Resolution Notes

The Basics of Image Resolution

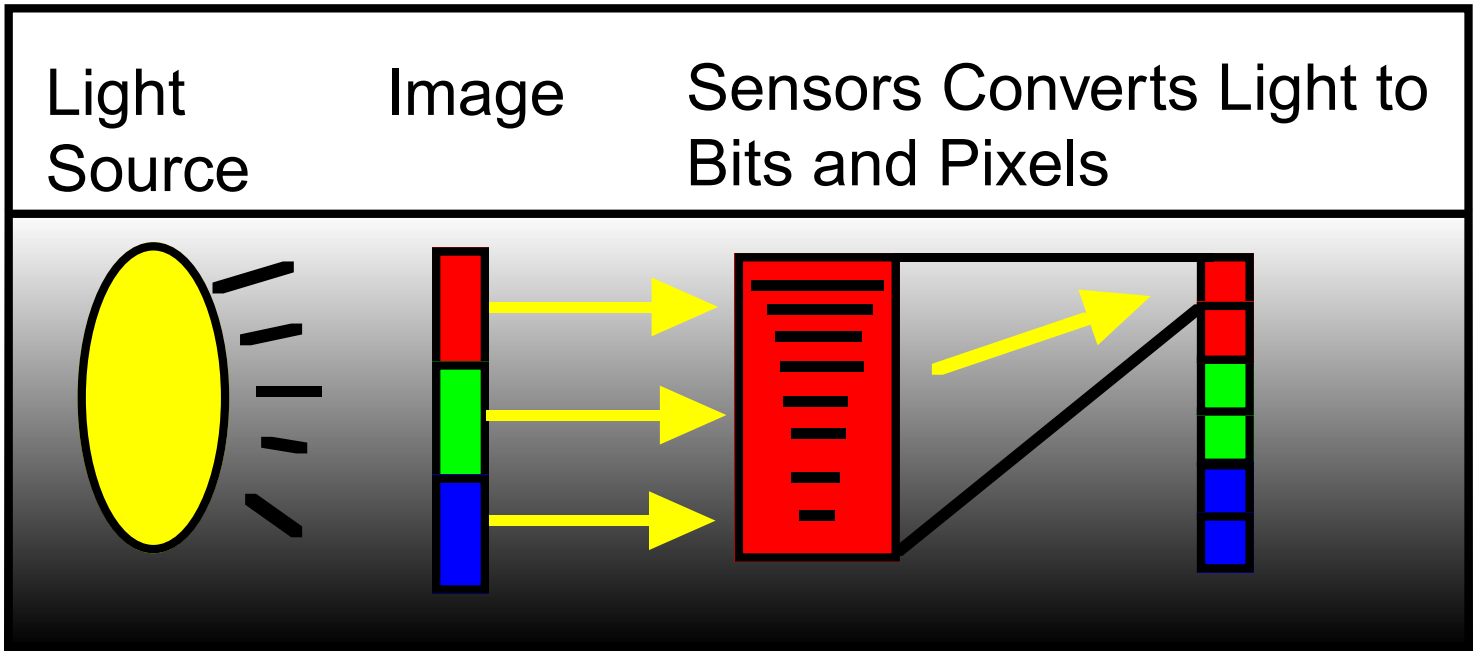
Rich & Associates Learning Series

Jim Rich

President
Rich & Associates, LLC
jim@jimrich.com

Image Resolution

Pixels* is an acronym for *picture elements



PPI = DPI

Pixels Per Inch and Dots Per Inch are different terms that describe the same measure of input resolution

Sensors & Image Capture

Sensors convert light into electronic bits

Bits input are distributed into picture elements

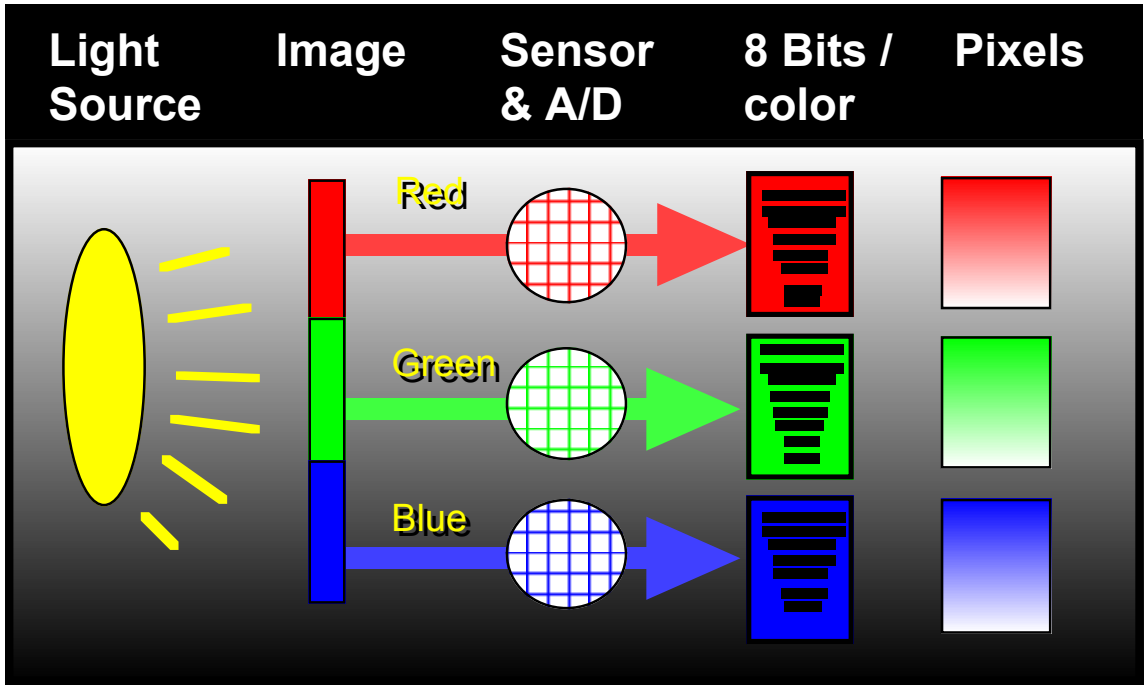


Image Resolution Terms

Resolution is a measure of fineness between details that a device can record

Input Terms	Output Terms	
• **Pixels** • **Spots** • **Dots**	• **Pixels** • **Spots** • **Dots**	• **Halftone Screen Elements** • **Lines Per Inch** • **Dot Shapes**

