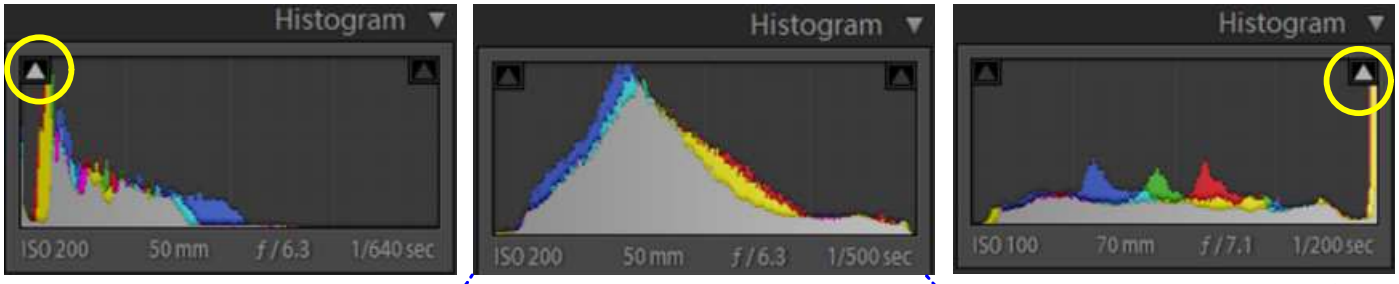
Benefits of Camera HISTOGRAM



Under Exposed image **Well Exposed image** **Blown Out**

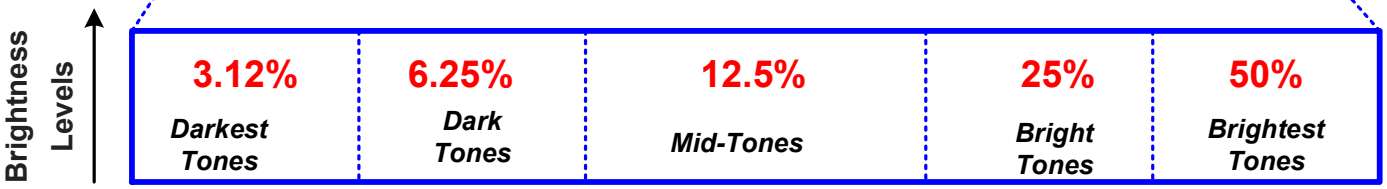
Reference: https://x-equals.com/content/uploads/undated/xe_hist_03_01.jpg

A **"Histogram"** is a graphical representation of an Image's spread of ***Luminance Levels,*** showing the approximate number of **Pixels** for each Luminance Level.

The **Vertical axis** displays the number of Pixels, and the **Horizontal axis** the range of ***Luminance Levels*** from ***"Black at the Left"*** to ***"White at the Right"***.

A **Histogram** is a simple graph that displays **Five Groups** where all of the **"Brightness Levels"** contained in the scene are found, from the ***Darkest*** to the ***Brightest.***

These values are arrayed across the bottom of the graph from **Left (Darkest)** to **Right (Brightest).**



The **Vertical axis** (the High points on the graph) shows how much of the **Image** is found at any particular **Brightness Level**.

1. What is a HISTOGRAM

Reference Canon-Europe

http://cpn.canon-europe.com/content/education/infobank/image_information/histograms.do

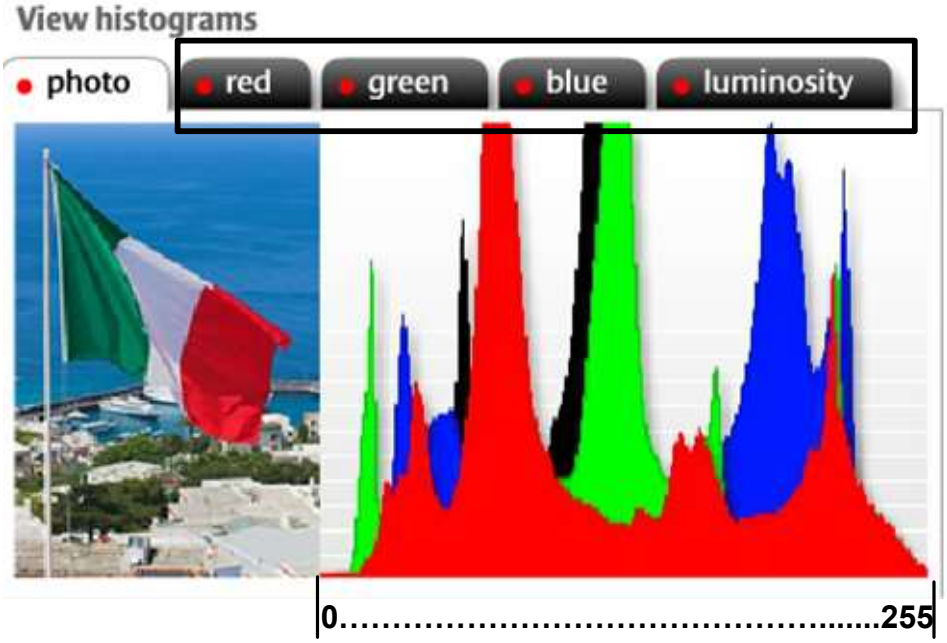
What is a Histogram?

A ***Histogram*** is a 'diagram in which columns represent frequencies of various ranges of values of a quantity', says The Concise Oxford Dictionary.
This is one of those definitions that only makes sense once you have seen examples.

