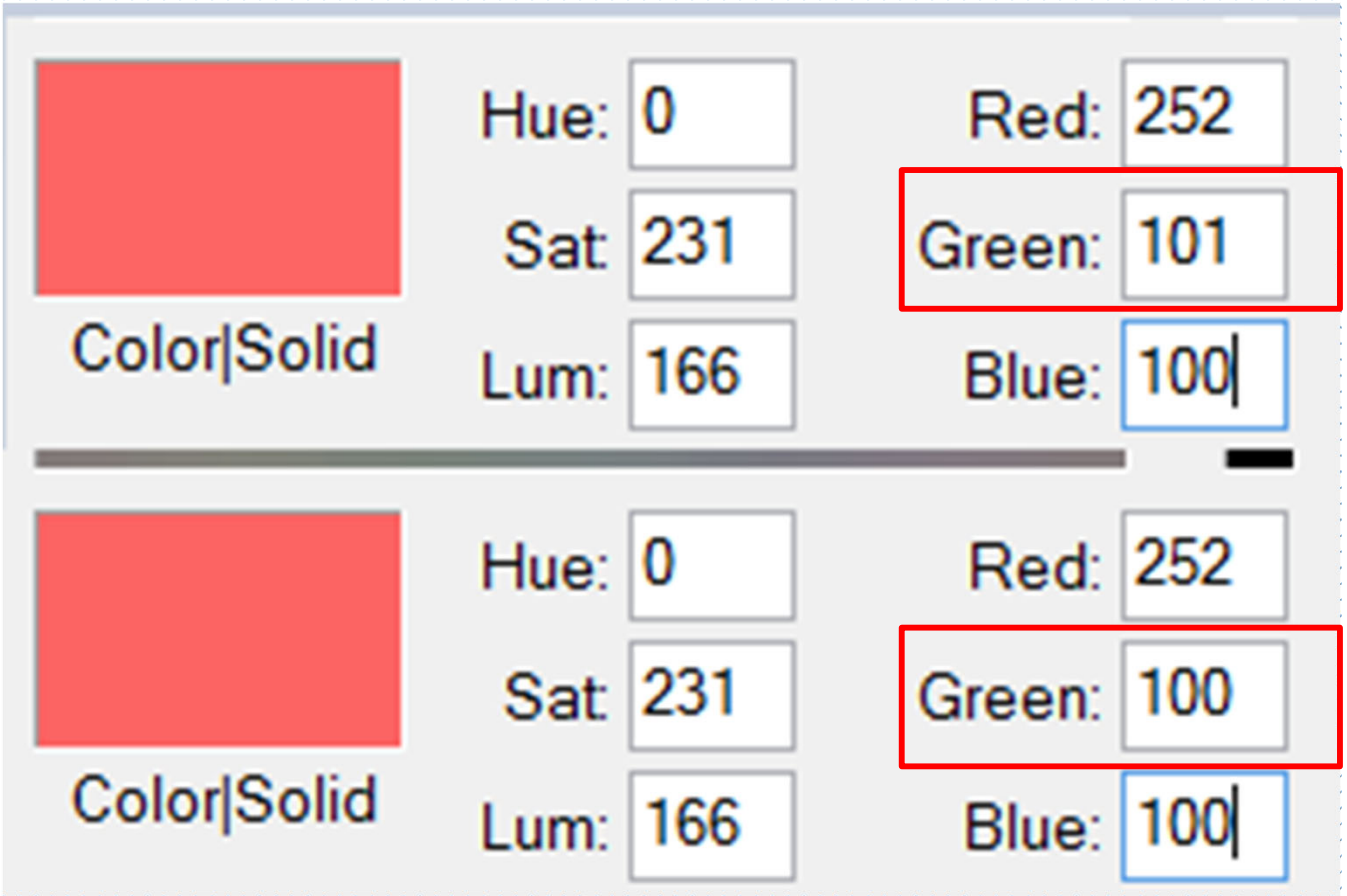
- Decimal equivalent conversion of binary number 11111111

  1x2^7+1x2^6+…+1x2^2+ 1x2^1 + 1x2^0 = 255

LSB Method



LSB Method



LSB Method

- E.g. 3 pixels of a 24-bit color image, uses 9 bytes:

  (00100111 11101001 11001000)

  (00100111 11001000 11101001)

  (11001000 00100111 11101001)

- After hiding A (binary 10000001):

  (00100111 11101000 11001000)

  (00100110 11001000 11101000)

  (11001000 00100111 11101001)

- Only three bits were sufficient to hide A

Other Image Steganography Methods

- Masking and filtering
  - Hide information by modifying the luminance to create a marking on an image (similar to watermarks)
  - Restricted to 24 bits

- Transformations
  - Hide information by modifying discrete cosine transformations (DCT)
  - DCT is performed by an image compression algorithm to reduce the size of an image for efficiency

Text Steganography

- Hide information by modifying textual characters, page layouts and other similar textual content and formatting items in a text file.