Bit Maps = Continuous Tone Images

- Continuous tone images are rasterized into bit mapped images
- A series of rectangular girds define the image

Cartesian Coordinate System

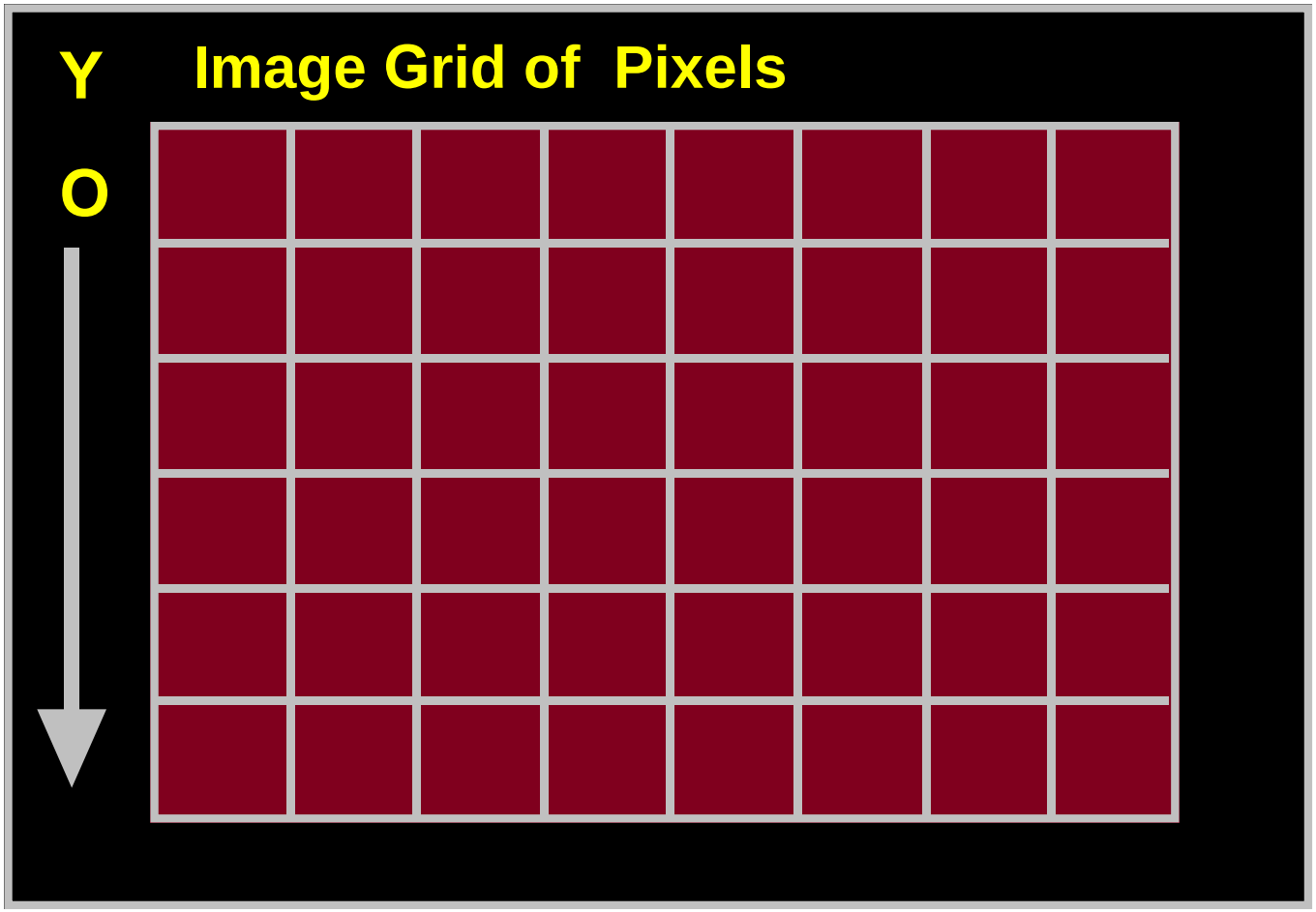


Image Resolution Factors