In statistics, ***Histograms*** are used to make numbers visual.
A simple diagram is usually much easier to understand than a mass of figures.
Also, diagrams can reveal relationships between some of the numbers that are hidden in the raw data.

256 Tones (8 Bits)

In Digital Photography, a Histogram displays the ***Tonal Distribution of an Image.***
It does this by **Categorizing** every **Pixel** into one of **256 Groups**, where **0 is Black**, **255 is White** and all the other numbers represent **shades of Grey.**

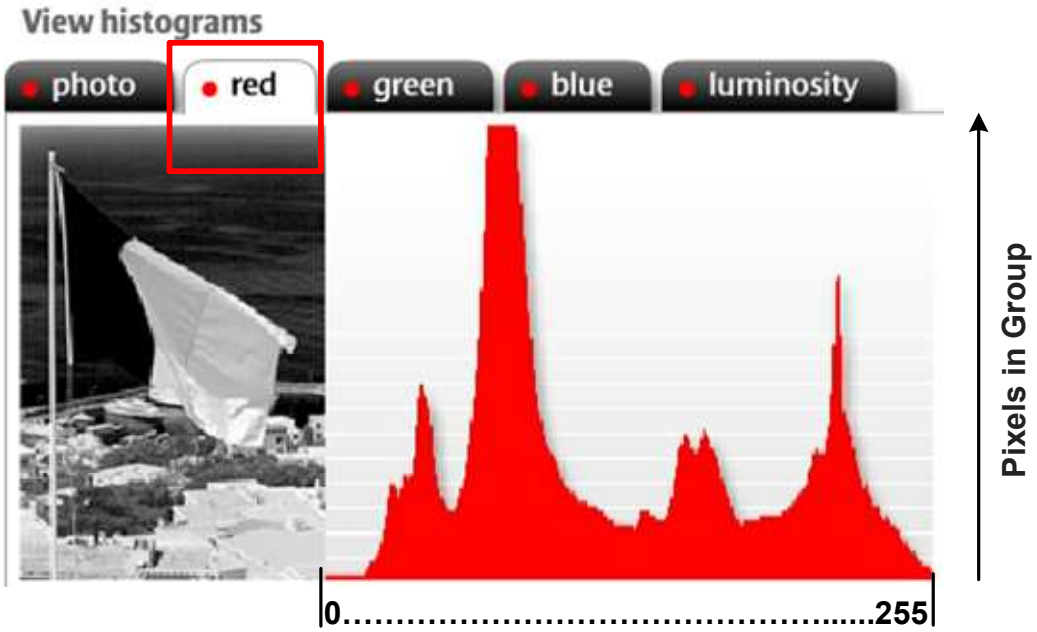


This **Image** of a Flag and Landscape translates into the Histogram shown here.

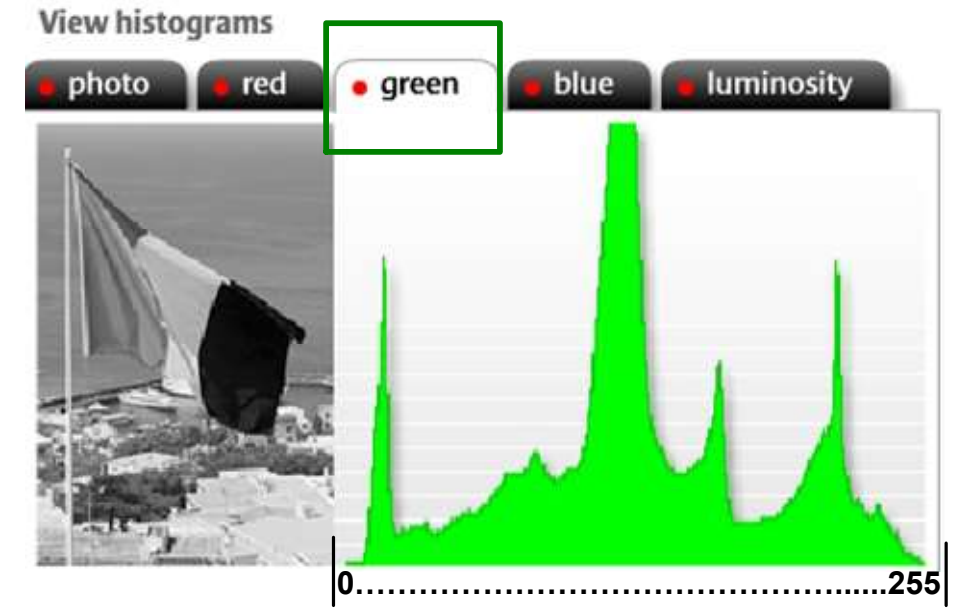
The peaks of the **Tones** towards the **Centre** of the **Histogram** indicate that this is a **well-Exposed Image.**

Some cameras also show Histograms for the **Red, Green** and **Blue** components of the **Image**.

These are the **Colour Histograms** for the **Flag Image**.



