

# WHITEPAPER

## **New Third-Generation Camera Transmission Solutions for the LDK Elite Series Cameras**

Klaus Weber, *Product Marketing Manager, Cameras*

June 2012

This document describes the development of Grass Valley's third-generation of camera transmission solutions, capable of 3 Gb/s transmission over triax, fiber, or a combination of the two.

# Introduction

Grass Valley™ introduced the main components of its third-generation camera transmission system at NAB 2011 and IBC 2011, with the final component—a 3G fiber camera to 3G triax converter box, being introduced at NAB 2012.

When we started the development process on what we call *3G Transmission*—our third-generation camera transmission system capable of 3 Gb/s, we looked carefully into the market of HD camera transmission systems. There we found a nearly even split of users for triax and fiber.

Triax has the advantage of being able to reuse existing cable infrastructures and in the extremely robust and

easy to handle cables and connectors.

Fiber offered larger head-room for extended bandwidth and format support, and offered much longer maximum cable runs.

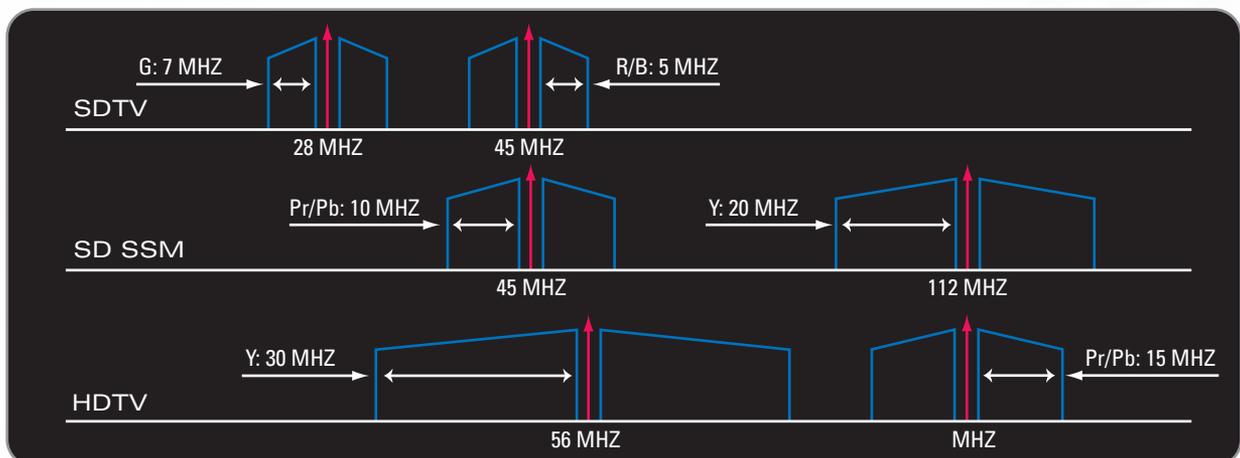
But in many cases, users of one system or the other wished to combine the strengths of both systems into a single transmission system—and this is why we developed 3G Transmission.



# History

In the late 1960's, the Philips camera factory in Breda, the Netherlands got together with CBS Labs and developed the original triax transmission technology, for which they would later share an Emmy® Award. Soon after its introduction, triax became the almost exclusive camera signal transmission system for all SD broadcast cameras. It was only at the end of the last century with the introduction of the first regular HD system cameras, that the available bandwidth of these SD triax systems was no longer sufficient.

Most other camera manufacturers concentrated their early HD camera developments on hybrid fiber optical transmission systems where the additional bandwidth was easily available. It was only when the Grass Valley camera development team in Breda used their extensive knowledge of more than 30 years in triax technology—including a high-bandwidth solution for its SD super slow-motion camera system—that the first full-quality analog HD triax transmission for all 1.5 Gb/s formats was developed. For this HD triax solution, the carriers of the Y-channel and the Cr/Cb-channel had to be moved much higher in frequency compared to the SD triax systems (see Figure 1).



**Figure 1** – For HD triax, the carriers of the Y-channel and the Cr/Cb-channel had to be moved much higher in frequency compared to the SD triax systems.

