



LDX Image Acquisition Solutions: The Power of Choice

LDX 86^N: Native 4K pixels when resolution counts

Native HD performance with better pixels when you need them

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BACKGROUND DOCUMENT



UPDATED OCTOBER 2018

Image acquisition for live broadcast applications faces many challenges in a multiformat landscape. The increase in spatial resolution required by 4K UHD, in combination with the additional requirements of UHD standards, including a potential increase in frame rate and high dynamic range — with good sensitivity and S/N ratio — will require some compromises and design decisions on the part of manufacturers, and camera selection on the part of camera users.

Some of these new requirements, especially increased resolution, have a negative impact on some important image parameters, such as sensitivity, noise performance and dynamic range. Multiple flexible solutions can address these challenges, including native format switching. Grass Valley's industry-leading LDX 86 Series cameras provide solutions for all these challenges and uniquely provide comprehensive upgrade/downgrade paths that present flexibility that's unmatched in the industry. This background document will explain the latest developments in imaging technology and outline Grass Valley's latest solutions to these live broadcasting challenges.

Pixel Size Matters

Image acquisition with a higher pixel count on any set imager size inherently leads to smaller pixels.

Pixel Size: 2/3" (11 mm diameter)		
Format	2K HD	4K UHD
Pixel Resolution	1920x1080	3840x2160
Pixel Count	2,073,600	8,294,400
Pixel Dimensions	5.0 μm^2	2.5 μm^2

Table 1. Pixel size comparison for 2/3" imagers between high definition and ultra high definition.

Smaller pixels naturally deliver lower sensitivity due to their smaller photon capture area, with a linear relation between pixel size (A_{cell}) and sensitivity. This means that if the same technology is used for 4K imagers with 4X smaller pixels (2.5 $\mu\text{m} \times 2.5 \mu\text{m}$), compared to 2K imagers (5.0 $\mu\text{m} \times 5.0 \mu\text{m}$), they will have 4X lower light sensitivity. It's a simple law of physics.

$$Sensitivity = A_{cell} \cdot T_{int} \cdot \frac{E_v \cdot p}{4 \cdot F^2}$$

In other words, despite the apparent benefit of having MORE pixels when capturing content in native 4K, it may not always be ideal. The increased sensitivity of the larger pixels captured using full HD imagers is sometimes preferable.

LDX 86^N

Native 4K pixels when resolution counts Native HD performance with better pixels when you need them

The LDX 86^N Series of system cameras is the latest addition to Grass Valley’s LDX Series, delivering both native HD/3G images and native 4K images for the highest possible resolution and image clarity. The key to providing native resolution in both 1920x1080 and 3840x2160 in the LDX 86^N Series is a new generation of imagers developed in-house — the native 4K Xensium^{HAWK} CMOS imager. For many applications, the additional image clarity achieved by native 4K will result in the best viewing experience for viewers.

The 3840x2160p 4K Xensium^{HAWK} supports full native 4K resolution, as well as native HD resolution with a unique pixel technology called DPM^{Ultra} (dynamic pixel management) functionality.

With DPM^{Ultra}, LDX 86^N Series native 4K UHD cameras also provide native 1920x1080p HD acquisition within the imager by combining two horizontal and two vertical adjacent pixels. This is without the intrinsic

downsides of traditional 4K acquisition — such as rolling shutter and decreased sensitivity — while delivering native 4K crispness when needed. This means the LDX 86^N Series delivers 4K images with the highest resolution when required, but, when required, it can also be switched to native HD format and deliver similar HD performance as our HD-only LDX 86 cameras. No other camera on the market can boast this type of flexibility:performance ratio.

In HD operation, the camera delivers 4X increased sensitivity and true global shutter behavior, both of which are not possible today in any native 4K camera with 2/3" imagers.

