Introducing the Digital Negative Specification

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The Digital Negative (DNG) specification provides a solution to a growing problem in digital photography workflows. Raw file formats are becoming increasingly popular for photographers because they offer increased flexibility, quality, and control compared to traditional JPEG and TIFF formats. Unlike JPEG and TIFF, however, there is no standard file format specification for raw files. Almost every camera has a different raw format, and the specifications for these formats are not publicly available. As a result, a variety of software applications cannot read every raw format, and using these raw files as a long-term archive is a risky proposition.

In contrast, the Digital Negative specification—which is designed to accommodate the information stored in manufacturer-specific raw files—is available at no charge to the public, making it more accessible and, ultimately, a safer choice for long-term archival purposes.

To understand more about the Digital Negative specification, it's important to have a general understanding of how a raw format differs from JPEG and TIFF files.

What is a raw file?

The term "raw" is appropriate for these camera files, because they represent exposures that have been made, but have not yet been "developed." A raw file contains the actual pixel data captured by a camera sensor before it has undergone any processing inside the camera.

A full-color JPEG or TIFF file typically consists of three color channels—red, green, and blue. The color of each pixel in the image is determined by mixing values of red, green, and blue in varying amounts. However, most digital camera sensors are only capable of capturing one grayscale value at each pixel location. To compensate for this limitation, color filters are used at each pixel, so that each location can capture the amount of either red, green, or blue that is found in the scene. The resulting capture still has just one full channel of information, but some of those pixels represent red values, some represent green, and some represent blue. When the red, green, and blue pixels are separated, they create three incomplete color channels.

To create a JPEG or TIFF file, a digital camera starts with the incomplete color channels captured by the sensor, and does further calculations to fill in the holes in each channel. At this point some of the settings that you specify before you take the picture—such as white balance and sharpness—are actually applied. Many of these settings have no impact on how the image is captured; they only affect the final conversion to TIFF or JPEG.

You can think of this final processing of the file to create a JPEG or TIFF as "developing" the file. The raw file represents the information before it has been processed in this way. The raw file includes the actual, incomplete color channels captured by the camera sensor, along with additional metadata that describes the contents and how to make use of them. For example, the white balance and sharpness settings you choose before taking the picture are typically stored as metadata in the raw file, so that they can be used later when the raw file is processed on the computer.

Thus, a raw camera file is the most direct representation of what was captured by the camera sensor, and it provides you with the ability to more precisely control how the final JPEG or TIFF is generated. It also gives you the ability to easily change your mind, such as choosing a different white balance or sharpness setting during processing than you originally picked before taking the shot.

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The problem with current raw file formats

Raw files evolved because camera manufacturers wanted to give their professional users more control over the creation of a final image file. Rather than complete all of the processing of the file inside the camera, the idea was to delay the final processing until the captured file was copied to the computer. At this point the photographer could use special software to duplicate some of the same controls that were on the camera, but with the flexibility of modifying and refining the settings.

Unfortunately, no standard file format existed for storing these raw image files, so the manufacturers had to design their own formats. Furthermore, because the contents of the raw file were so dependent on the design of the camera, the tendency has been for manufacturers to make slightly different raw formats for each camera that they create. Over time, an incredible number of new file formats have been created. The vast majority of these formats are not publicly documented, making it challenging for third-party software vendors to support them.

If you use raw files as a mechanism to only delay the final processing of the files until you copy them onto your computer, you don't have a problem. You simply capture the raw files to your computer and convert them to JPEG or TIFF using the manufacturer-provided software. You can then just delete the original raw file and archive the final, converted version.

Many photographers, however, realize that such an approach doesn't take advantage of the real benefits of raw files. These photographers want to treat the raw files as the digital equivalent of a film negative. Just as you can generate multiple prints from a single film negative, you may want to create multiple, different files from an original raw image. Just as you want to store your film negatives indefinitely, so that you can develop additional prints in the future, you will want to archive your raw files for many years into the future.

Moreover, it's quite possible that the images you'll be able to generate from your raw files years from now will be superior to the images you can create today. Advancements in software development may lead to superior conversion algorithms, giving you enhanced color and detail. By saving your raw files, you can be assured of taking advantage of these improvements.

Or, at least, you should be assured of taking advantage of these improvements. In reality, given the confusing array of raw formats, you can't assume that you'll be able to use all raw formats in the future. Already, there have been instances where new versions of manufacturer-supplied conversion software did not support older file formats created by the same manufacturers. In these instances, some of these camera-specific file formats are nothing more than a dead end.

Unfortunately, with so many different formats, it's difficult even for camera manufacturers to support them all. For independent software vendors, who don't have the benefit of published specifications, it can be even more difficult. Without an openly published raw format specification, photographs you consider very valuable could potentially become inaccessible in just a few years.

A single, published file format that can handle raw images from any camera could solve this problem. Such a file format has the potential to offer a number of significant benefits:

- An open, published format can more easily be supported by a wide variety of third-party software products, which would give you a wider choice of software to use for conversion.
- A format designed to work with all cameras would be much less likely to be rendered obsolete at some point in the future. Unlike camera-specific formats that fade out of use when the camera model is no longer sold, a generalized format should continue to be compatible with new cameras, ensuring that it would still be in demand and supported by newer software solutions.
- Because software that is compatible with an open format could automatically support all files written to it, regardless of the source camera, there would be no more waiting for compatibility updates for your favorite software. Any camera that supports an open format could work with your software automatically.