- Line-Shift Coding
  - Vertically shifting the location of text lines to hide new information.

- Word-Shift Coding
  - Horizontally shifting the location of words within text lines to hide new information.

Other Forms of Steganography

Steganophony	• Hiding messages in sound files
Video steganography	• Hiding information in video files • Combination of image and audio

Audio steganography

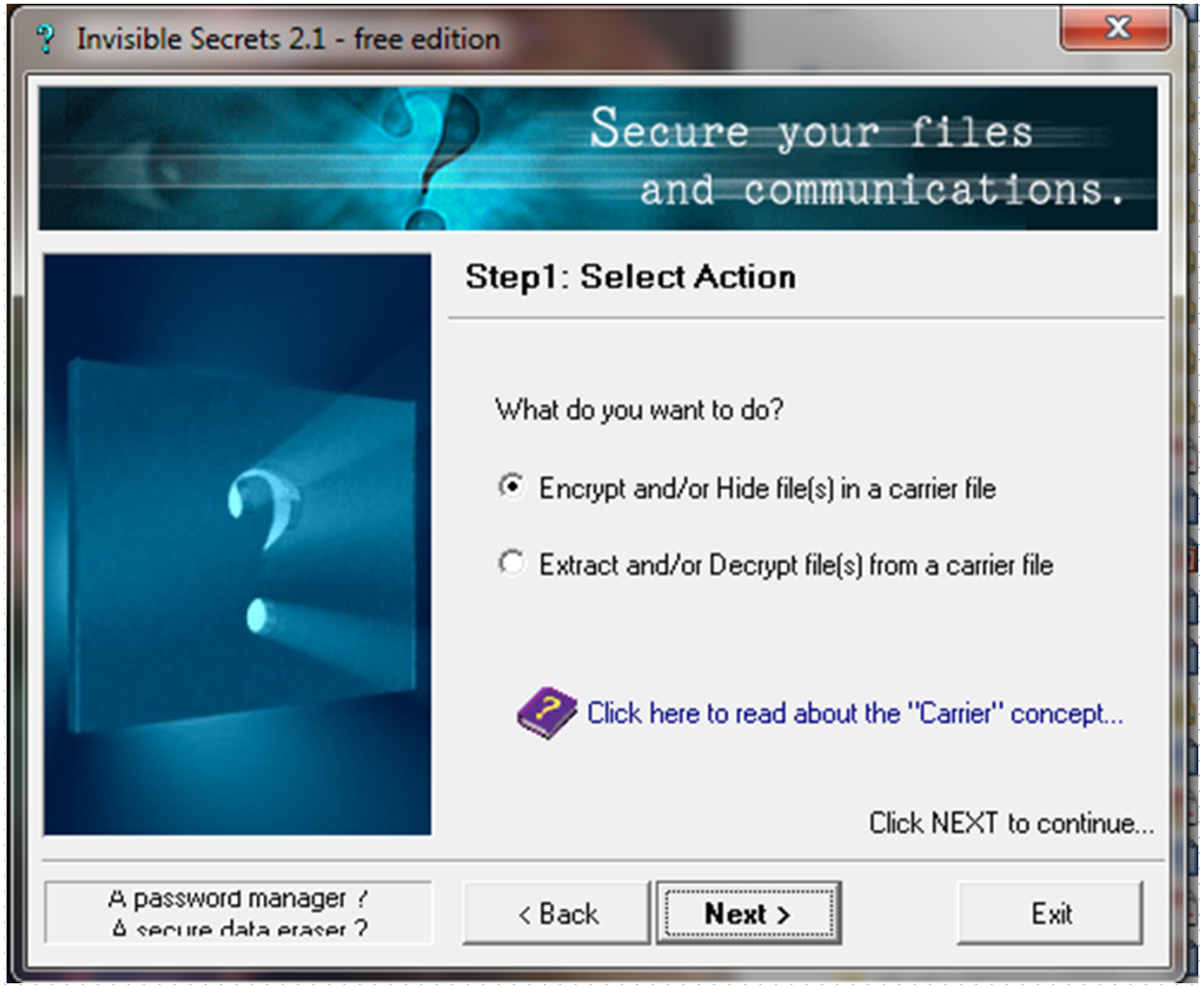
- LSB coding
  - LSB are modified after analog voice signal is converted to digital voice signal.