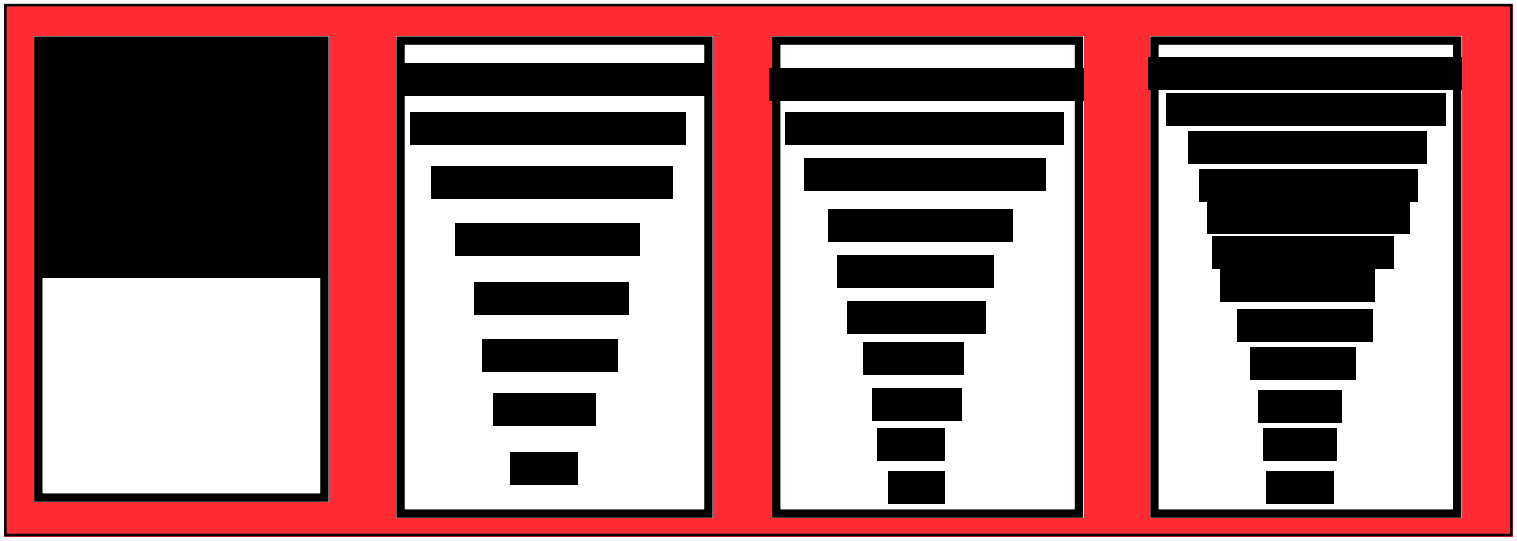
Three key factors identify image resolution:

1 - Physical dimensions of an image
Such as inches - vertically and horizontally

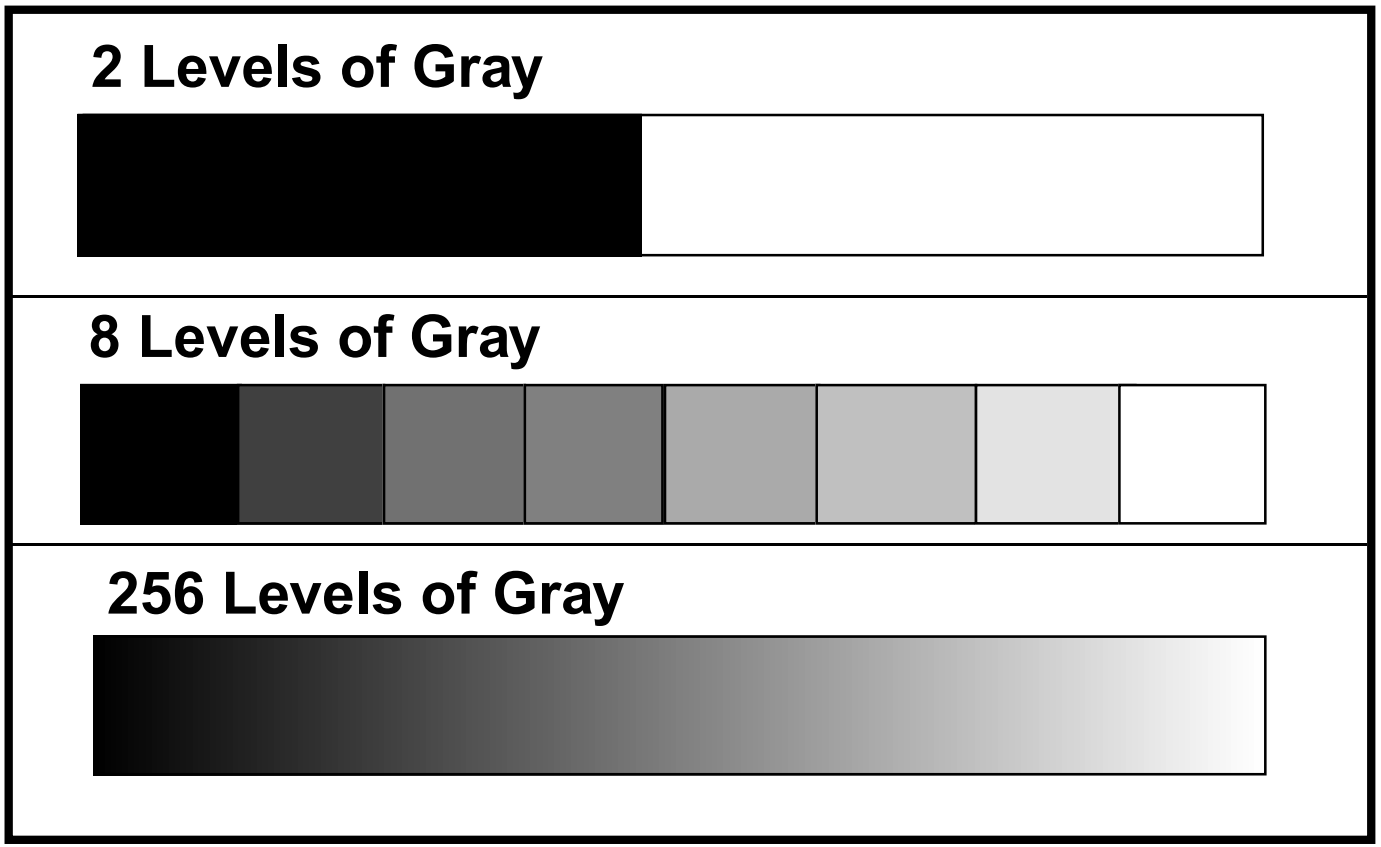
2 - The number or pixels -per inch/ millimeter