## History (cont.)

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As a consequence of using higher frequencies, the maximum cable length was reduced to about 40% of the previous SD triax systems. It was only with a triax repeater that maximum cable lengths could have been doubled for many applications.

But, for the transmission of 3 Gb/s formats such as 1080p50 and 1080p59.94, a fiber transmission system had to be used. At IBC 2009, Grass Valley introduced the first commercially available 3 Gb/s end-to-end camera transmission solution based on the LDK 8000 Elite WorldCam and a fiber transmission system.

To increase the bandwidth of the analog HD triax transmission system in order to handle 3 Gb/s formats would decrease the maximum cable length to unacceptable levels. Therefore a different way to transmit the camera signals over triax had to be developed.

In many cases, the mindset in broadcast and the technical limitations have become natural barriers in our minds to further development. But the latest achievements in digital encoding technologies, such as COFDM, combined with the most efficient bit rate reduction technologies, allowed Grass Valley to develop a fully digital triax transmission solution capable of transmitting any HD format up to 3 Gb/s without any visible degradation.

## 3G Triax, Fiber, or Both

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Until this time, the choice for a camera transmission system was either triax or fiber. Once chosen, you were married to that decision for life, or confronted with serious restrictions when making conversions in the field—such as making concessions with video quality and losing all transmission diagnostics. Grass Valley 3G Transmission is different in one very notable way: It has converged today's triax- and fiber-centric solutions into one transmission solution. There are no more differences and no more limitations!

The 3G Transmission topology has been crafted around the reality of broadcast life: very long pre-installed cable runs, multiple production formats, and the need to produce images of the highest quality.

Today, with 3G Transmission, outside broadcast (OB) companies can say “yes” to any kind of bid request or tender, without regard to camera transmission cable type. That's because 3G Transmission converges 3G triax and 3G fiber into a single transmission system.

Grass Valley 3G Transmission solutions will, fully independent of the cable or even the combination of cables used, always support all HD video formats—including 1080p50/60—and always offer exactly the same feature set.

As stated above, there are good reasons to opt for fiber cables and there are good reasons to opt for triax cables. Both have their particular strengths, but both also have limitations and the selection of cable type has to be selected on a case-by-case basis.

Fiber transmission can be used for the longest cable runs and it offers the headroom for additional bandwidth requirements, such as triple speed super slow-motion cameras (4.5 Gb/s).

Triax transmission offers maximum reliability and robustness in the field and can be found at almost all prewired venues.

But in many cases, both triax and fiber are needed, such as at a downhill ski race where most of the camera positions can be reached either with a triax cable or a hybrid fiber cable. But some camera positions, typically the cameras at the start, which are far away from the OB van, can be best reached by (2X single mode) dark fiber cables. These cables are relatively cheap and in many cases they are already prewired at these locations.

With the 3G Transmission twin base station (with both triax and fiber connectivity) any combination of camera cables can be used directly from the base station: triax, dark fiber, or hybrid fiber (with a converter box).

To be able to use a cable to the camera which includes the power for the camera and the lens, a field converter somewhere near the camera is needed. At the converter, the two dark fiber cables will be converted into a hybrid fiber cable or a triax cable depending on the transmission adapter which is used on the camera head.

Figure 2 shows all of the different transmission possibilities when the camera head uses a 3G Triax adapter. The example described above, of a winter sports production, could use a combination of triax cameras (the first and second examples) for the camera positions located close to the OB van, and triax to dark fiber cameras (the third example from the top) for the camera positions which are located far away from the OB van.