On the **Histogram**, the **Horizontal axis** shows the **Group** numbers with **0 (Black)** at the **Left** and **255** (**White** at the **Right**. The **Vertical axis** indicates the number of **Pixels** in **each Group.**



What does a **Histogram** tell you**?**

Well, if nothing else, it will warn you of ***Over*** or ***Under Exposure.***

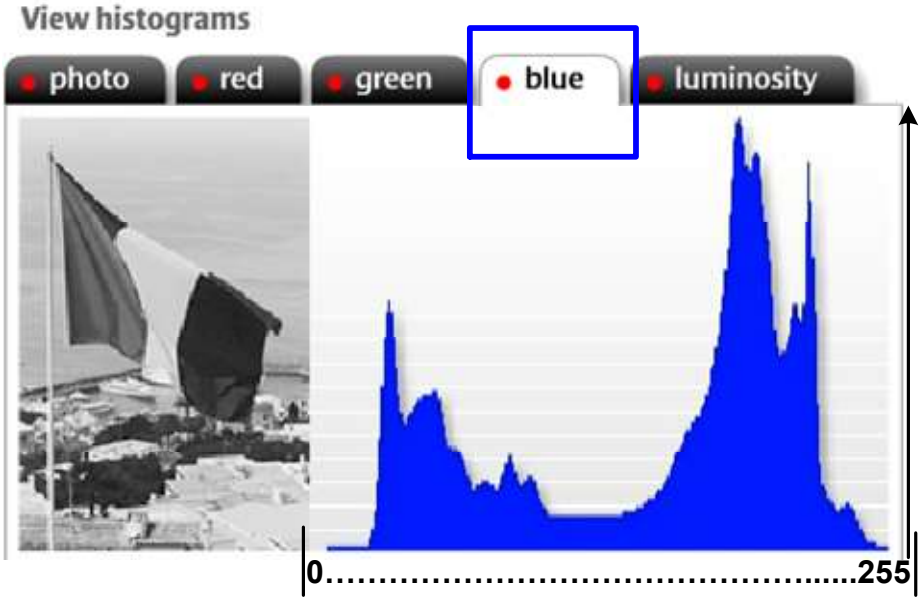
If there are lines right up against the ***Left*** of the diagram, the chances are the image is ***Underexposed***.

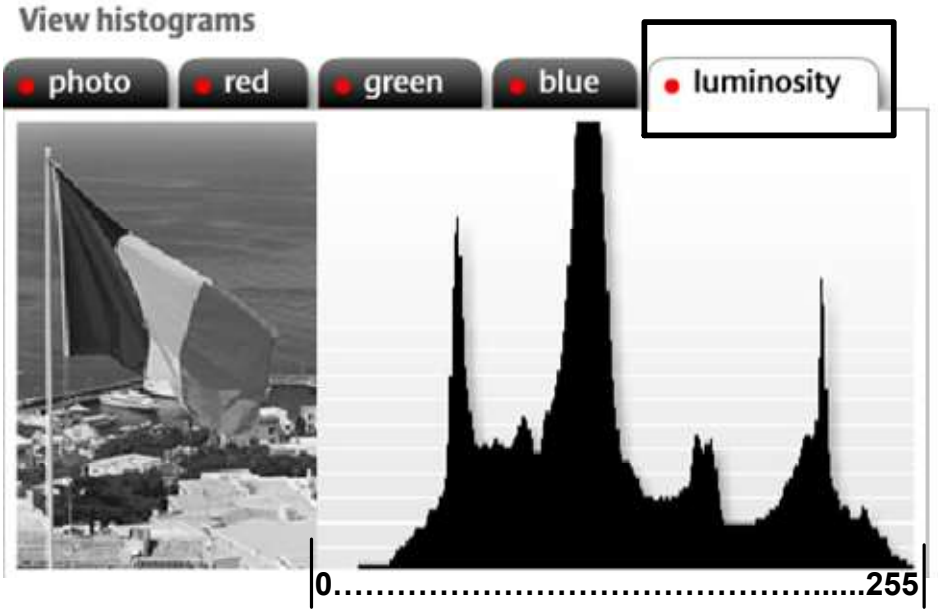
If there are lines right up against the ***Right*** of the diagram, the image is probably ***Overexposed.***

A typical **well-Exposed Image** will show the main distribution of **Tones** around the **Centre,** reducing towards the **Left** and **Right**.

(though there will be exceptions).