3 - File Size - usually in megabytes

Image Details & Gray Levels



Different Gray Levels

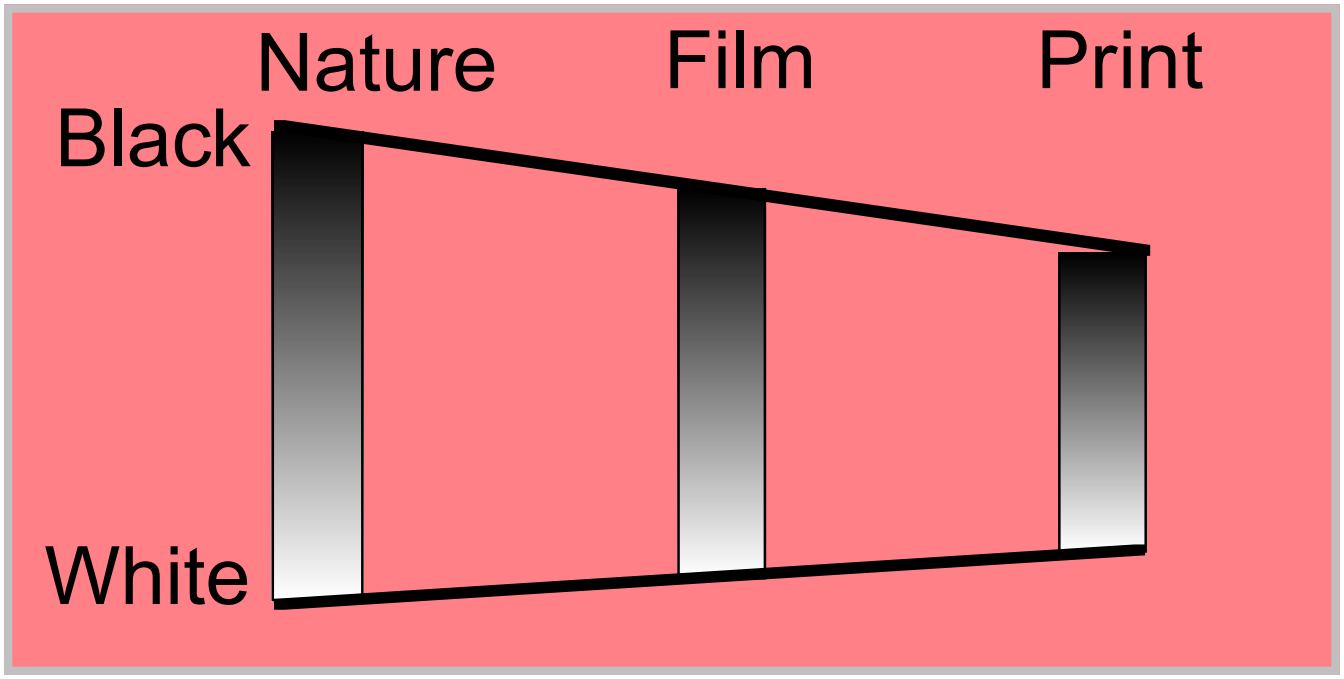


The More Bits, The Better

- 10, 12, 14 or 16 bits per pixel potentially creates more image data
- Greater Bit Depth mean more image data is captured during the image capture

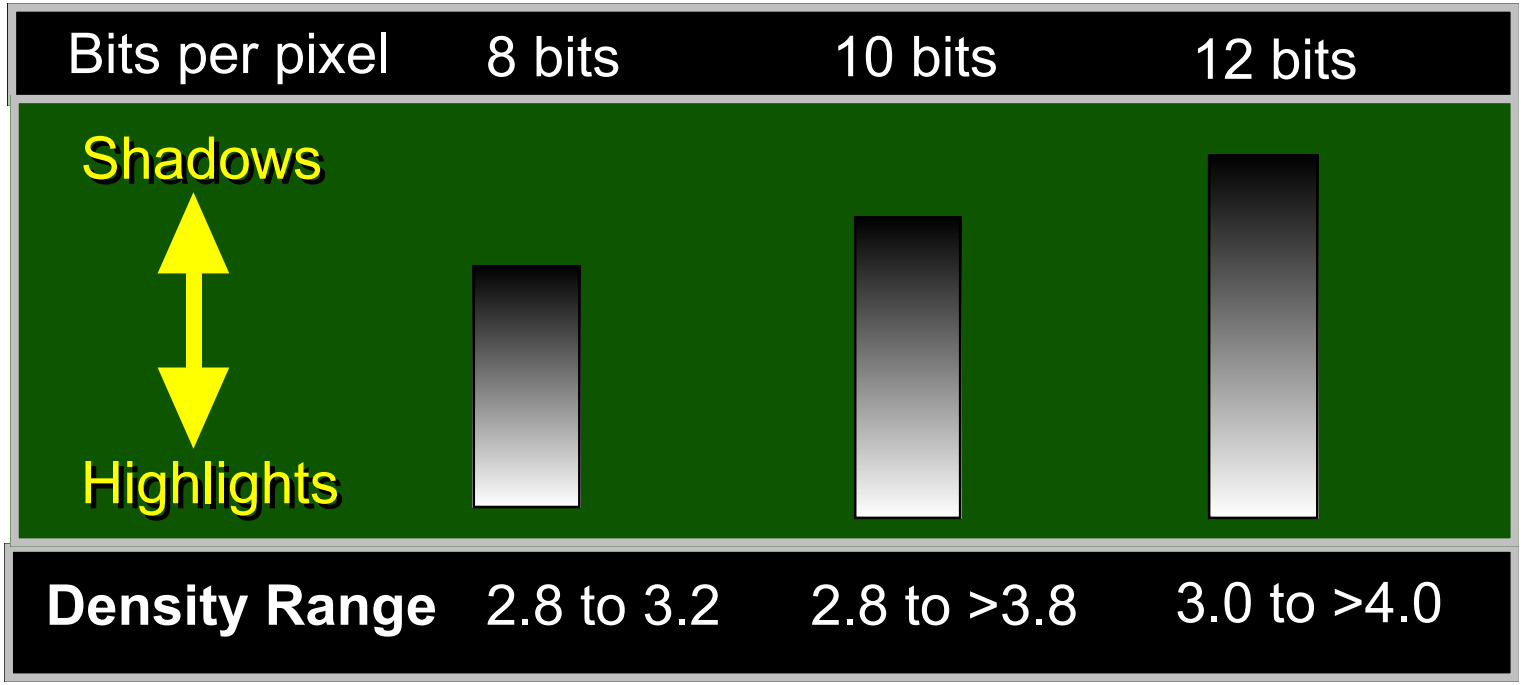
Dynamic Range

Dynamic range identifies the sensors capability to capture an images tones from white to pure hue or black