# 3G Triax, Fiber, or Both (cont.)

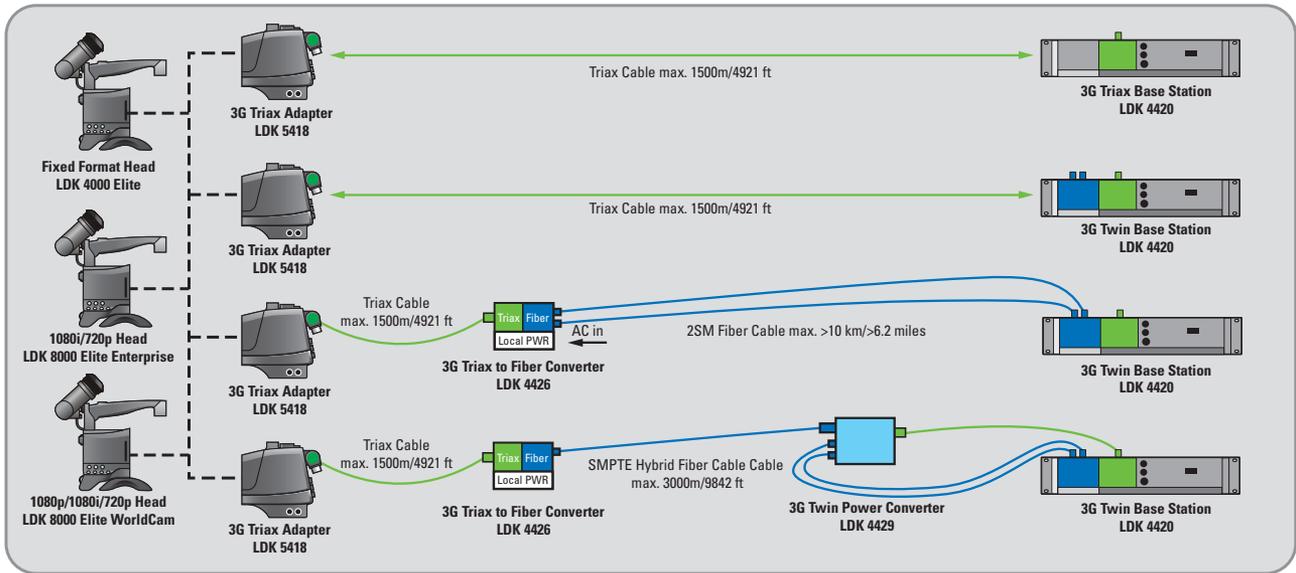


Figure 2 – 3G Triax adapter transmission options.

Figure 3 shows all the different transmission possibilities when the camera head uses a 3G Fiber adapter. The example described above, of a winter sports production, could use a combination of hybrid fiber cameras (the first or fourth examples from the top) for the camera positions close to the OB van, and hybrid fiber to dark

fiber cameras (the second and third examples from the top) for the camera positions which are located far away from the OB van.

In the last example, a solution is shown where a fixed, preinstalled triax infrastructure is used in combination with a 3G Fiber camera adapter.