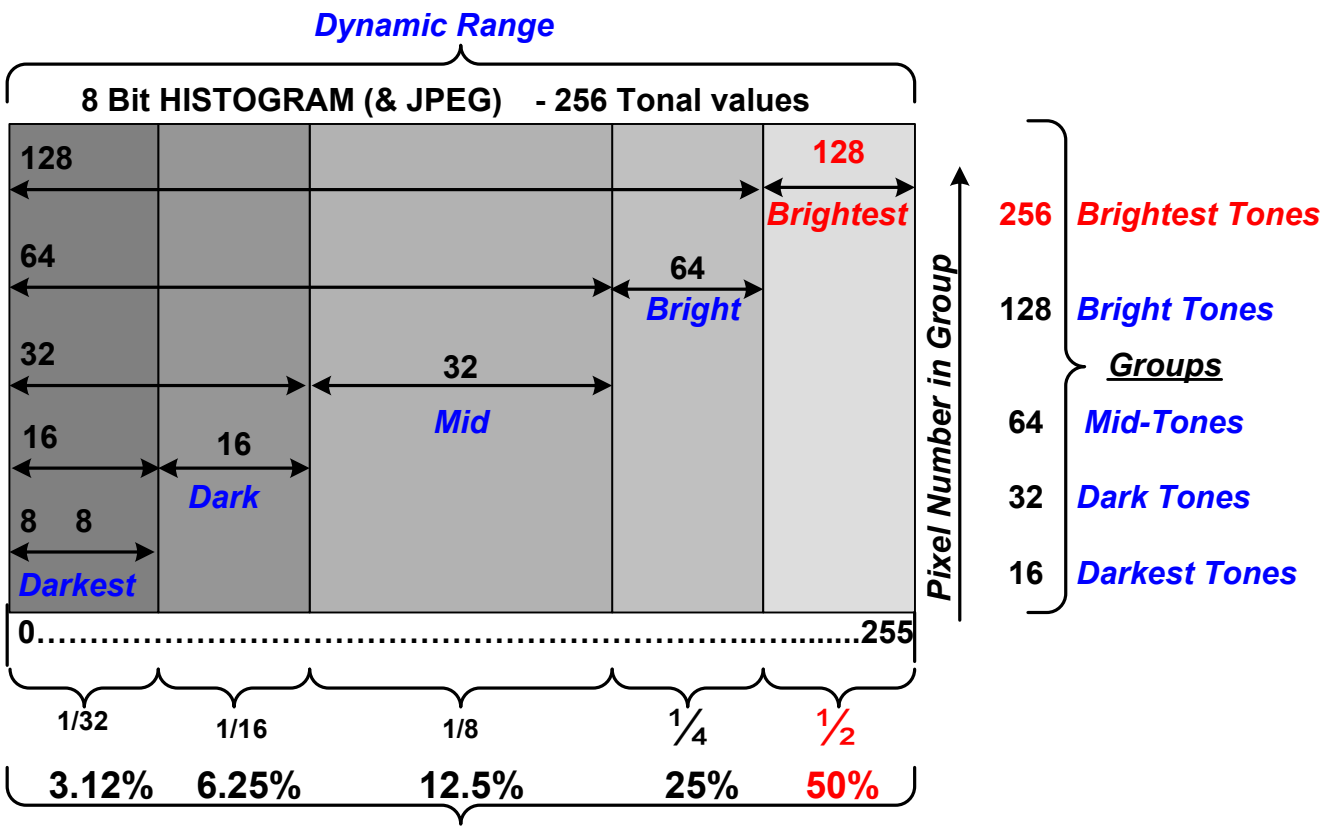
[Except Snow & Bright Whites e.g. Swans etc.]





When reviewing an image in the ***Histogram*** view, you may notice some areas that are ***Flashing.***
The ***Flashing*** indicates whether there are any ***Over Exposed Pixels.***

2. 8 Bit HISTOGRAM & Expose To The Right (ETTR)



Camera Encoding Levels - Available(Tones)

A JPEG Image Data will be represented on your "Camera LCD" as an 8 Bit Histogram

The way that it really works is that the first **(Brightest)** data contains **256** of these Tones - ***fully HALF of those available***.

Reference: https://luminous-landscape.com/expose-right/

The Histogram can display 8, 10, 12, 14, and 16 bit Histograms of Monochrome or Color images.

Histogram is a simple graph that displays where all of the **"Brightness Levels"** contained in the scene are found, from the ***Darkest to the Brightest.***

These values are arrayed across the bottom of the graph from **Left (Darkest)** to **Right (Brightest).**

The **Vertical axis** (the High points on the graph) shows how much of the image is found at any particular **Brightness Level**.

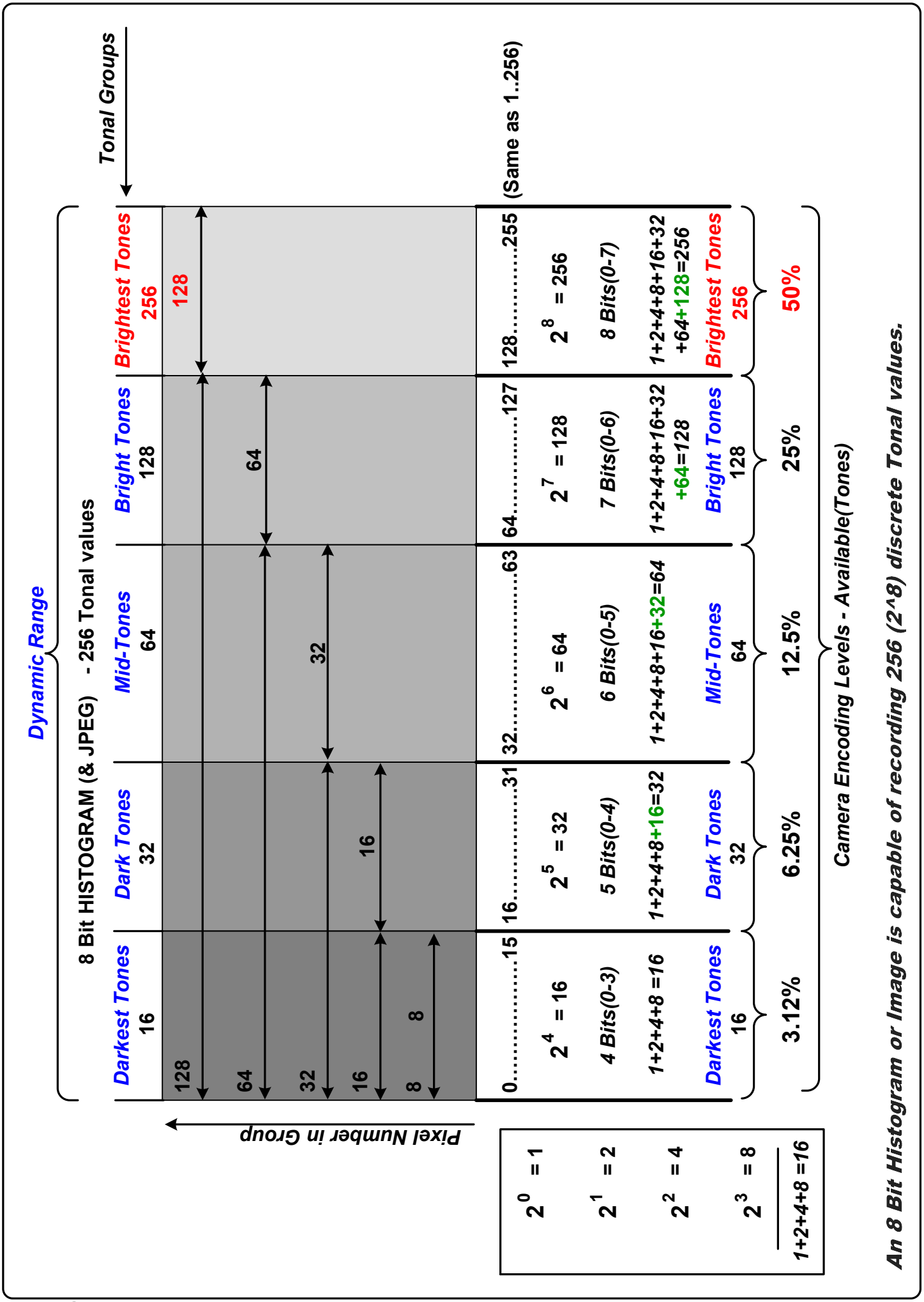
The way that it really works is that the first **(Brightest)** data contains **256** of these Tones - ***fully HALF of those available***.

