S1600 1394b at 1.6 Gigabit/Second Bandwidth Encourages Industrial Imaging and Instrumentation Applications Growth

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Virtually all but the most basic Personal Computers produced today are now able to support 800 Megabit/second (S800) 1394b hosts and devices. Early commercial 1.6 Gigabit/second (S1600) 1394b host adapters, devices and development tools have been available for almost six months now. The introduction of S1600 1394b can enable higher resolution industrial cameras or industrial cameras for industrial imaging with significantly higher frame rates, which has benefited this market, which is driving higher speeds. Both advantages are critical to improving industrial efficiency and capability. Yet another advantage: 1394b at 1.6 Gigabits/second bandwidth enables doubling the number of daisy-chained S800 cameras by simply replacing the S800 host adapter with an S1600 host adapter. Early test results of the ability of today's PC's to support S1600 1394b hosts and devices are excellent, and applications are expanding.

S1600 – Now a Mature Technology

The IEEE 1394b-2008 specification defines the electrical and functional requirements to manufacture S1600 (1600Mbits/sec) products. This is exactly twice as fast as S800 1394b and approximately 60% faster than gigabit ethernet. As defined, S1600 devices and hosts are backward compatible with S800 devices, cables and connectors. Next generation S3200 host and device prototypes are also backward compatible and have been demonstrated by DAP Technology at the 2012 Vision Show and are defined in the IEEE 1394-2008 specification but will not be evaluated in this article.

S1600 PCI-Express generation-1 host adapters (HAC1600) are commercially available from DAP Technology as well as an S1600 bus analyzer (FireSpy 1600). S1600 cameras are commercially available from Sony (XCDMV6) and have been prototyped by Point Grey Research. S3200/S1600b/S800b products utilize AC-coupled high speed interfaces and can easily be implemented with mature FPGA's, for example Xilinx Spartan 6 FPGA's. Expensive, bleeding edge technology is not required to implement S3200/S1600 1394b products. In addition, AC-coupled interfaces are historically more immune to electrical interference and to late-VG events than DC-coupled interfaces.

Experimental Set-Up

A DAP Technology HAC1600 host adapter and a Point Grey Grasshopper Express GX-FW-28S5C-C camera (black and white) were used in these tests. The S1600 camera was directly connected to the S1600 host adapter. Two different PC's were used in these tests, a dual Intel XEON X5355 (quad) (2.66GHz) PC (Windows 7 32-bit, 8gb of RAM) and a dual core AMD (3.3GHz) based PC (Windows 7 64-bit, 4GB of RAM). Point Grey FlyCapture 2 (version 2.5.1.2) software was used to configure the S1600 camera and Windows 7 Resource Monitor was used to measure the S1600 CPU load and memory utilization. Figure 1 shows the enumeration screen for the Point Grey Grasshopper Express GX-FW-28S5C-C S1600 camera.