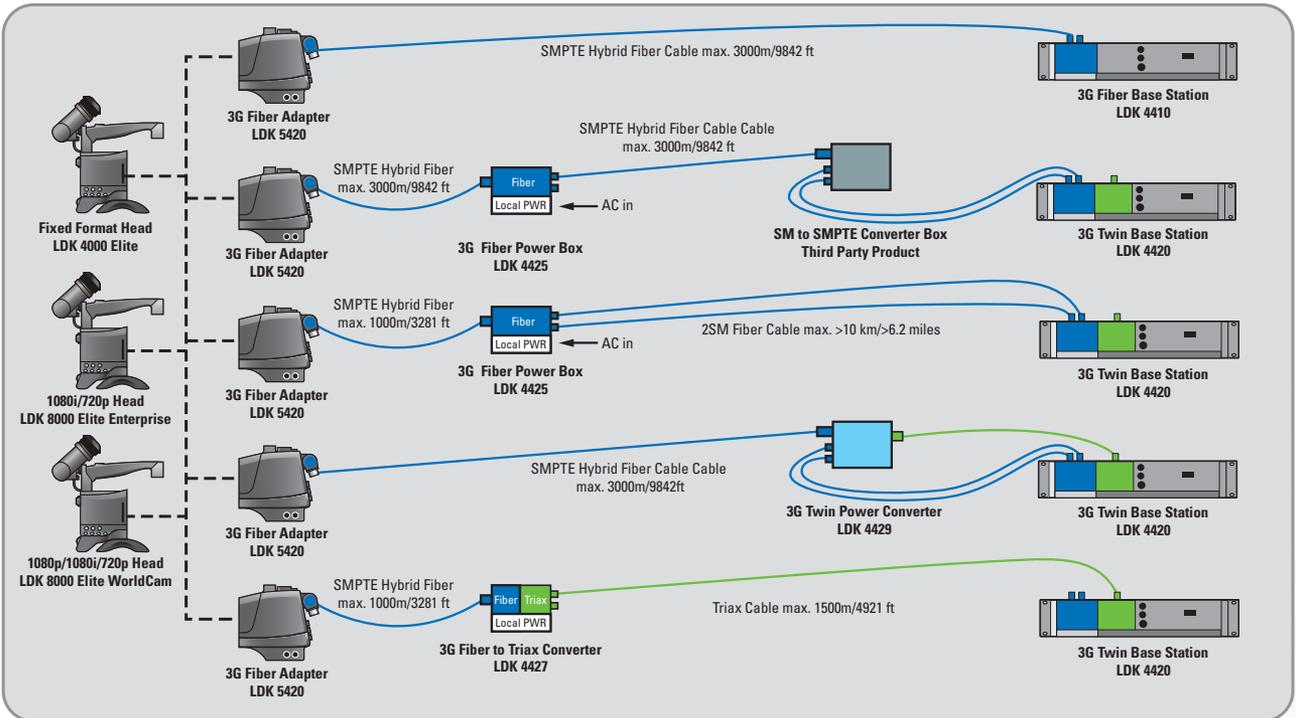


Figure 3 – 3G Fiber adapter transmission options.

# 3G Triax, Fiber, or Both (cont.)

The flexibility of Grass Valley's 3G Transmission solution goes even further.

In Figure 4, we document a three-part transmission solution where up to four cameras of any combination of LDK 4000 Elite, LDK 8000 Elite, and LDK 8300 Live

Super SloMo cameras with fiber or triax transmission adapters can be multiplexed onto one single-mode fiber cable. With the minimum amount of fiber cables, the cameras can be extended by up to 50 km (31.1 miles) from their base stations while still offering full functionality and performance.