This realization carries with it a number of important lessons, the most important of them being that if you do not use the ***"Right-Hand Fifth of the Histogram"*** for recording some of your image you are in fact ***wasting fully HALF of the available encoding levels of your camera***.

The reason why we want to ***Expose*** every shot that we take with the **Data** as far ***To The Right(ETTR)*** of the HISTOGRAM as possible is because ***that's*** *where* ***50% of the Data is*** **!**

It also is where there is ***NO Visible Noise***.
The ***Visible Noise*** is in the ***Darker Tones.***

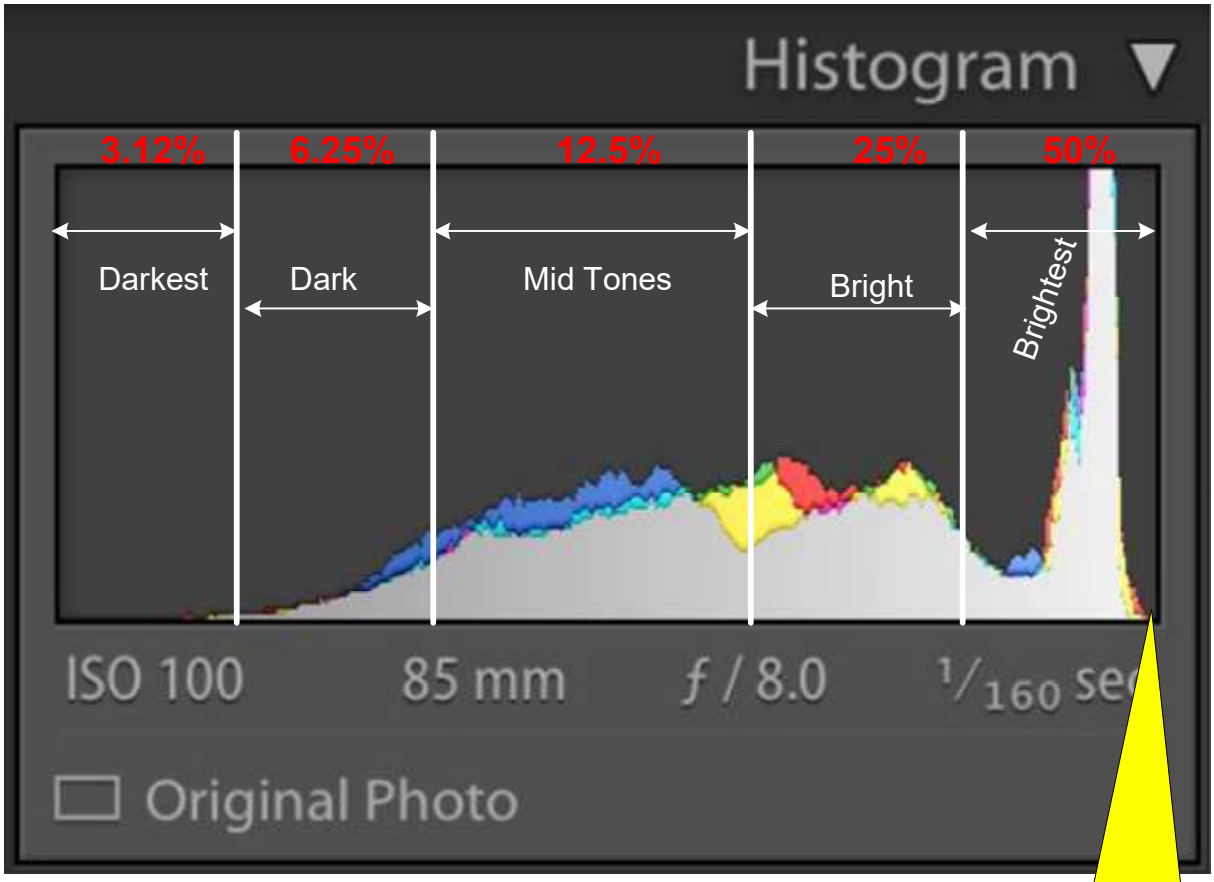
3. Mathematical/Computing Explanation for 8 BIT HISTOGRAM



4. HISTOGRAM : Good Example of ETTR (Expose To The Right)

Reference :

http://petapixel.com/2016/09/06/5-myths-digital-photography/



Do NOT Blow out or Clip the Image - Over Exposure

Reference :

http://theory.uchicago.edu/~ejm/pix/20d/tests/noise/noise-p3.html#bitdepth

https://www.dpreview.com/articles/6641165460/ettr-exposed

DPReview : ETTR (Expose To The Right) Exposed - Excellent article

Even though an **ETTR** image might look too Bright, it's actually better to record an optimal signal then take down the Brightness (or curve adjustments) in post processing.

