Extending the Distance between a Camera and the Controlling Host System

Technical Application Note TAN2008009
Revised November 5, 2012

1.1 Subject

Technical Application Note (TAN2008009): Extending the Distance between a Camera and the Controlling Host System

1.2 Applicable Product(s)

- All FireWire (IEEE1394) digital imaging cameras

1.3 Application Note Description

The purpose of this Technical Application Note is to describe and compare options for extending the length between Point Grey FireWire cameras and a host controller. A section on USB is also included.

1.4 Introduction

A variety of configurations are available for extending the distance between Point Grey cameras and host controllers beyond the maximum recommended 4.5-meter cable length specified by the IEEE-1394 standard. Depending on how far from the host system you want to mount your camera, the following components can be used to configure a solution:

- Standard 4.5-meter cable
- 10-meter cable
- Multiple cables connected to repeaters
- Category 5 cables connected by Point Grey Long Distance Repeaters (LDRs)
- Category 5 cables connected by repeaters from outside vendors
- Optical cables connected by repeaters

In the following section, each solution is compared for speed, distance, and cost. The remainder of the article explains the solutions in more detail and provides information about how to obtain parts.

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1.5 Solution Comparison

The table below summarizes the solutions for camera-to-host extensions at different distances. Following the table, each solution is described in more detail.

Max Distance	Solution	Max Speed	Total Cost (Approx.)	Cost Breakdown
4.5 meters	9-pin shielded twisted pair copper cable	800 Mbps	N/A	Cable: No extra cost; included with camera development kit
10 meters	9-pin shielded twisted pair copper cable	800 Mbps	US$75	Cable: US$75
30 meters	Externally-powered repeaters daisy chained with 10m IEEE-1394 cables	800 Mbps	US$623	Repeaters: US$149/ea x 2 Cables: US$75 x 3 Power supplies: US$50 x 2
36 meters	Externally-powered repeaters daisy chained with 4.5m IEEE-1394 cables	800 Mbps	US$1593	Repeaters: US$149/ea x 7 Cables: US$25 x 8 Power suppliesUS$50 x 7
74 meters	Category 5 cable connected by a pair of Newnex FireNEX-CAT5 S400 repeaters	400 Mbps	US$690	Repeater (1 pair): US$525 Cables: Approx. US$75 (65m Cat 5) + add'l 4.5m cable (US$25) Power supplies: US$ 50/each
109 meters	Category 5 cable connected by a pair of Point Grey long distance repeaters (LDRs)	800 Mbps	US$474	Repeater (1 pair): US$299 Cables: Approx US$100 (100m Cat 5) + add'l 4.5m cable (US$25) Power supplies: US$50/each
109 meters	Category 5 cable connected by a pair of Newnex FireNEX-CAT5 repeaters	100 Mbps	US$540	Repeater (1pair): US$350 Cables: Approx US$100 (100m Cat 5) + add'l 4.5m cable (US$25) Power supplies: US$50/each
218 meters	Two pairs of daisy-chained Point Grey LDRs, each pair connected by Category 5 cable	800 Mbps	US$998	Repeaters (2 pair): US$598 Cables: Approx US$200 (2 X 100m Cat 5) + add'l 4.5m cables (US$25/each) Power supplies: US$50/each
509 meters	Glass optical fiber cable connected by a pair of Newnex FireNEX800 optical repeaters	800 Mbps	US$1438	Repeater (1pair): US$798 Cables: $550 (500m optical) + add'l 4.5m cable (US$25) Power supplies: US$50/each

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1.5.1 4.5 Meter Solution

The maximum recommended distance for connecting to an IEEE-1394a and 1394b device is 4.5 meters. As part of their development kits, most Point Grey cameras ship with a 4.5-meter cable. Additional 1394a and 1394b cables can be purchased directly from Point Grey Research through our FirePRO™ line of accessories.

Description	Part Number	Address
4.5 meter IEEE-1394b cable	ACC-01-2006	http://www.ptgrey.com/products/firepro/index.asp
Oki high flex IEEE-1394b cable	ACC-01-2012	

1.5.2 10 Meter Solution

Point Grey Research provides a 10-meter cable for covering a longer distance between 1394b devices beyond the standard 4.5 meters.

Description	Part Number	Address
10 meter IEEE-1394b cable	ACC-01-2017	http://www.ptgrey.com/products/firepro/index.asp

Point Grey Research does not account for the reliability of cables that are longer than 4.5 meters, and which are not sold directly by us. Long cables from external vendors may result in unpredictable performance.