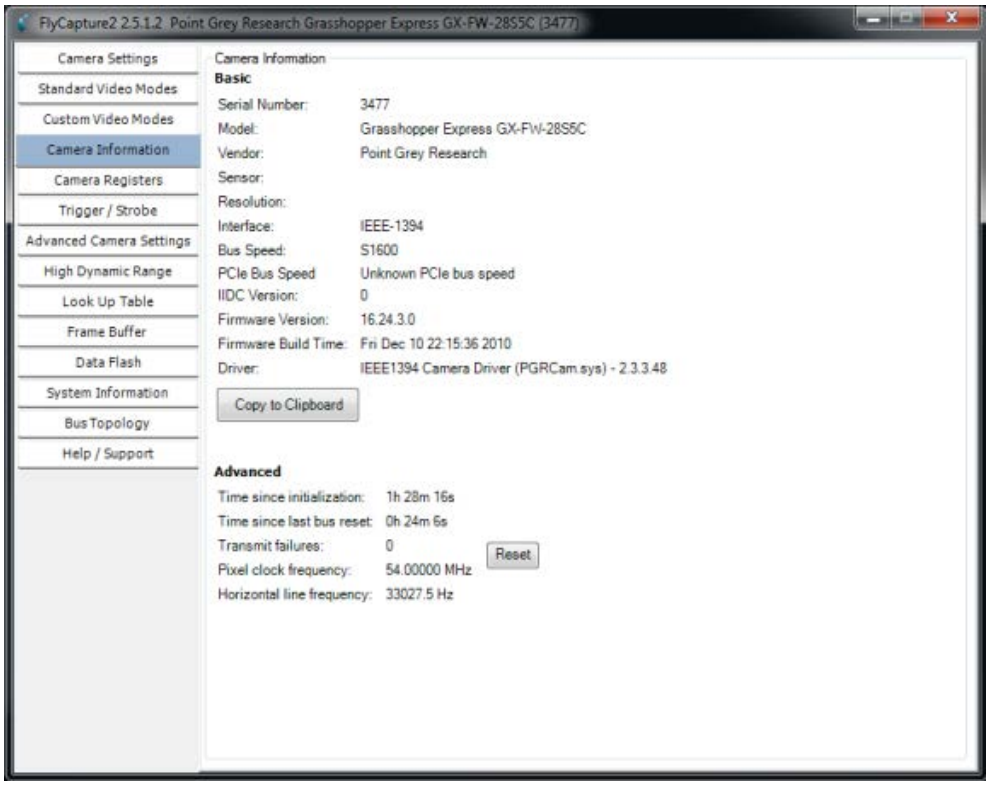

Figure 1 Point Grey Grasshopper Express GX-FW-28S5C-C S1600 Camera Detection

The CPU load rate was measured at two different S1600 camera resolutions: 800 by 600 pixels and 1600 by 1200 pixels. For both resolutions the frame rate was slightly more than 30 frames per second (fps) and 8-bits per pixel. The amount of physical memory used in each case was also measured, but did not saturate either PC.

Test Results

As a kind of sanity test, the HAC1600 adapter card was tested with the PCI-Sig PCI-Express compliance test application (version 1.4.6.0) and passed with 4 minor errors (for example, sub-sys ID, serial number).

The S1600 host adapter driver, camera driver and camera configuration software loaded successfully with no issues on both Intel and AMD PCs running Windows 7 (both 32-bit and 64-bit). Figure 2 shows Windows 7 Device Manager with both the S1600 camera and S1600 host enumerated successfully in the Intel PC.