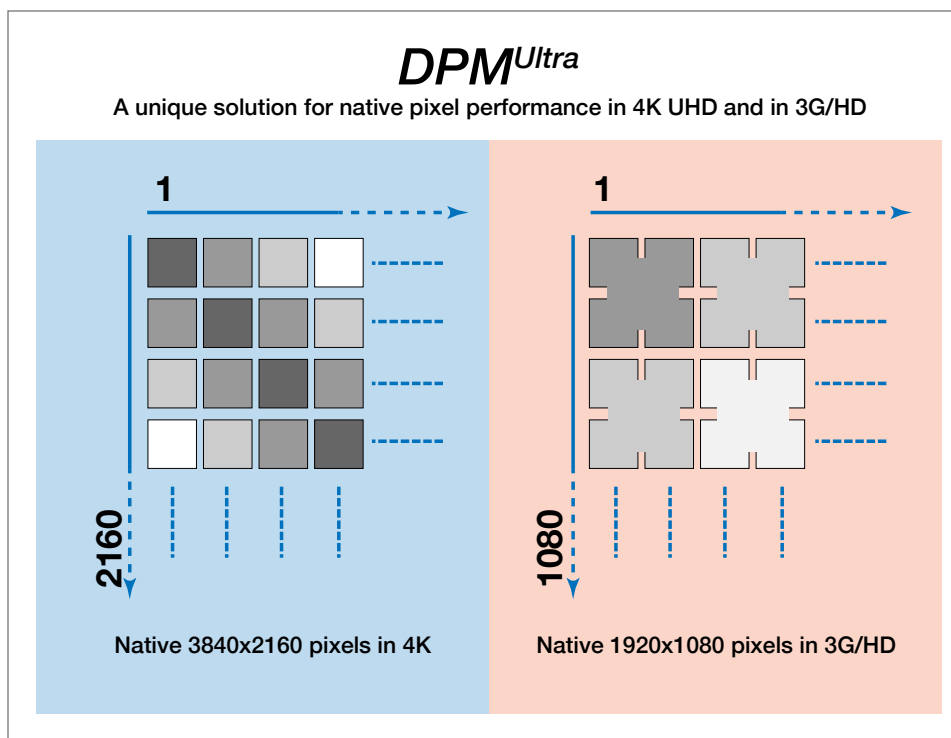


Figure 1. Comparison of how the 4K Xensium^{HAWK} imager with DPM^{Ultra} delivers native resolution in both 3840x2160 and 1920x1080.

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Not all 4K UHD productions will require native 4K resolution. For those situations, the LDX 86 Series offers a solution for 4K acquisition by deriving a 4K image from a bicubic interpolation process of the RGB images from the camera's native HD imagers. This offers users both high sensitivity and global shutter (and optional high dynamic range), with a unique closed-system process for 3840x2160 UHD where all of the processing takes place within the camera system. This delivers a 4K image with the highest light sensitivity available in any system camera, with images almost indistinguishable from native 4K acquisition in most applications.

Therefore, for applications that require 4K with the highest sensitivity, global shutter and high dynamic range, the LDX 86 Series is the best option.

However, in many applications, different camera positions have different requirements, so being able to use the LDX 86 and the LDX 86^N together provides the best of both worlds for each camera position.

As such, the LDX 86^N native 4K pixels offer the best resolution performance when required and the LDX 86 4K pixels, derived from a special processing of the large HD pixels, offer the highest sensitivity and global shutter when required.

Details about the specific differences of the two solutions can be found in Figure 2 below.

It is important to note that independent the solution selected for either 4K application, both offer the same uncompromised HD performance.