- Echo Hiding
  - Hide information by adding an echo to the audio signal
  - Intensity of echo is kept below the threshold of human auditory system

Steganalysis

- The process of analyzing a file or files for hidden content
- Can show a likelihood that a given file has additional information hidden in it
- Common method for detecting LSB steganography is to examine close-color pairs (created by LSB embedding)
- S-Tools, Invisible Secrets

Invisible Secrets

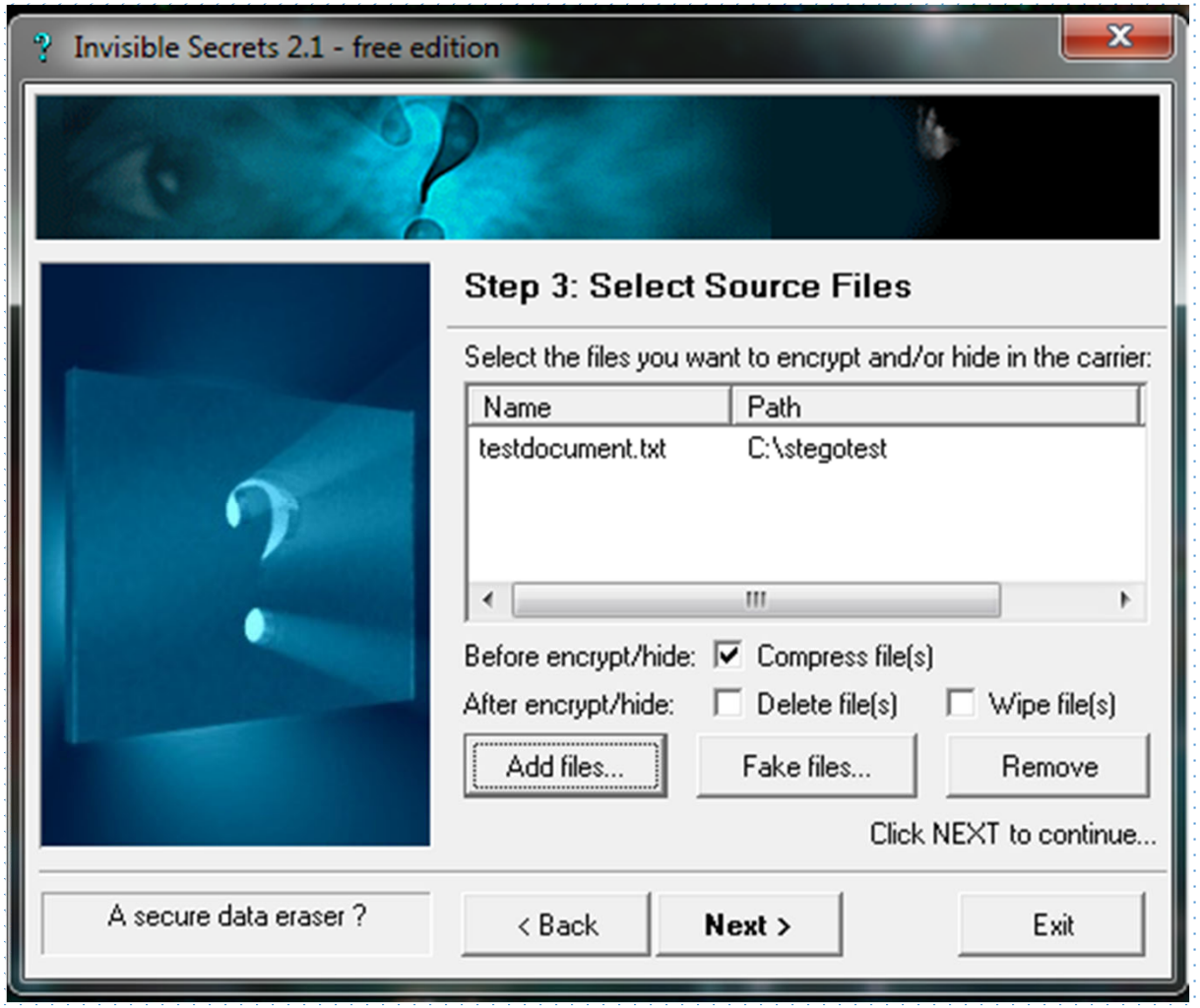


Courtesy of NeoByte Solutions

Invisible Secrets