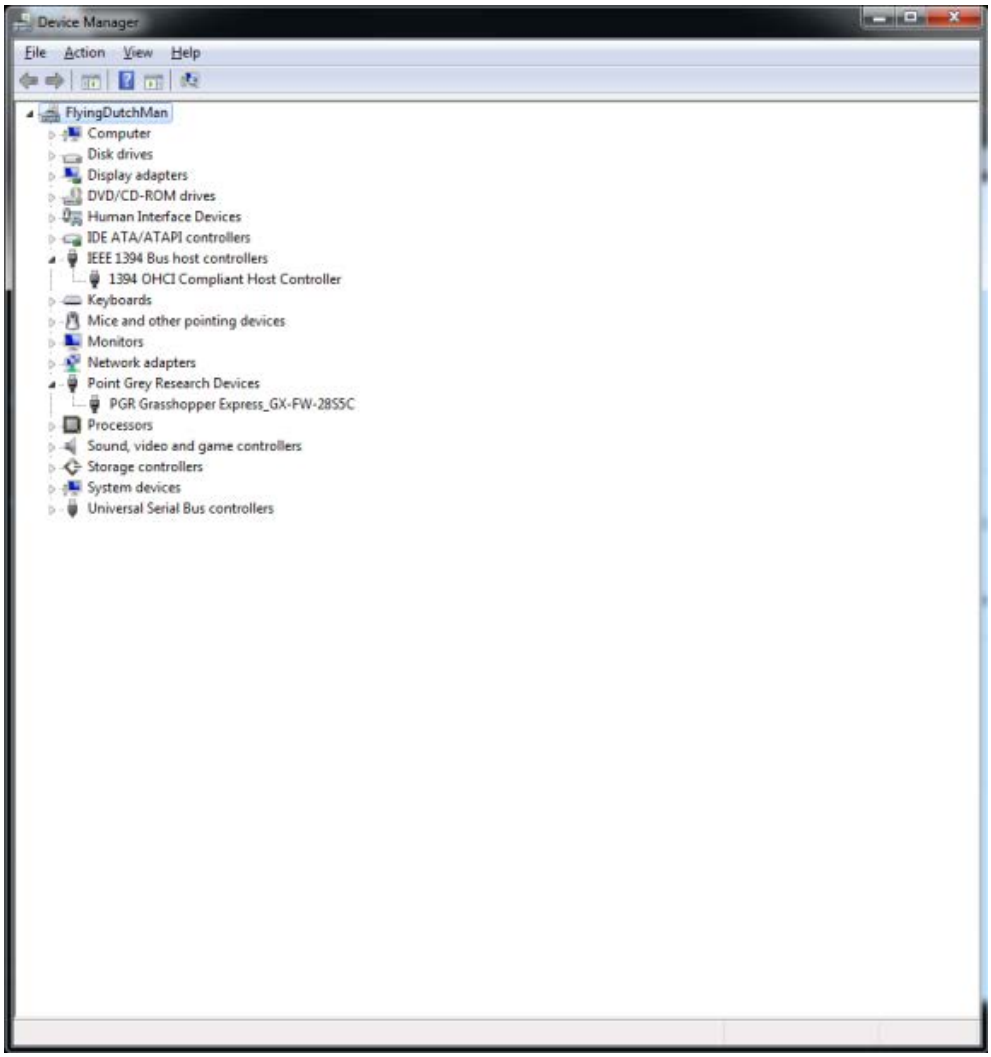

Figure 2 Windows 7 Device Manager with Congifured S1600 Host and Device

800 by 600 Pixel Video Resolution Results

The default setting for the Point Grey FlyCapture software is 800 by 600 pixel resolution and 30 fps. Figures 3 and 4 below show the FlyCapture image/settings and Windows 7 Resource Monitor output for the Intel PC.

Intel based PC 2.2% average CPU load

AMD based PC 3.5% average CPU load

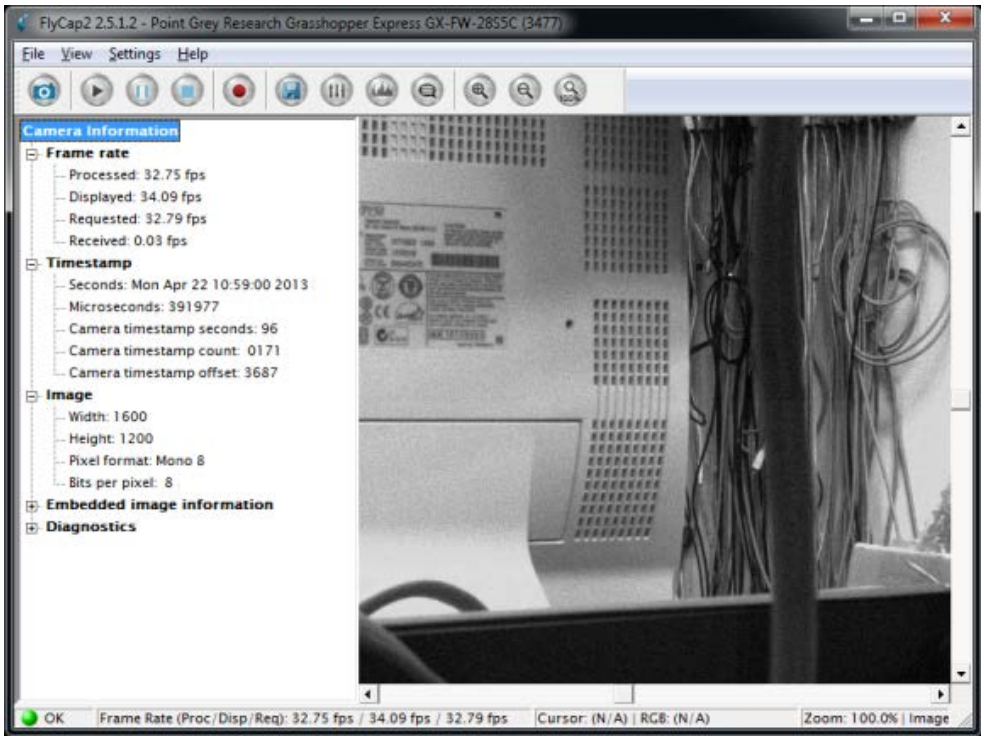

Figure 3 FlyCapture Preview Image on Intel PC, 30 fps, 800 x 600 pixel resolution