1.5.3 30-36 Meter Solutions

You can use repeaters with 1394 cables in a daisy chain for coverage beyond 10 meters. If 10-meter cables are used, we recommend using a maximum of two repeaters, which allows for three cables, or 30 meters. If 4.5-meter cables are used, the 1394 specification allows for 16 cables to be daisy chained for a maximum length of 72 meters. However, we recommend that the number of repeaters not exceed seven, which allows for eight cables, or 36 meters. As indicated by the chart in Section 1.5, this solution can become costly and impractical as the number of hops increases.

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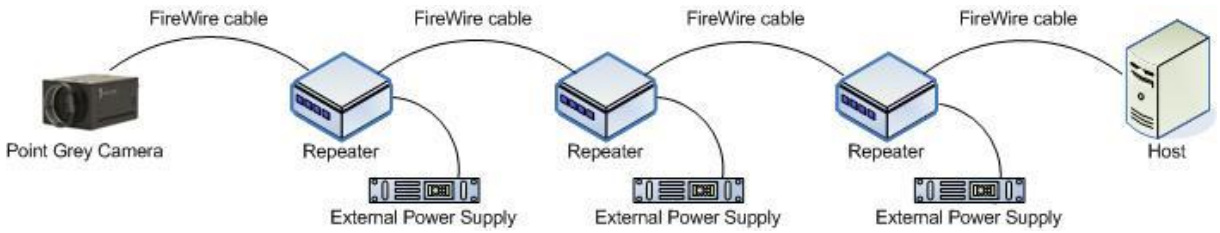

An external power supply is not always necessary when using only a single repeater. However, to ensure adequate power to the camera, we recommend powering the repeater in all cases with an 8-30 volt AC-to-DC external power supply (ideal voltage is 12V). Consult your camera's Technical Reference or Getting Started Manual for individual camera power requirements.

Point Grey Research sells the following 1394b repeaters and power supplies. Note that the 2-port repeater does not accept external power.

Description	Part Number	Address
2-port IEEE-1394b repeater*	FWB-HUB-2PORT	http://www.ptgrey.com/products/firepro/index.asp
3-port IEEE-1394b hub	FWB-HUB-3PORT	
5-port IEEE-1394b hub	FWB-HUB-5PORT	
RoHS 12V 1.25A (15W) Wall Mount Power Supply	ACC-01-9010	
RoHS 15V 2.7A (40W) Desktop Power Supply	ACC-01-9002	
RoHS LD2 24V 2.5A Wall Wart Power Supply	ACC-01-9001	

* The 2-port repeater does not accept external power.

For more information about powering the camera, maintaining a connection, or using repeater-hubs to connect multiple cameras to a single host controller, consult the applicable knowledge base articles in Section 1.8 Related Knowledge Base Articles, below.

1.5.4 74 Meter Solution

For distances beyond 36 meters, you may find solutions with other vendors. For example, a pair of Newnex FireNEX-CAT5 S400 repeaters claims to work with a 65-meter Category 5 cable, but at a 1394a data rate of 400 Mbps. These devices are configured in a manner similar to what is described in the following section. With the addition of two 4.5-meter cables connected to the camera at one end and the host at the other end, the total distance is 74 meters.