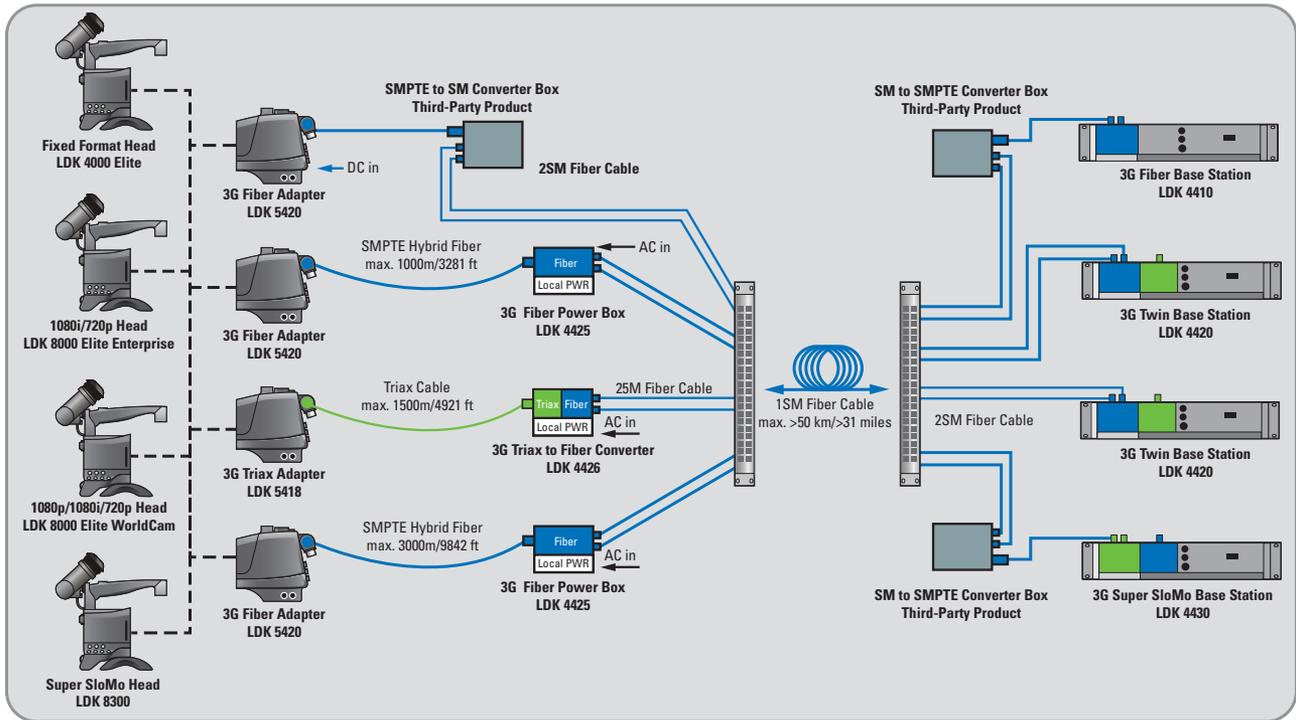


Figure 4 – 3G Transmission options using a combination of 3G Triax and 3G Fiber adapters.

# Camera Control

There is one more important point to consider, especially with long distance operations and/or the use of multiple cable combinations: full transmission diagnostic is essential.

With the LDK Connect Gateway (Figure 5), Grass Valley offers a unique solution for local and remote diagnostics of all camera systems in a production.

With a Wi-Fi extension, remote monitoring from a tablet or smart phone becomes possible.

The LDK Connect Gateway also provides digital serial tally control from all current Grass Valley production switchers and allow for third-party control integration into the C2IP camera control network.

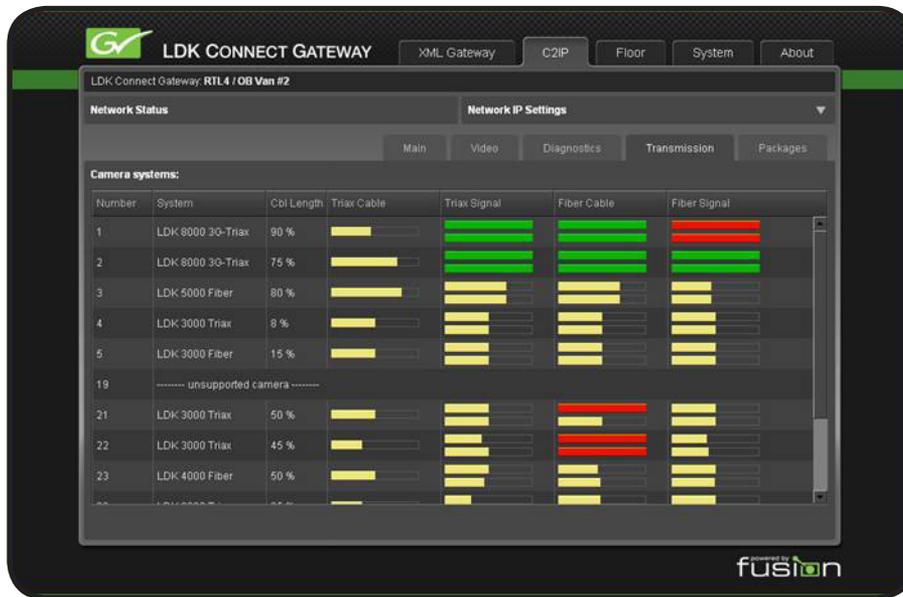


Figure 5 – The LDK Connect Gateway provides local and remote operational diagnostics.

## ABOUT GRASS VALLEY – THE PREMIER VIDEO TECHNOLOGY SOLUTIONS COMPANY

With a rich history serving the broadcast and professional video industries, the Grass Valley name is synonymous with innovation, leadership, and performance. With a full range of products and services supporting many of the world's most high-profile live events, Grass Valley offers the most comprehensive portfolio of software, services and IT infrastructure. Customers deploying Grass Valley solutions include most of the world's leading broadcast and teleproduction IT facilities, independent video professionals, as well

as emerging content creators and distributors providers of broadband, telecommunications, and transmission services. When you're watching news, sports, or entertainment programming, whether on a TV, the web, or a mobile phone, you're watching Grass Valley at work in the connected world.

For information about Grass Valley products, please visit [www.grassvalley.com](http://www.grassvalley.com).

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