Bottom line:

Want the best quality image from your equipment? Shoot **RAW** at your camera's **base ISO and ETTR.**

When working in **RAW mode**, which you should be, most cameras record a **12 to 16 Bit Image**.

A 12 Bit Image is capable of recording 4,096 (2^12) discrete Tonal values.

12 Bit e.g.

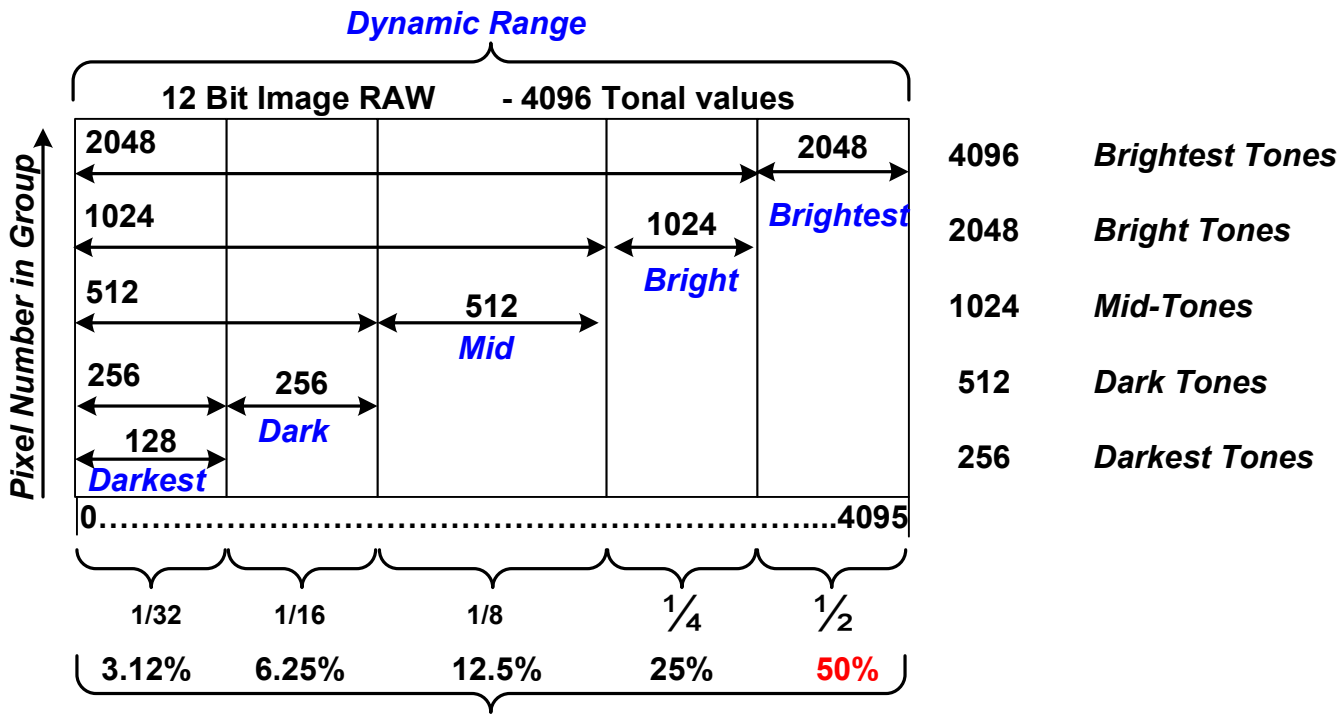
A 14 Bit Image is capable of recording 16,384 (2^14) discrete Tonal values.

14 Bit e.g.

A 16 Bit Image is capable of recording 66,536 (2^16) discrete Tonal values.

16 Bit e.g. Canon EOS 7D & EOS7D MkII

5. 12 Bit IMAGES & Expose To The Right (ETTR)



Camera Encoding Levels Available(Tones)

A 12 Bit RAW Image Data will be represented on your "Camera LCD" as an 8 Bit Histogram

The way that it really works is that the first **(Brightest)** data contains **2048** of these Tones - ***fully HALF of those available***.