Measuring Dynamic Range

Dynamic Range is measured by density & bits per pixel

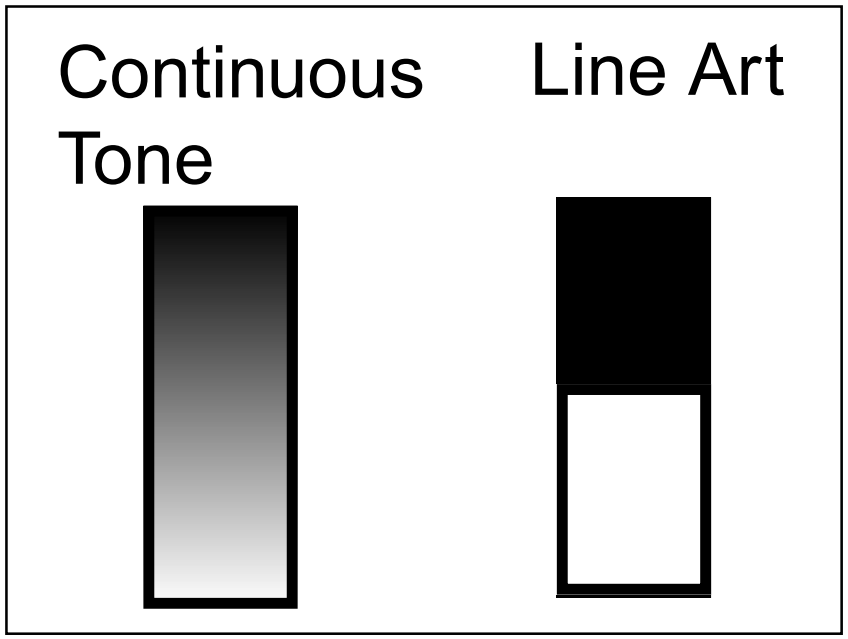


RGB & CMYK Images

- Color images are comprised of 3 or 4 layers of tones, often called Channels

Line Art

- Line art or line work has no tonal values
- Line images are either black or white