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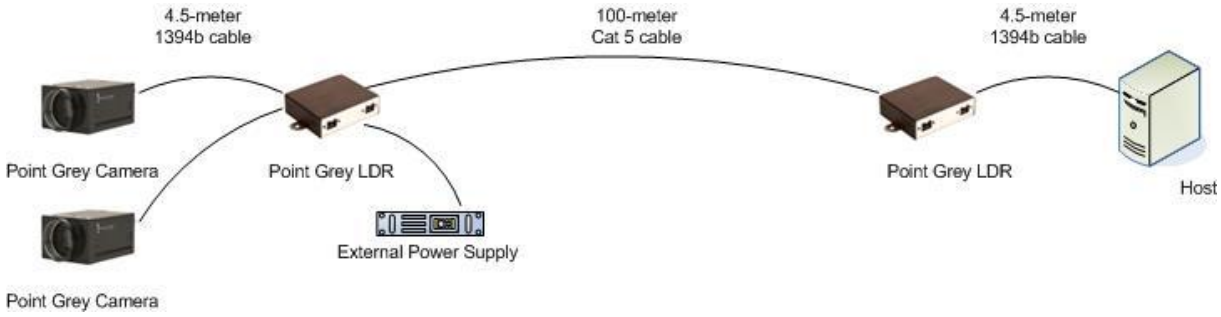
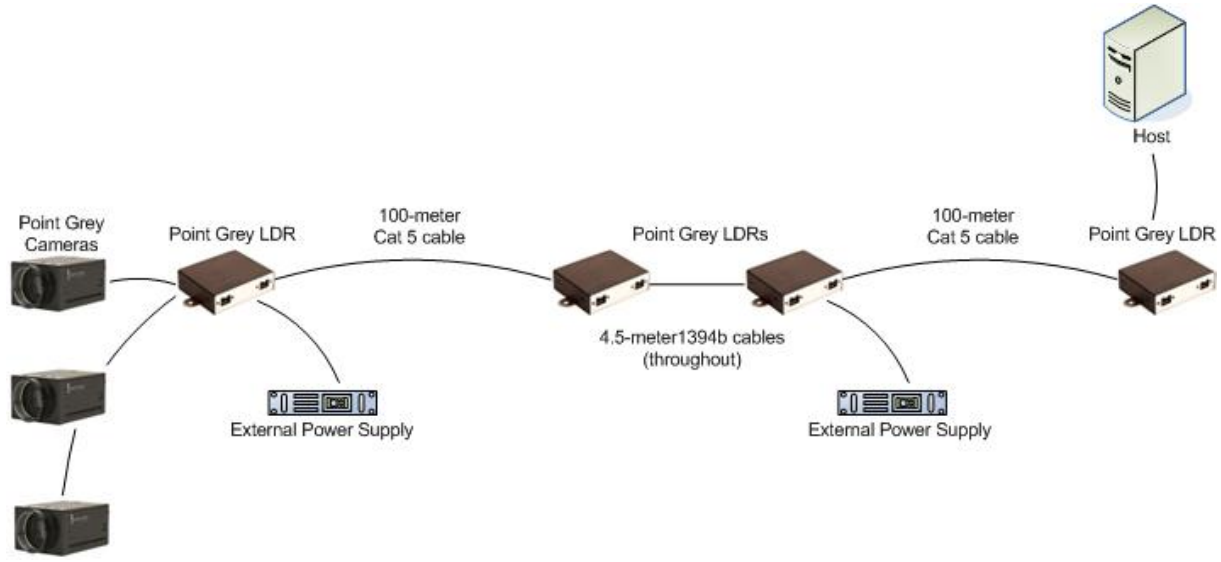
1.5.5 100 Meter and Longer Solutions

To cover a 100-meter distance, Point Grey Research offers Long Distance Repeaters (LDRs), which connect to a Category 5 cable, and provide an 800Mbps rate across the full distance. The LDR has two ports to support a pair of cameras or a camera array. To ensure adequate power to the camera, we recommend powering the LDR that connects directly to the camera with an 8-30 volt power supply. A pair of LDRs must connect directly to each other. Routing an LDR through a switch device is not supported.



In addition to the configuration above, Point Grey has successfully tested daisy-chaining two pairs of LDRs, connected by a 4.5-meter cable. The LDR furthest from the host system supported three Grasshopper cameras (two cameras daisy-chained). This configuration, shown below, can cover a maximum distance of 218 meters.



The LDR is available directly from Point Grey Research. As indicated by the chart in Section 1.5, it is a cost-effective solution for achieving a 1394b data rate over a long distance.

Description	Part Number	Address
2-port Long Distance Repeater	FWB-LDR-CAT5	http://www.ptgrey.com/products/firepro/index.asp

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An even longer solution may include a pair of optical repeaters, connected with an optical cable. The Newnex FireNEX800 optical repeater claims to work up to 500 meters, and retails for US$ 798.

1.6 Synchronization Considerations

The devices described in this Technical Application Note do not interfere with the ability of multiple Point Grey cameras to auto-synchronize. For more information about auto-synchronization, consult your camera's *Technical Reference Manual*.

1.7 USB Cameras

The maximum cable length between any USB node (e.g. camera to USB, USB to hub, etc.) is 5.0 m, as indicated by the USB specification. For more information about extending distances between USB cameras and host systems, refer to this FAQ on the usb.org website.

1.8 Related Knowledge Base Articles

Article	Title	Address
140	Using PGR IEEE-1394a cameras with 1394b Open Host Controller interface cards	http://www.ptgrey.com/support/kb/index.asp?a=4&q=140
193	Maximum suggested IEEE-1394 cable lengths	http://www.ptgrey.com/support/kb/index.asp?a=4&q=193
292	Factors to consider when designing a multiple FireWire camera array	http://www.ptgrey.com/support/kb/index.asp?a=4&q=292
295	Providing power to Point Grey Research cameras	http://www.ptgrey.com/support/kb/index.asp?a=4&q=295

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1.9 Additional Downloads and Support

Point Grey Research Inc. endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the Support section of our website.

Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name and email address. To apply for a Customer Login Account go to the Downloads page.

Knowledge Base

Our Knowledge Base contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

Product Downloads

Customers with a Customer Login Account can access the latest software and firmware for their cameras from our Downloads page. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Contacting Technical Support

Before contacting Technical Support, have you:

1. *Read the product documentation and user manual?*
2. *Searched the Knowledge Base?*
3. *Downloaded and installed the latest version of software and/or firmware?*

If you have done all the above and still can't find an answer to your question, contact our Technical Support team.

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