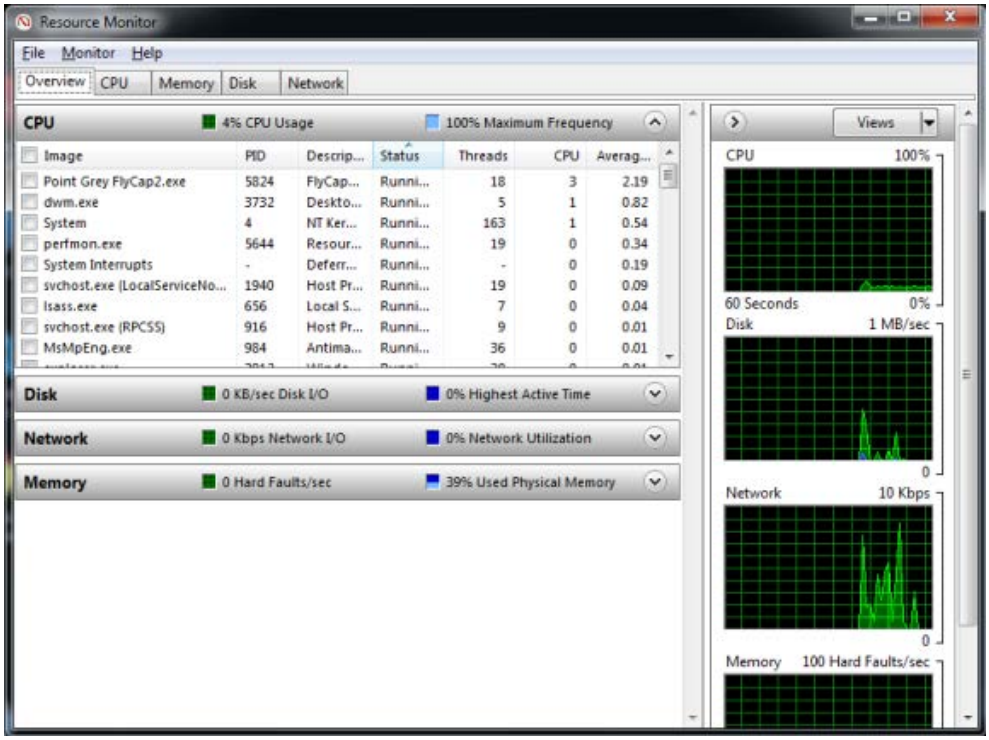

Figure 4 Windows Resource Monitor, Intel PC, 30 fps, 800 by 600 pixel resolution

1600 by 1200 Video Resolution Results

The Point Grey FlyCapture software easily allowed the resolution to be increased to 1600 by 1200 pixel resolution. Figures 5 and 6 below show the FlyCapture image/settings and Windows 7 Resource Monitor output for the AMD PC.

