CCD's "most recently" used at ESO

CCD TYPE	DIMENSION/ # OUTPUTS	PIXEL SIZE	SPEED PER PORT kilopixels/ second	NOISE e^-	INSTRUMENTS
Tektronix/SITe	2k x 2k / 4 outp	24 µm	50	4.1	FORS 1 and 2 VLTTC 1
MIT/LL CCID-20	2k x 4k / 2 outp	15 µm	50-1000	1.9 @ 100 kps 3.4 @ 225 kps 5.5 @ 625 kps	UVES red (mosaic with EEV 2k x 4k) ? GIRAFFE (mosaic of 2) [in 2000]
EEV CCD44-82	2k x 4k / 2 outp	15 µm	50-1000	2.7 @ 100 kps 4.7 @ 350 kps 5.8 @ 625 kps	SUSI 2 (mosaic of 2) @ NTT FEROS @ 1.52 m WFI (mosaic of 8 + 1 tracker) @ 2.2m EFOSC 2 @ 3.6 m UVES blue UVES red (mosaic with MIT/LL 2k x 4k) CES @ 3.6m [in 1999] VLTTC 2 [in 1999] VIMOS (mosaic of 4) [in 1999] ? GIRAFFE (mosaic of 2) [in 2000]
EEV CCD50	128 x 128 / 16 outp	24 µm	50-1000		NAOS [in 1999]
	16k x 16 k / 32 outp		50-1000		OMEGACAM @ VST [in 2001]
	4k x 4k / 4 outp	15 µm	50-1000		HARPS @ 3.6 m [in 2000]
Philips	7k x 9k / 16 outp	12 µm			

Instrument and CCDs

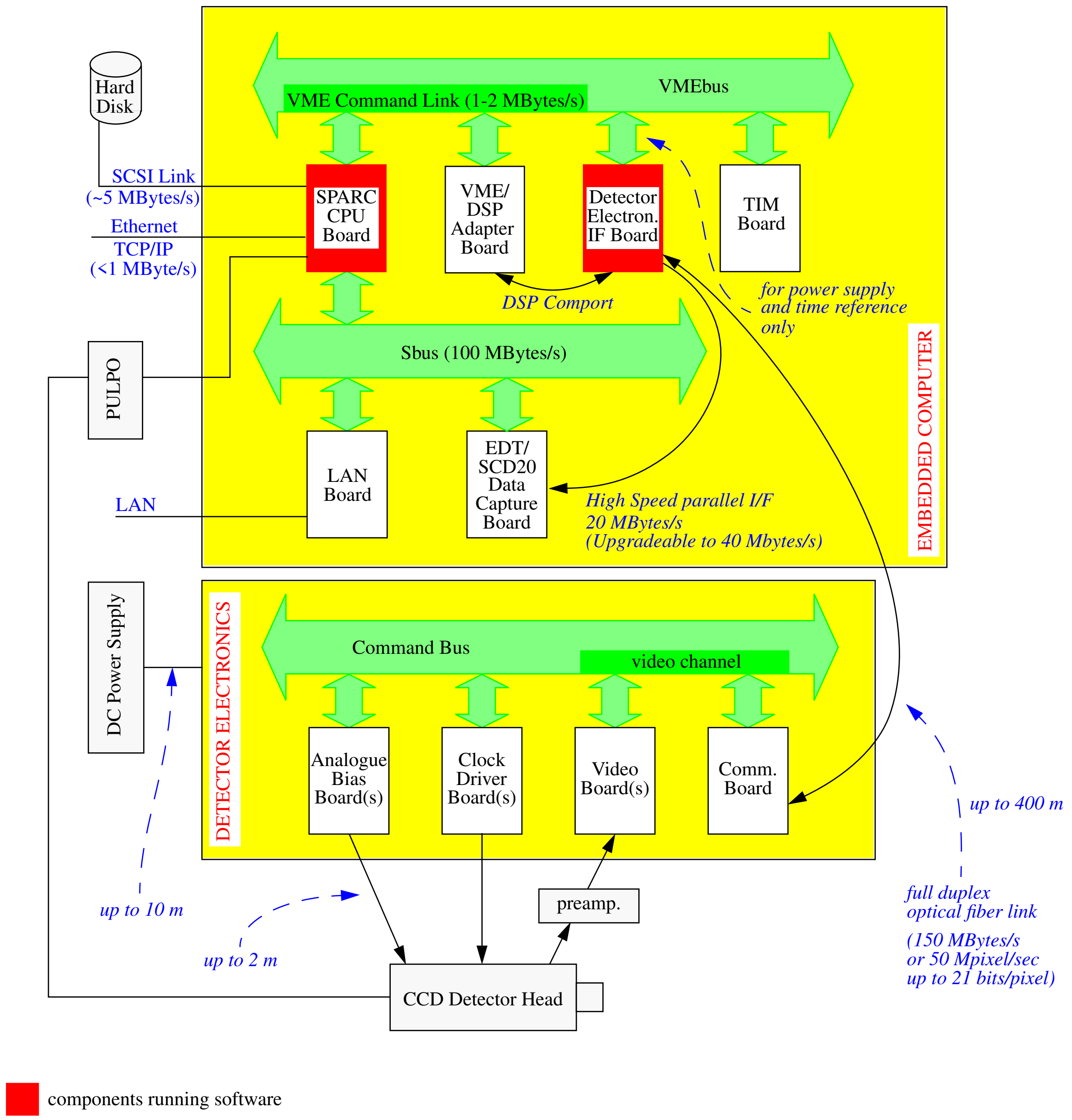
- Instrument Delivery Summary in 1998-2001:
  - ☞16 Instruments
  - ☞16 Controllers
  - ☞31 CCD's + 16k x 16 k

