

Firewire Camera support for Epics

What is 'Firewire'

- IEEE1394 or 'firewire' is a high speed serial bus
- Up to 400 Mbit/sec
- Twisted pair media
- Multiple devices on a bus
- Up to 10m between devices or repeaters
- Longer at slower speed
- Standard on most new PCs

Differences to USB

- Not 'PC centric' – multiple or no PCs possible
- Guaranteed bandwidth (Important for video)

Firewire for Cameras - DCII

- Well defined high level protocol over firewire
- Supported by many cameras
- Low end (\$80) to high performance industrial
- Protocol includes support for triggering, ROI etc.

Firewire for Linux

- Very good support
- www.linux1394.org
- Support included in newer kernels ($\geq 2.4.18$)
- Many applications available
- Library (libdc1394) for writing your own applications

Firewire for VxWorks

- Hardware available as PMC or PCI card
- PMC is standard on Motorola PPC processors
- Multiple firewire PMC vendors (Mindready, SBC, technobox, Synergy, ...)
- VxWorks drivers and libraries from Mindready
- But Mindready software quite expensive

Firewire for Epics

- Device support written for Linux
- Uses libdc
- Provides
 - Camera control
 - Image acquisition
 - Analysis

Analogue Inputs

- brightness, exposure, gain
- NumNodes, numCameras,
- height, width, hoffset, woffset, size
- xp, yp – image center position
- xw, yw – image width
- xsn, ysn – signal/noise ratio

MBBI

- mode
- format (Mono, RGB, YUV, depth,size)
- framerate

Analogue Outputs

- set_height
- set_width
- set_hoffset
- set_woffset
- set_gain*
- set_exposure*

MBBO

- set_mode*
- set_format*
- set_frame Rate*

Waveform

- data – raw image
- xdist – sum of each column
- ydist – sum of each row

DB file

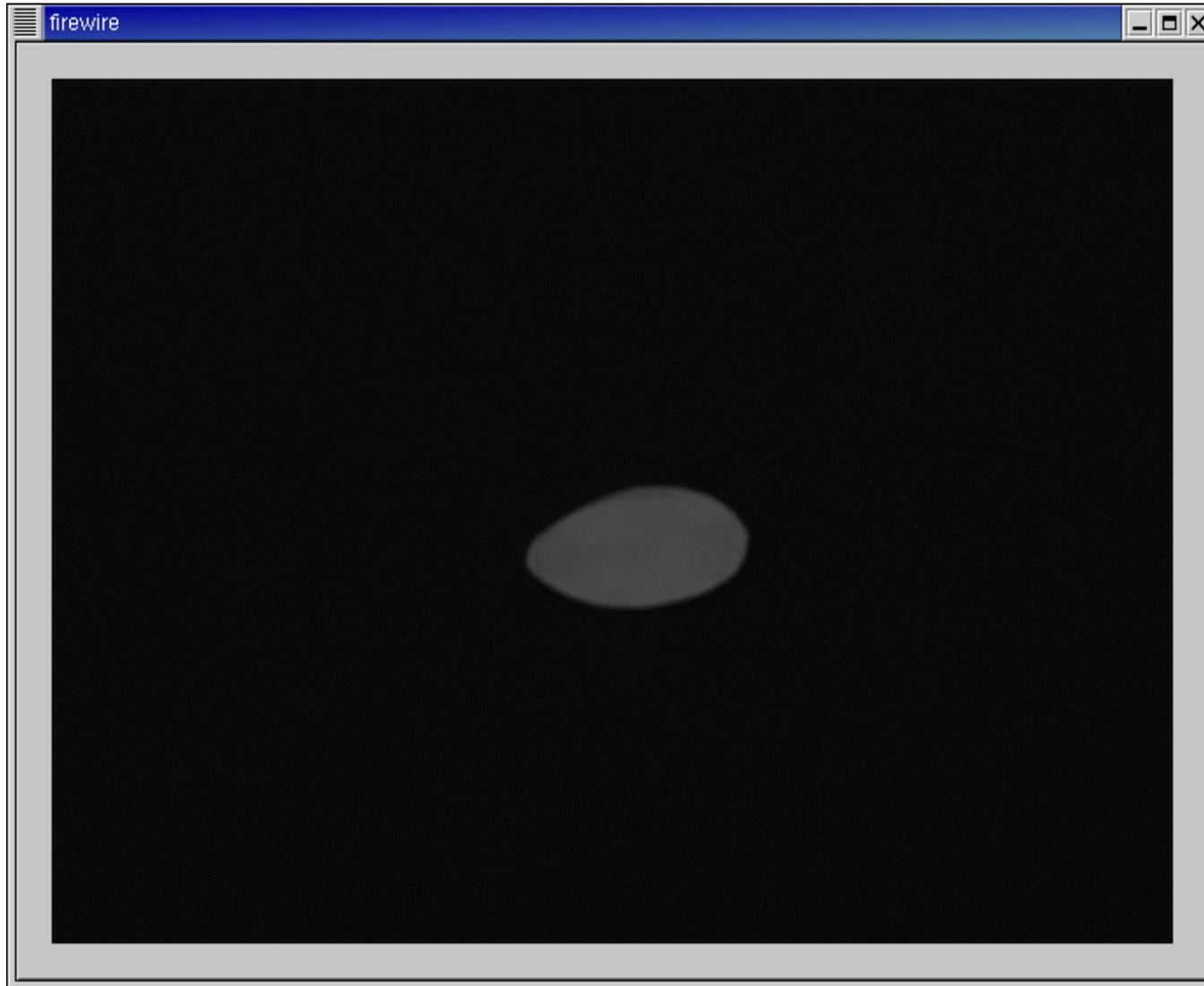
```
record(waveform,"camera1:data"){  
    field(SCAN, ".1 second")  
    field(DTYP, "1394")  
    field(INP, "#C0 S0 @data")  
    field(NELM, "1000000")  
    field(FTVL, "UCHAR")  
}
```

- For waveforms set NELM to max possible value, driver will adjust to actual size
- Param selects what to return (data, xdist, xp, etc...)

Image display CA client

- X application
- Resizes as image width and height changes
- 10Hz update 640x480 mono uses ~5% of 2.4G P4
- Writing image to screen takes ~10mS

X client



Cameras Tested

Vendor cost	Model	Col	dep	res		fs	trig
Unibrain	FireI	m/c	8	640x480	30	n	\$80
Point Grey	Flea	m	8	1024x768	30	y	\$800
Basler	A302S	m	8	782x582	30	y	

Radiation resistance

- Tests done at SRS booster and NRPI
- All cameras worked up to 100 Gy
- Repeater worked > 7000 Gy

Problems encountered (minor)

- Lack of documentation of libdc (read the .h file)
- CA manual (3.14.4) does not match example made by makeBaseApp
- Video1394 kernel module (needed for dma mode) did not work on our installation – needed kernel >2.4.21

Further Work

- Support all modes
- Read status while acquisition running
- Change format while acquisition running
- DMA mode to improve speed
- Interrupt not periodic scan
- Image record support (for 3.13 clients)
- Auto support for 16bit X servers

Advantages

- Beam position, width, quality can be alarmed/archived as well as displayed
- Reduced network traffic
- Does not rely on operator
- No extra electronics required for triggering or image conversion

Example Applications

- Auto beam alignment
- Injection optimization
- Pinhole array analysis
- emittance measurement
- Auto sample centering
- ???