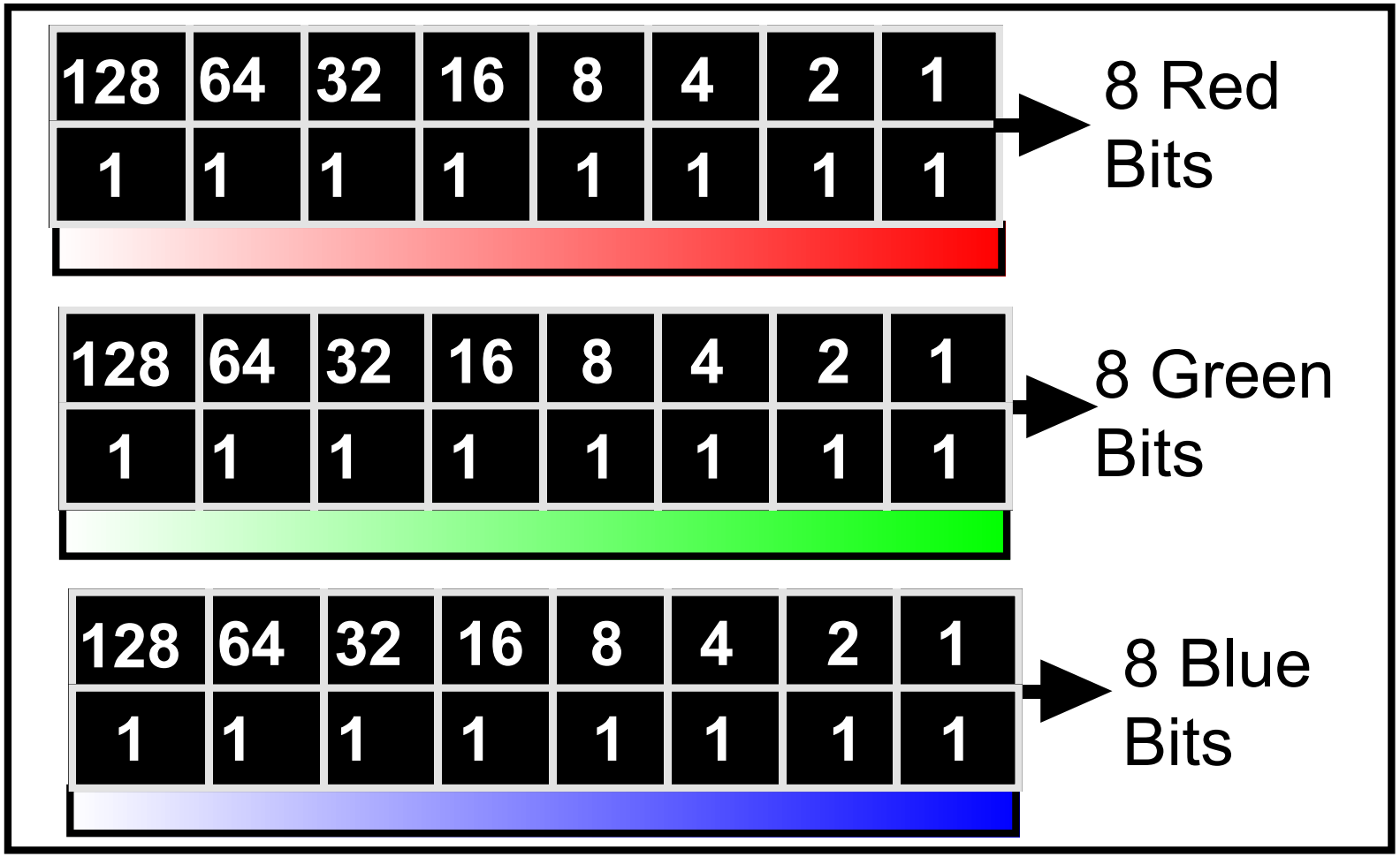


24, 30, 36 & 48 bit Devices

Input devices are sometimes identified by senors and their capabilities

- 10 bits per pixel x 3 (RGB) = 30 bits
- 12 bits per pixel x 3 (RGB) = 36 bits
- 16 bits per pixel x 3 (RGB) = 48 bits

24 Bits for Color



Kilo & Mega - Bytes

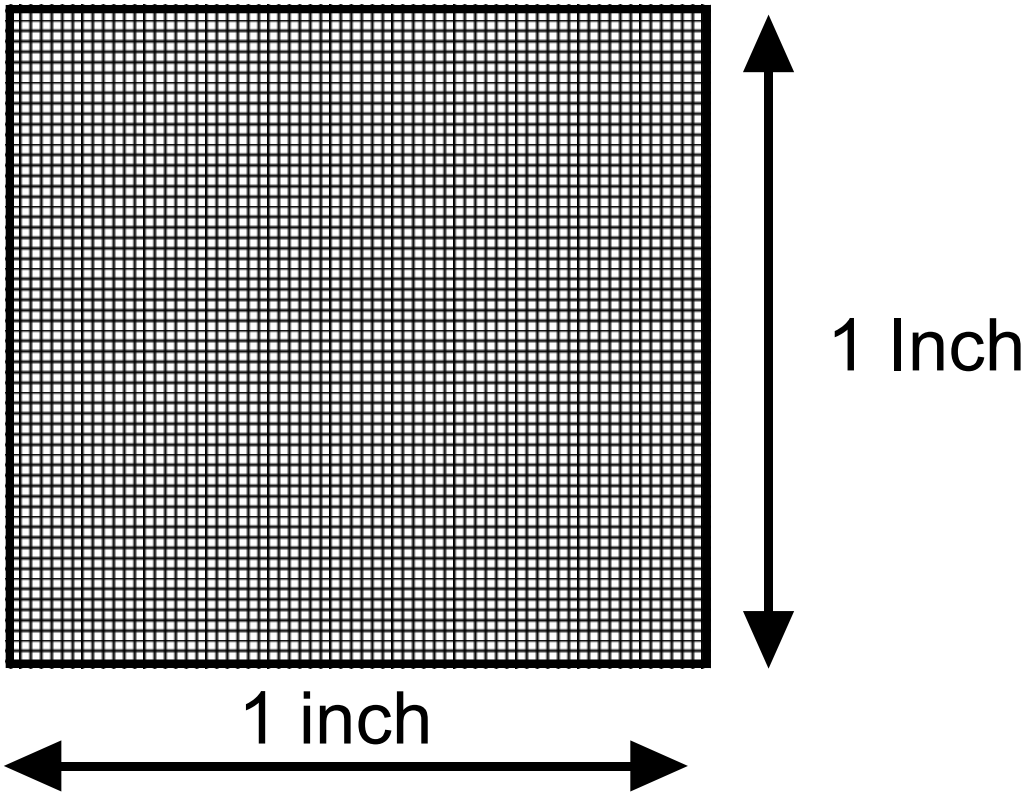
- 8 bits = 1 byte
- 1000 bytes =1 Kilobytes (10^3)
- 1,000,000 Bytes = 1 Megabyte (10^6)

Kilobytes = Thousand characters of information (10^3)