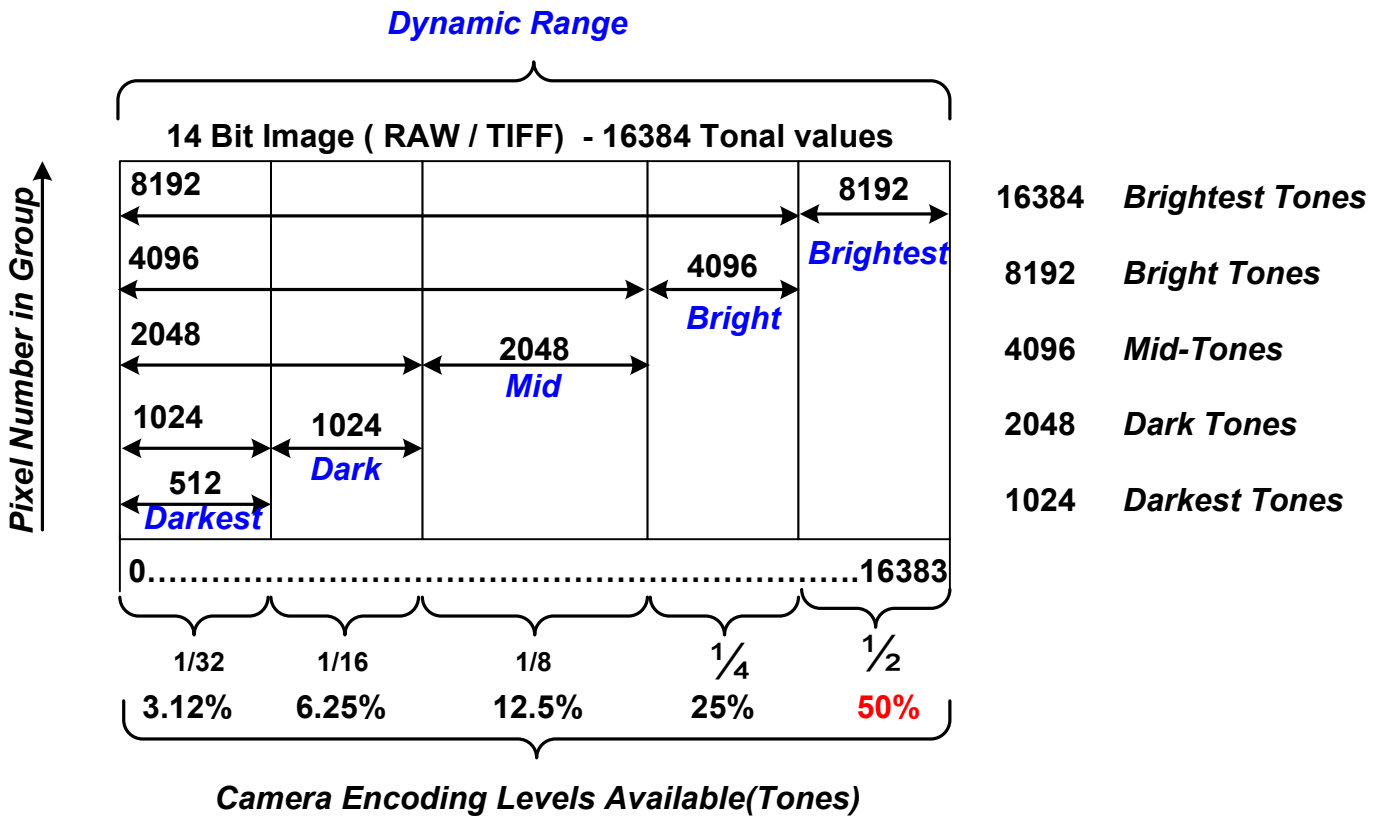
A **"Histogram"** is a graphical representation of an image's spread of Luminance Levels, showing the approximate number of **Pixels** for each Luminance Level.

The **Vertical axis** displays the number of Pixels, and the **Horizontal axis** the range of luminance levels from ***"Black at the Left"*** to ***"White at the Right"***.

The reason why we want to ***Expose*** every shot that we take with the **Data** as far ***To The Right*** of the Histogram as possible is because ***that's*** *where* ***the Data is*** **!**

It also is where there is NO ***Visible Noise***.
The ***Visible Noise*** is in the ***Darker Tones.***

6. 14 Bit IMAGES & Expose To The Right (ETTR)



A 14 Bit RAW Image Data will be represented on your "Camera LCD" as an 8 Bit Histogram

The way that it really works is that the first **(Brightest)** data contains **8192** of these Tones - ***fully HALF of those available***.