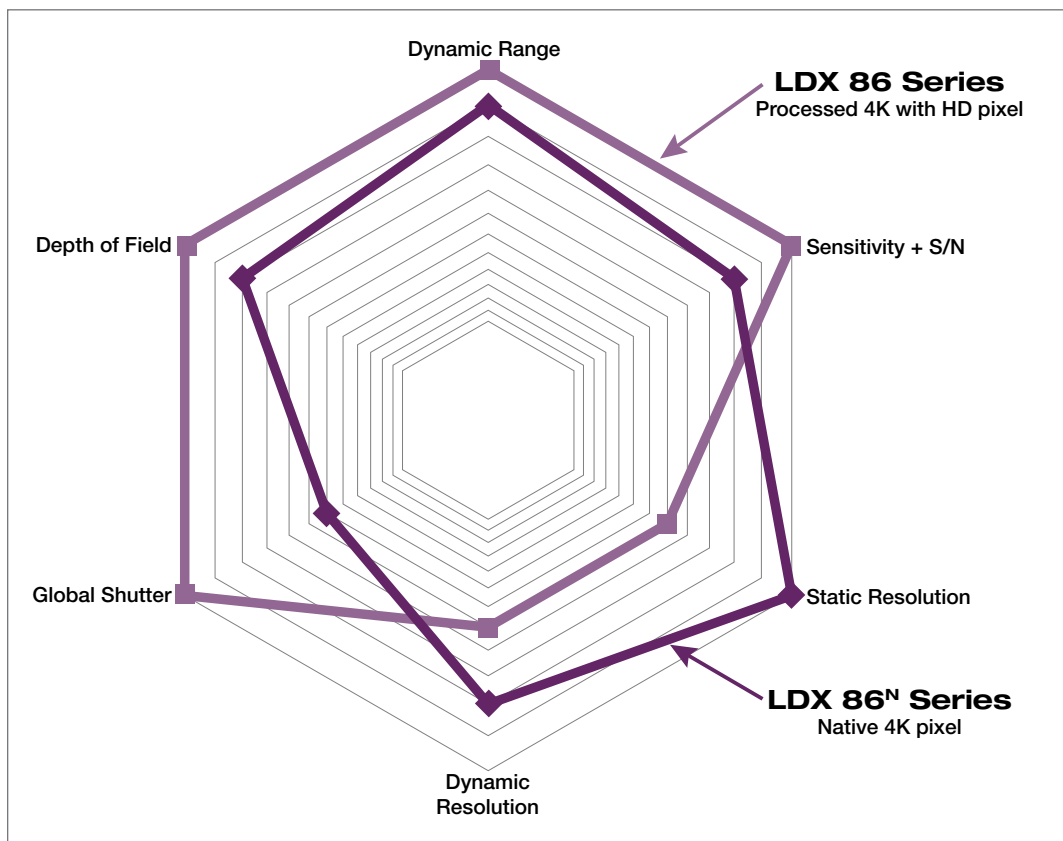


Figure 2. Comparison of performance of the LDX 86^N Series and LDX 86 Series system cameras.

Two Different Approaches to 4K Acquisition
Delivering Outstanding HD/3G Performance

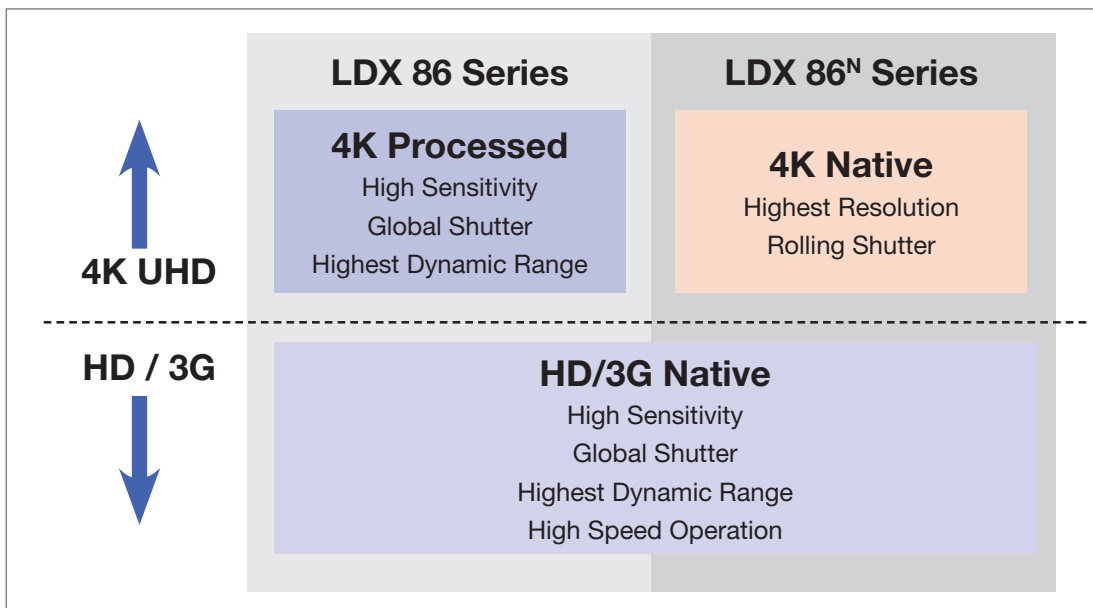


Figure 3: Regardless of the Grass Valley 4K camera option chosen, each achieves native HD/3G performance.

Summary

Today, the technology available does not offer native 4K imaging that delivers the same performance in terms of sensitivity as the best HD cameras available. In addition, native 4K acquisition with 2/3" imagers does not offer global shutter operation — a requirement in many of the more demanding applications with high speed movement.

With the LDX 86^N and its newly developed Xensium^{HAWK} CMOS imagers with unique DPM^{Ultra} functionality, only Grass Valley offers the option to select between native 4K acquisition and native HD acquisition without compromise.

The combination of the LDX 86^N with native 4K pixel operation and the LDX 86 with processed 4K output signals offer the unique possibility to select the best solution for every single camera position — even in the most demanding 4K applications. And with the DPM^{Ultra} functionality, both cameras offer similar performance when used in any HD production format.



GVB-1-0593C-EN-GV

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