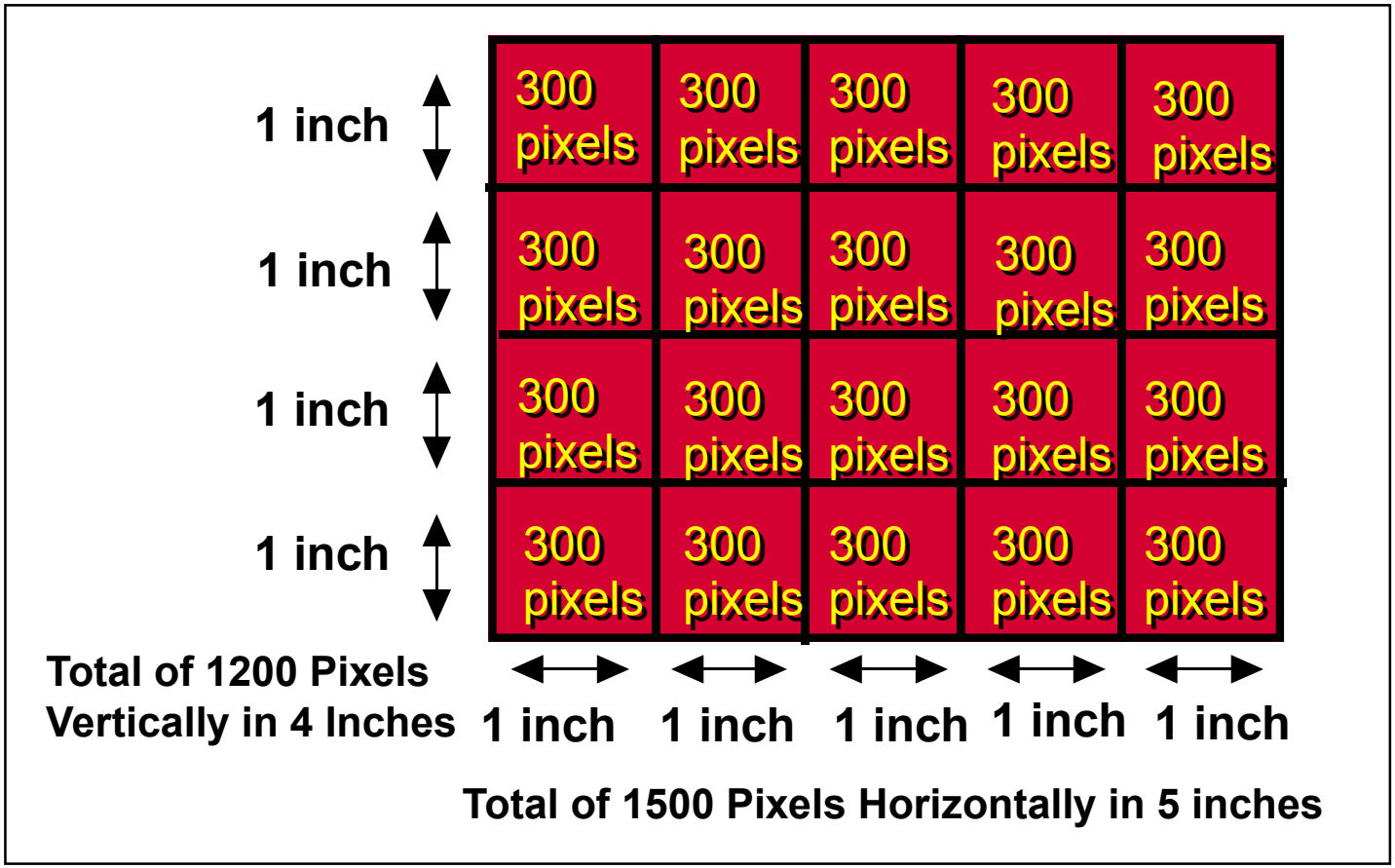
Megabytes = a Million characters of information (10^6)
Actually one megabyte = 1,048,576 bytes

Resolution Close Up

One Square Inch @ 300 PPI



4” x 5” Image @ 300 PPI



Factors for 300 dpi Files

One Square Inch of Bitmap Pixel Data @300 ppi

- .09 x 1 =.09 megabytes per square inch (B&W)
- .09 x 3 =.27 megabytes per square inch (3 Color RGB)
- .09 x 4 =.36 megabytes per square inch (4 Color CMYK)

Factoring Pixels to Megabytes

One square inch @300 ppi = .09 megabytes

- **Determine One Square Inch of Pixel Data**

300 ppi x 300 ppi = 90,000 pixels or 90,000 bytes

- **Divide by 90,000 pixels by 1,000,000 (mb)**

90,000 /1,000,000 (10^{6}) = .09 megabytes per sq in.

4”x 5” Image @ 300 ppi

4" x 5" = 20 sq. inches

.09 x 20 sq. inches = 1.80 MB for B &W

.27 x 20 sq. inches = 5.4 MB for RGB

.36 x 20 sq. inches = 7.2 MB for CMYK

Image Resolution Factors

Three key factors identify image resolution:

1 - Physical dimensions of an image
Such as inches - vertically and horizontally

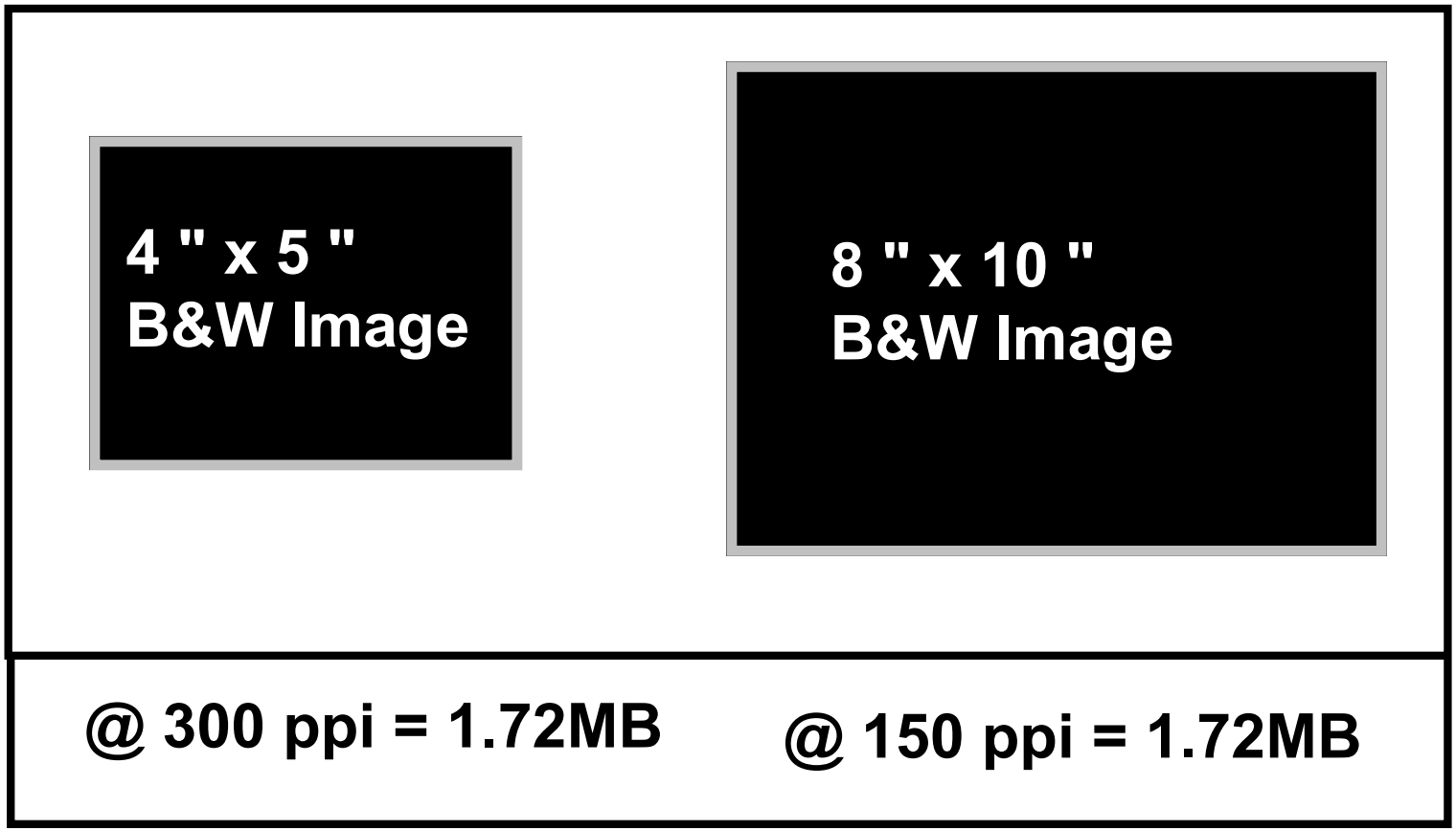
2 - The number or pixels -per inch/ millimeter