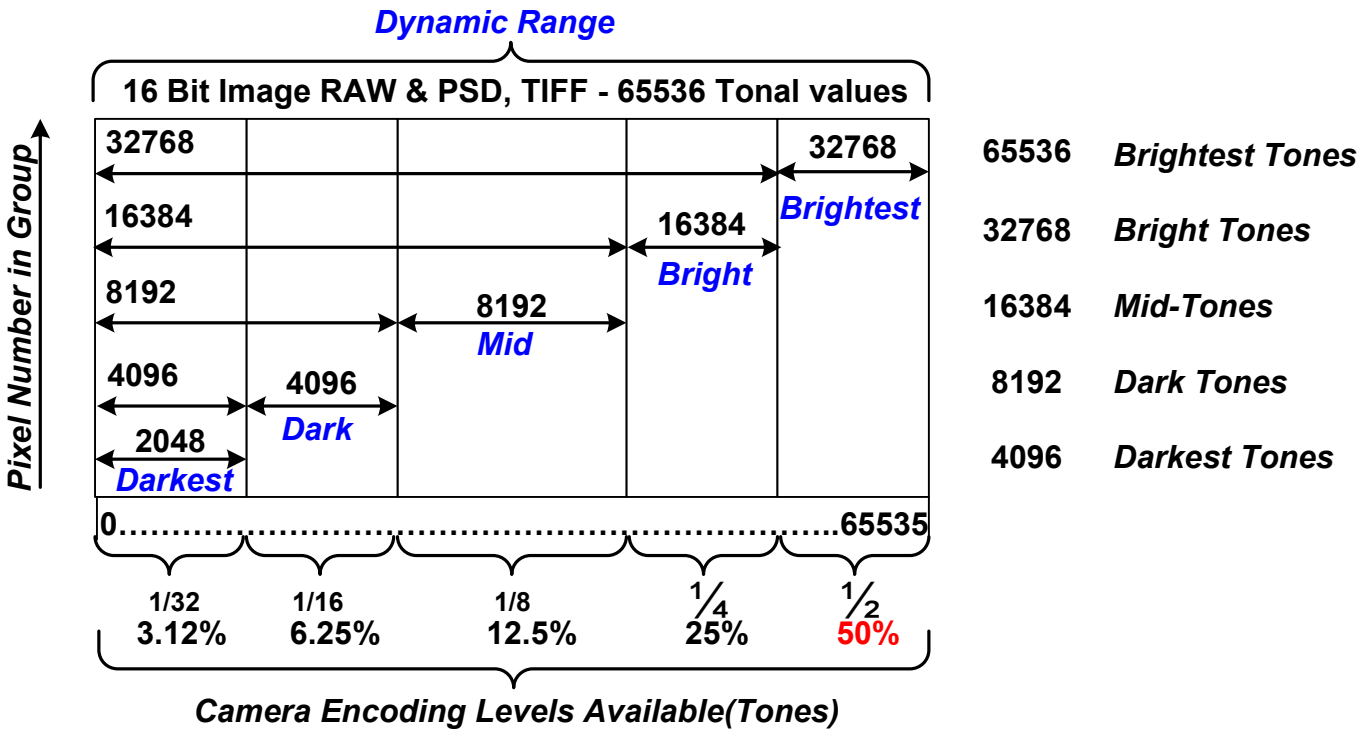
A **"Histogram"** is a graphical representation of an image's spread of Luminance Levels, showing the approximate number of **Pixels** for each Luminance Level.

The **Vertical axis** displays the number of Pixels, and the **Horizontal axis** the range of luminance levels from ***"Black at the Left"*** to ***"White at the Right"***.

The reason why we want to ***Expose*** every shot that we take with the **Data** as far ***To The Right*** of the Histogram as possible is because ***that's*** *where* ***the Data is*** **!**

It also is where there is NO ***Visible Noise***.
The ***Visible Noise*** is in the ***Darker Tones.***

7. 16 Bit IMAGES & Expose To The Right (ETTR)



A 16 Bit RAW Image Data will be represented on your "Camera LCD" as an 8 Bit Histogram

The way that it really works is that the first **(Brightest)** data contains **32768** of these Tones - ***fully HALF of those available***.

A **"Histogram"** is a graphical representation of an image's spread of Luminance Levels, showing the approximate number of **Pixels** for each Luminance Level.

The **Vertical axis** displays the number of Pixels, and the **Horizontal axis** the range of luminance levels from ***"Black at the Left"*** to ***"White at the Right"***.

The reason why we want to ***Expose*** every shot that we take with the **Data** as far ***To The Right*** of the Histogram as possible is because ***that's*** *where* ***the Data is*** **!**

It also is where there is NO ***Visible Noise***.
The ***Visible Noise*** is in the ***Darker Tones.***

8. What Does Digital Image Bit Depth Mean

Google SEARCH: What Does Digital Image Bit Depth Mean

REFERENCE:
http://www.graphics.com/article-old/digital-photography-fundamentals-understanding-resolution-and-bit-depth

8 Bit vs. 16 Bit

The difference between an **8-Bit and a 16-Bit** image is the number of **Tonal Values** that can be recorded. (Anything over **8 Bits** per channel is generally referred to as ***High Bit***.) An **8-Bit**-per-channel capture contains up to **256 Tonal Values** for each of the three**(RGB)** color channels, because each bit can store one of two possible values, and there are **8 Bits.**

That translates into two raised to the power of eight, which results in **256 possible Tonal values.**

A **16-Bit** image can store up to **65,536 Tonal Values** per channel, or two raised to the power of 16.

The actual analog-to-digital conversion that takes place within digital cameras supports:

8 Bits (**256 Tonal values** per channel[RGB]),

12 Bits (**4096 Tonal values** per channel[RGB]),

14 Bits (**16,384 Tonal** values per channel[RGB]),

16 Bits (**65,536 Tonal values** per channel[RGB])

When working with a single exposure, imaging software only supports **8-Bit** and **16-Bit-**per-channel modes, anything over **8 Bits** per channel will be stored as a **16-Bit**-per-channel image, even if the image doesn't actually contain that level of information.

When you start with a **High-Bit** image by capturing the image in the **RAW** format, you have more **Tonal** information available when making your adjustments.

Even if your adjustments—such as increases in contrast or other changes—cause a loss of certain Tonal values, the huge number of available values means you'll almost certainly end up with many more Tonal values per channel than if you started with an **8-Bit** .

That means that even with relatively large adjustments in a **High-Bit**, you can still end up with perfectly smooth gradations in the output.

Working in **16-Bit**-per-channel**(RGB)** mode offers a number of advantages, not the least of which is helping to ensure smooth gradations of Tone and Color within the image, even with the application of strong adjustments to the image.

Because the Bit depth is doubled for a **16-Bit**-per-channel image relative to an **8-Bit**-per-channel image, this means the actual size will be double.

However, since **Image Quality** is our **Primary** concern we feel the advantages of a **High-Bit** work far exceed the (relatively low) extra storage costs and other drawbacks, and thus recommend always working in **16-Bi**t-per-channel mode.