Clearly, the benefits of such a format are significant. The Digital Negative specification provides an answer.

What is a Digital Negative?

The Digital Negative specification describes a generalized way of storing the raw data created by any digital camera. The specification was written by Adobe Systems Incorporated, who already has experience supporting a wide range of different camera-specific formats within the Camera Raw plug-in for Adobe Photoshop CS2 and Photoshop Elements. The format was designed to support a wide range of variations in camera design and features.

Similar to most camera-specific raw formats, a Digital Negative is composed of two parts: the actual image data, and the metadata that describes it. The format of the image data is actually based on the TIFF format—as are many camera-specific raw formats—although it is designed to hold the incomplete image data captured by most camera sensors. The key to the power of a Digital Negative, however, is in the metadata. The metadata in a Digital Negative contains all the information that a raw converter needs in order to convert the file, even if a Digital Negative-compatible converter has never seen a file from that camera before.

Current camera-specific raw formats must be individually supported and tested by software programs. When a new camera appears on the market, you sometimes need to wait before its raw format is supported by your favorite software program. The software developers must design the software to recognize each specific camera, and include information on how each format should be processed.

In contrast, using the metadata inside a Digital Negative, a compatible converter can adapt its conversion routines to handle new cameras. The metadata informs the converter exactly what the arrangement of red, green, and blue pixels is, and how the image should be handled.

The DNG format is flexible; it can handle all current known variations in camera sensor designs. Although it requires that a certain set of metadata is present to allow for high-quality processing by any Digital Negative-compatible converter, it does not prevent manufacturers from adding additional metadata. Much like the existing EXIF (Exchangeable Image Format) standard, the Digital Negative specification allows camera manufacturers to add "private" metadata to a file. This private data always stays with the file, although it might not be used by third-party conversion programs.

Perhaps most importantly, the Digital Negative specification is designed to evolve over time. Just as your favorite software has a version number, a Digital Negative file contains a version number. If future technological innovation results in an unusual camera design that produces raw data which cannot be handled by the current Digital Negative specification, a modified version of the specification can be developed, and the version number can be incremented. Thus, the Digital Negative should theoretically never become obsolete.

What is metadata?

Metadata is, quite simply, data about data. It's information that goes with a file and describes what the contents of the file are, where it came from, and what to do with it. The simplest examples of metadata are the file name and the creation date. The rich EXIF data created by most digital cameras, such as storing information about what camera was used, what the exposure was, and whether a flash was used, is another example of metadata.

How can you adopt the Digital Negative in your workflow?

There are multiple ways in which you might see the Digital Negative begin to appear in your workflow. Digital cameras can begin to support the format directly, either as their default raw format, or as an optional format. Alternatively, manufacturers may choose to include conversion utilities that convert their camera-specific raw formats into a Digital Negative file. Within a few months of introducing the Digital Negative specification, a variety of software and hardware manufacturers began incorporating support. This is a good indication of future broad support of the format throughout industry workflows.

You don't need to buy a new camera or wait for new software from your camera vendor. Adobe has released the Adobe Digital Negative Converter, which will convert the raw formats from more than 70 different digital cameras—the same cameras supported by the Adobe Camera Raw plug-in—into DNG files. This converter is available at no charge from the Adobe website. It allows you to take advantage of the archival benefits of Digital Negatives, or to convert your camera-specific raw files for use in a raw converter that supports Digital Negatives, but doesn't support your camera-specific format. Plus, the current Adobe Camera Raw plug-in is already Digital Negative-compatible, which means a program that can open these files is widely available.

By converting your camera-specific raw files to Digital Negatives, you can archive them with greater confidence, knowing that their format is publicly documented and can be supported by Adobe and other companies long into the future.

Note: When archiving, it is recommended that you embed the original raw file into the DNG when using the Adobe Digital Negative Converter or Adobe Camera Raw to create Digital Negatives. Embedding the original, camera-specific raw file into your Digital Negative ensures that you can always extract it later if necessary. Although Digital Negatives contain all of the image data found in the original, all private metadata is not always duplicated; saving the raw file into the Digital Negative ensures that you can open the file in the future.

As a camera format, Digital Negative will offer complete support for the manufacturer's private metadata. This means in the future, if you are photographing with a camera that supports DNG as a native format, all the manufacturer's metadata, as well as the image data, will be stored in one file.

What is the future of digital photography?

Given the incredible pace of change in digital cameras in the past few years, it's hard to predict what digital cameras will look like ten years from now. It's likely that you'll buy a new camera several times in the next decade. Using camera-specific raw formats, you could wind up with an archive filled with a multitude of incompatible files, each requiring different software applications, some of which might not be able to run on the latest computers and operating systems. The Digital Negative specification can unify this collection of images under a single standard, which can evolve with the technology, and give you reliable access to your treasured images, regardless of what camera was used.

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