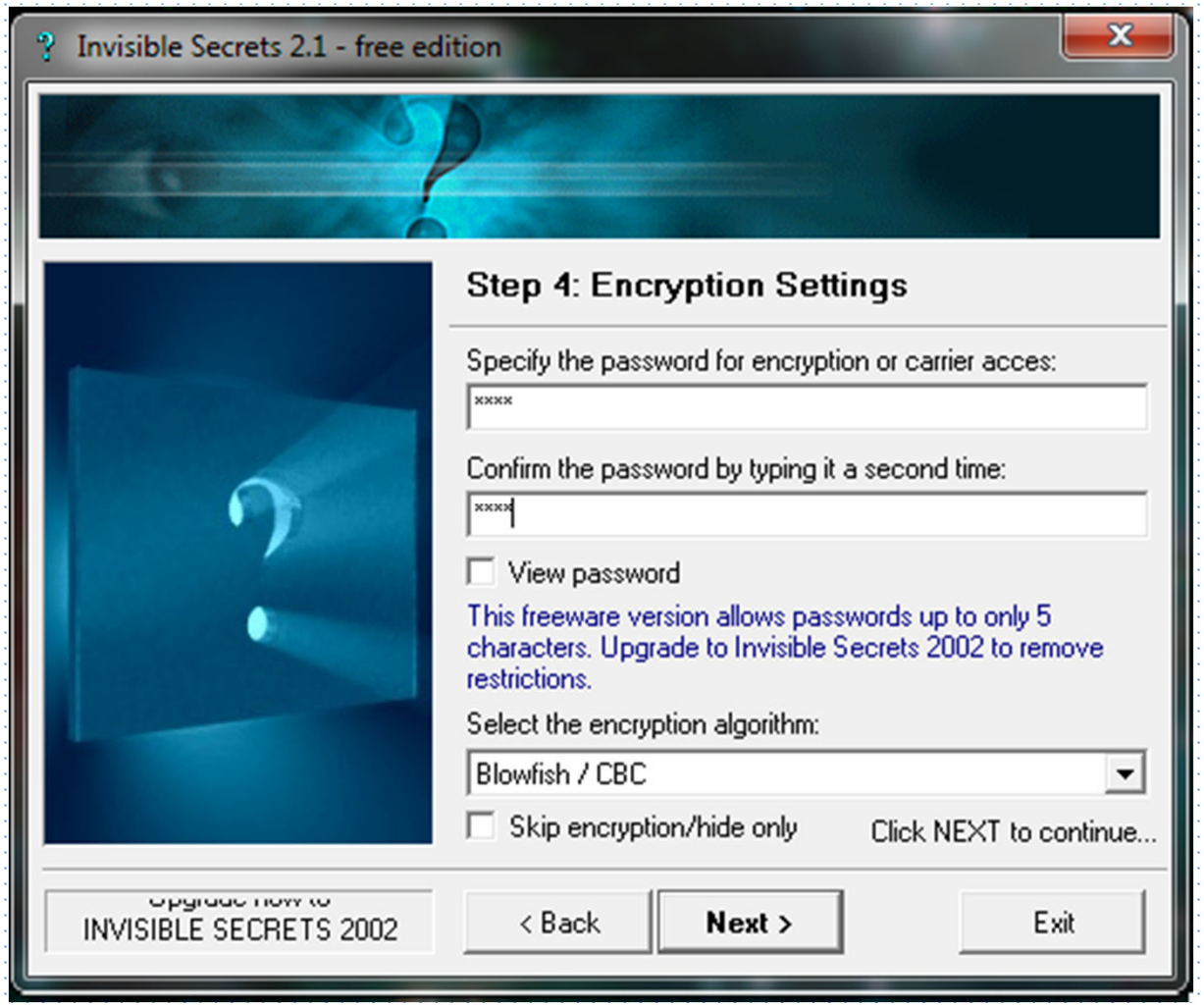
Courtesy of NeoByte Solutions

Invisible Secrets



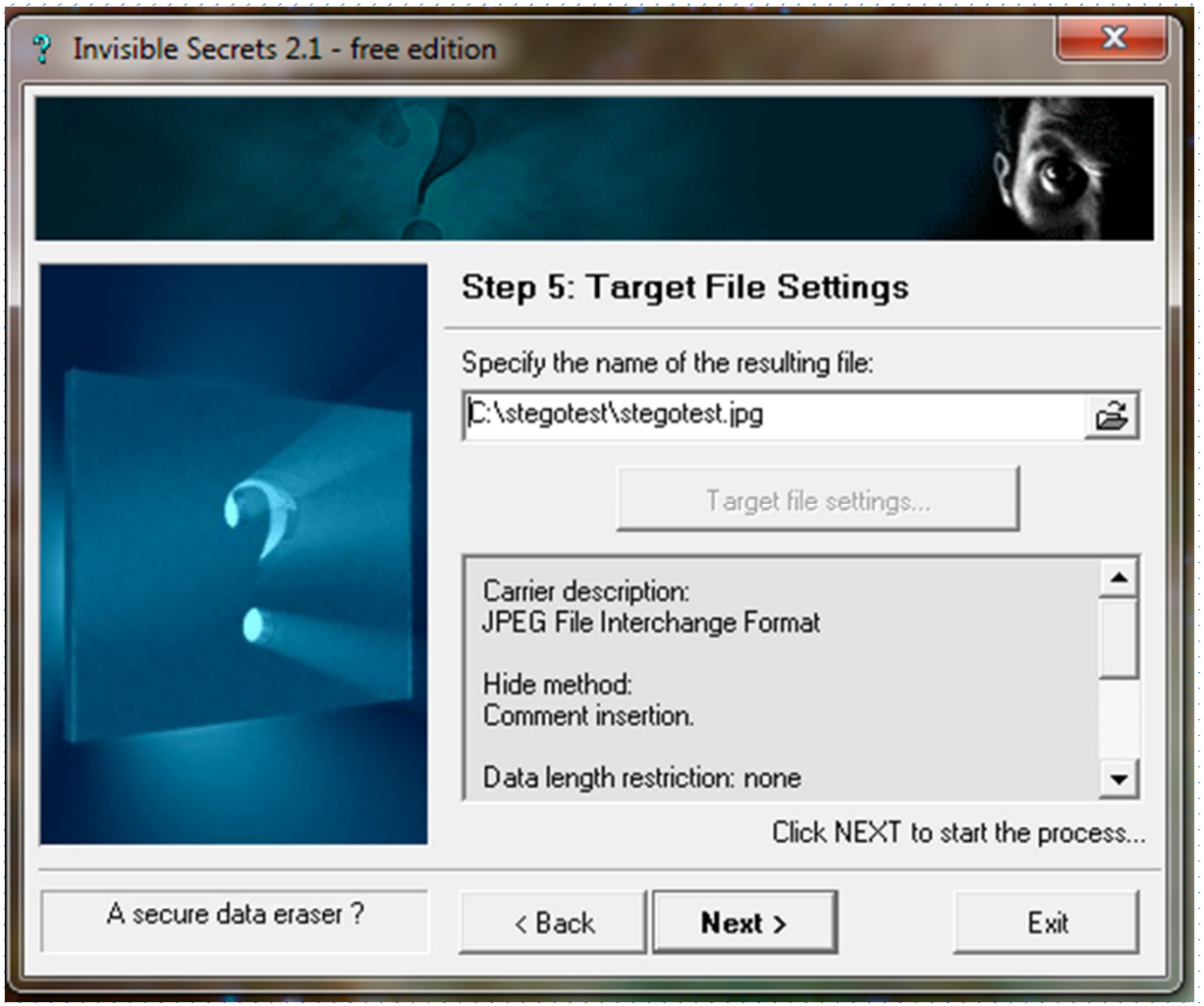
Courtesy of NeoByte Solutions

Invisible Secrets



Courtesy of NeoByte Solutions

Invisible Secrets



Courtesy of NeoByte Solutions

Thank You