3 - File Size - usually in megabytes

Expressing Image Resolution

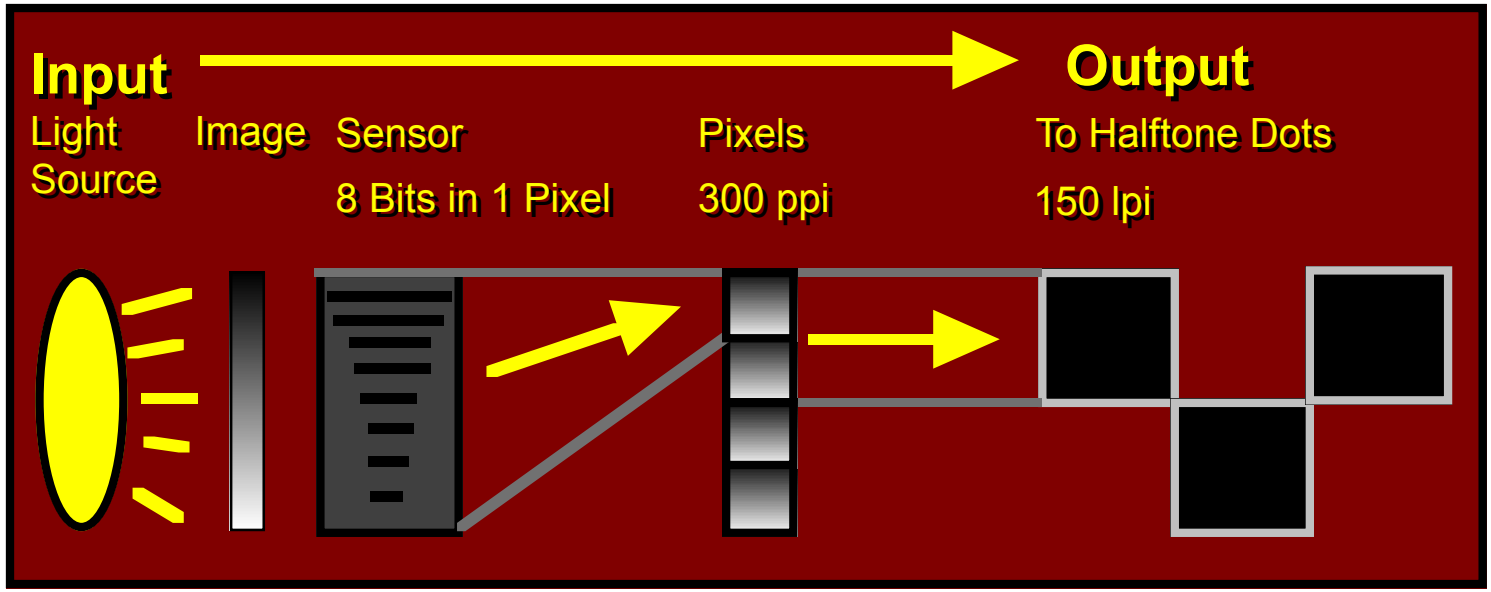
Physical Dimensions	Pixels Per Inch		File Size Megabytes
4 X 5	300 ppi	=	1.72 mb
2 X 10	300 ppi	=	1.72 mb
1 X 20	300 ppi	=	1.72 mb

Different Resolutions



Sensors, Bits, Pixels & Halftones

- Input sensors break up the input light signals into electronic bits that are divided into pixels
- Output pixels are divided into halftone dots



Determining Input Resolution

Input Resolution (Pixels)	=	**Output Halftone LPI**	X	**Magnification x [2]** Enlargement or Reduction

Example of 100% enlargement

[300 ppi] = [150 lpi] x [100 %] x [2]

Sizing and Scaling Images

One Inch Original Final Size = 2 inches

Example of a 200% enlargement

Formula for Scaling Images

Enlargement Formula

Output size / Input size = % of Enlargement factor

2 inches / 1 inch = 200% Enlargement

Reduction Formula

Input size / Output size = % of Reduction factor

1 inch / 2 inches = 50% Reduction

Review of Resolution Issues

- Different terms describe the same amount of image resolution (pixels & dots)
- Input bit depth - 8 bits per pixel is the minimum shades of gray or color required
- More shades or levels of gray provide better color results