Intel based PC 4.6% average CPU load

AMD based PC 8.7% average CPU load

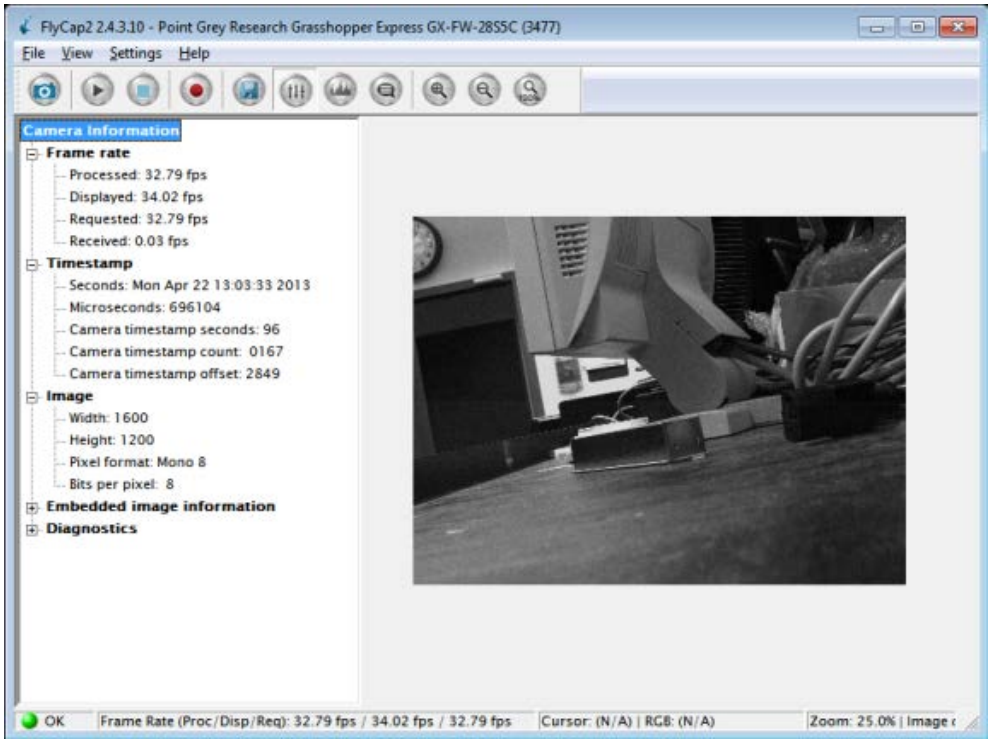

Figure 5 FlyCapture preview Image on AMD PC, 30fps, 1600 by 1200 pixel resolution

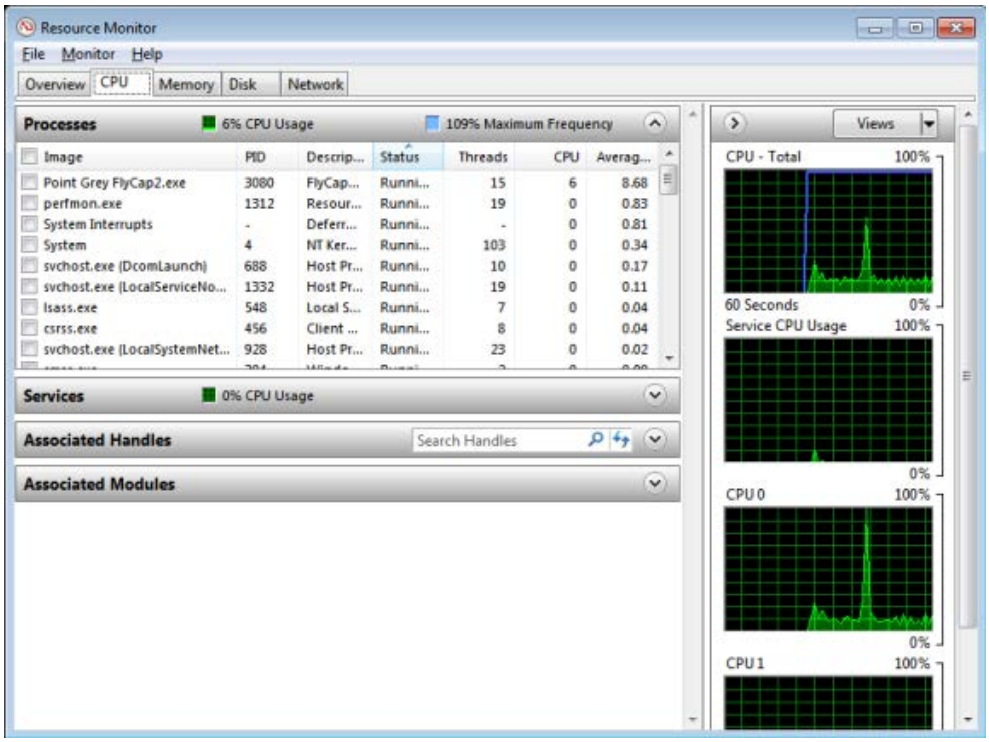

Figure 6 Windows Resource Monitor, AMD PC, 30fps, 1600 by 1200 pixel resolution

In all cases the CPU load was less than 10%, an almost negligible additional load for current production PC's. Therefore S1600 1394b host adapters and devices will provide a positive user experience on production PC's today. Not surprisingly, across the board, the average CPU load was lower with the 8-core Intel XEON PC compared to the 2-core AMD PC. While not tested for this report, the Sony XCDMV6 S1600 1394b camera has been used in numerous trade show demonstrations and has proven compatible with the HAC1600 host adapter and Windows 7.

As for future efforts and priorities, since more S1600 cameras are available, it will be valuable to test networks of multiple S1600 cameras on an S1600 host adapter.