- Instrument Requirements:
  - Imagers are satisfied with reasonable noise - less that 5 e^- - but would like high speed
  - Spectroscopy requires noise less than 2 e^-
  - high speed acquisition : "time is money"

FIERA CCD Controller Philosophy

- A single controller for all future CCDs and Mosaics, both for Optical and Adaptive Optics systems
- Controller must not constrain the performance of the CCD (1 e^- @ 1000 kps soon ?)
- Design life of > 10 years
- Built from industry standard components
- Modular, extensible, adaptable
- Operate "standalone" when needed, but fit seemlessy with the VLT control system

FIERA Hardware Architecture



FIERA Software Description - 1

- Features:
  - CCDs and mosaics:
    - in image size: from a single 128 x 128 to the 16k x 16k
    - in outptus: from 1 up to 32 ports
    - in speed: from 50 to 1000 kpixel/sec/port
  - Possibility to control two different cryostats and shutters from one FIERA Controller
  - Readout:
    - Full Frame
    - Windowed 1 or 2 disconnected
  - Image Processing:
    - Statistics Extrema, RMS
    - Centroid Centroid, FWHM
    - Image Quality
  - Image Transfer & Display:
    - Transfer to WS A-/Synchronous
    - Display configurable 1 out of N via RTD
    - Storage idem above in FITS format (Image Extension)

FIERA Software Description - 2

•Real-time response:

Response time	Implemented in	Type of function
nanosec.	Detector head electronics microsequencer	Clocking of individual CCD lines
microsec.	Embedded computer DSP's	Sends commands to microsequencer (e.g., shift a line on CCD, read a line of pixels ...)
millisec.	Embedded computer SPARC	Image acquisition, image reordering and processing (centroiding), exposure coordination
sec.	Instrument Workstation	Interface to the VLT control System, Observation handling and scheduling, Instrument supervision

•Documentation:

- "FIERA CCD Controller - Software User Manual", VLT-MAN-ESO-13640-1388 (ftp://te1.hq.eso.org/vlt/pub/doc/fiera_sum<ver.num>.ps.gz)

INS/DCS Interface Overview

SETUP Files :

- Exposure time, type (Dark, Normal), Window definitions, Readout "mode" ...

Commands :

- SETUP, START, PAUSE, ABORT ...

Online Database :

- Exposure Status, Transmission Status, Image Processing Results, Telemetry, ...

RTD data :

- New data available for display
- Image coordinates

FITS Files :

- FITS Standard Keywords
- FITS Hierarchical Keywords
- Raw Image Data optionally organised in Image Extension per output

Messages:

- log and error messages
- alarms

Working with a CCD

All the details for the FIERA System configuration on both the INStrument workstation and the SLCU are in the "Installation Guide" of the "FIERA Software User Manual"

•RTAP environment

Edit the files

```
    $VLTDATA/ENVIRONMENTS/$RTAPENV/dbl/DATABASE.db
    $VLTDATA/ENVIRONMENTS/$RTAPENV/dbl/USER.db
```

Make databases of both WS and SLCU environments and start them.

•Detector Environment

Set the environment variables RTAPENV, CCDNAME, CCDLENV, INS_ROOT appropriately:

•installation

```
-> mkdir $INS_ROOT
-> fcdInstall.sh fcdSci<CCD>.dbcfg
-> fcdDcsSetLogMask.sh $CCDNAME $RTAPENV <MASK>
-> fcdDcsScan.sh
```

Operating from an Application

•Startup/Shutdown

- `fcdDcsStart.sh / fcdDcsStop.sh`
- `INIT / STANDBY / ONLINE / OFF / EXIT`

•Setup

- ```
  SETUP  [-expId -1|0]
         [-file <filename>]
         [-function <fct par>[,<fct par>]*]
  ```

•Exposures

- `START`
- `STOP, END, ABORT`
- `WAIT [[0|expId][,Global|Single]]`

•Telemetry

- `STARTTL / STOPTL`

NOTE: All the commands are addressed to the fcdconCI_$CCDNAME process running on the INStrument workstation.
  ```

Example of Operation

Start the system:

```
fcdDcsStart.sh [$CCDNAME $RTAPENV $CCDLENV $INS_ROOT]
msgSend $RTAPENV fcdconCI_$CCDNAME ONLINE “”
```

Start some exposures with different binning factors:

```
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-file fcdSetupComplete.det”
msgSend $RTAPENV fcdconCI_$CCDNAME START “”
msgSend $RTAPENV fcdconCI_$CCDNAME WAIT “0”
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.BINX 2 DET1.WIN1.BINY 2”
msgSend $RTAPENV fcdconCI_$CCDNAME START “”
msgSend $RTAPENV fcdconCI_$CCDNAME WAIT “0”
```

Start exposures with image processing:

```
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.MINMAX T”
msgSend $RTAPENV fcdconCI_$CCDNAME START “”
msgSend $RTAPENV fcdconCI_$CCDNAME WAIT “0”
dbRead “<alias>${CCDNAME}:images:process:window_1.ipMinVal”
dbRead “<alias>${CCDNAME}:images:process:window_1.ipMaxVal”
dbRead “<alias>${CCDNAME}:images:process:window_1.ipRMS”
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.MINMAX F”

msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.CENTROID threshold”
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.BACKGND 10”
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.THRMIN 100”
msgSend $RTAPENV fcdconCI_$CCDNAME START “”
msgSend $RTAPENV fcdconCI_$CCDNAME WAIT “0”
dbRead “<alias>${CCDNAME}:images:process:window_1.ipXCen”
dbRead “<alias>${CCDNAME}:images:process:window_1.ipYCen”
msgSend $RTAPENV fcdconCI_$CCDNAME SETUP “-function DET1.WIN1.CENTROID none”
```

Perform telemetry:

```
msgSend $RTAPENV fcdconCI_$CCDNAME STARTTL “”
dbRead “<alias>${CCDNAME}:telemetry.current”
msgSend $RTAPENV fcdconCI_$CCDNAME STOPTL “”
```

Exit:

```
msgSend $RTAPENV fcdconCI_$CCDNAME STANDBY “”
fcdDcsStop.sh [$CCDNAME $RTAPENV $CCDLENV $INS_ROOT]
```

Example of Log File

```
15:56:50>-START DET SOFW / CCD control sw started [wuvccdb]
15:56:50> DET SOFW ID = 'CCD Rev 2.42' / CCD control program name-version [wuvccdb]
15:56:50> DET SOFW MODE = 'Normal' / CCD sw operational mode [wuvccdb]
15:56:50> DET STATE = 'LOADED' / CCD sw state [wuvccdb]
15:57:37>-CHANGE DET STATE / CCD sw state change [wuvccdb]
15:57:38> DET STATE = 'STANDBY' / CCD sw state [wuvccdb]
15:57:53>-CHANGE DET STATE / CCD sw state change [wuvccdb]
15:57:54> DET STATE = 'ONLINE' / CCD sw state [wuvccdb]
15:57:54>/World Coordinates: Enabled [wuvccdb]
16:07:16> DET SHUT TYPE = 'Slit' / type of shutter [wuvccdb]
16:07:16> DET SHUT ID = 'ccd shutter' / Shutter unique identifier [wuvccdb]
16:07:24> DET TELE NO = 3 / # of sources active [wuvccdb]
16:07:24> DET TLM1 NAME = 'CCD T1' / Description of telemetry param. [wuvccdb]
16:07:24> DET TLM1 ID = 'CCD Sensor1' / ID of telemetry sensor [wuvccdb]
16:07:24> DET TLM2 NAME = 'CCD T2' / Description of telemetry param. [wuvccdb]
16:07:24> DET TLM2 ID = 'CCD Sensor2' / ID of telemetry sensor [wuvccdb]
16:07:24> DET TLM3 NAME = 'EBOX T' / Description of telemetry param. [wuvccdb]
16:07:24> DET TLM3 ID = 'Box Temp' / ID of telemetry sensor [wuvccdb]
16:07:31>-START DET EXP / Start exposure [wuvccdb]
16:07:31> DET EXP NO = 11 / Unique exposure ID number [wuvccdb]
16:07:32>-START DET CHIP WIPE / CCD start wipe action [wuvccdb]
16:07:36> DET CHIP WIPE STATUS = 'DONE' / CCD wipe completed [wuvccdb]
16:07:36>-OPEN DET SHUT / CCD shutter open [wuvccdb]
16:07:37>-CLOSE DET SHUT / CCD shutter closed [wuvccdb]
16:07:38>-START DET CHIP READ / start readout of CCD chip [wuvccdb]
16:09:53> DET CHIP READ STATUS = 'DONE' / CCD chip readout completed [wuvccdb]
16:17:46>-START DET TELE / Telemetry monitoring is active [wuvccdb]
16:17:46> DET TELE INT = 60.0 / Interval between two successive telemetry reading [wuvccdb]
16:36:37>-CHANGE DET STATE / CCD sw state change [wuvccdb]
16:36:45> DET STATE = 'OFF' / CCD sw state [wuvccdb]
```