MONSOON/Torrent Software

Adding automation to detector controller configuration and startup

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Where are we now
Baseline Information

- Torrent Systems are being run with "orange" software now. We could continue to configure Torrent systems by hand.
- **None** of the software being presented here is *required* to run Torrent hardware.
- This software will make Torrent systems safer, easier to use and simpler to configure, maintain and document.
Torrent Software Goals

to move from “orange” Configuration Tools like this:
To Torrent Configuration tools more like this:
Torrent Software Goals

1. Support the hardware in providing detector limited performance for image acquisition.
2. Use the same PAN & User software as MONSOON “orange” systems.
3. Minimize image acquisition process overheads.
4. Store the board calibration values in the DHE not on external media.
5. Store the focal plane attribute default values with the Dewar not on external media.
6. Automate the configuration, testing, calibration & optimization of Torrent focal planes.
7. To provide tools to:

- Automate the description of the hardware/firmware attributes/registers/functions and the connection of the user attribute-value pairs to the hardware functions.
- Automate the design & specification of Torrent controller configurations and documentation of Torrent controller configurations.
- Automate the startup & initialization of the MONSOON software when used with Torrent systems.
Achieving the Goals

1. Support detector limited observing
   - Readout speed determined by the science.
   - Detector clock and bias voltage can be changed at readout clock speeds (subject to electrical filter settling).
   - Readout sequences and exposure time can overlap data transfer to DHS.
   - Detector library can be custom designed to support complex operations required by detector or science.
2. Use the same software as the “orange” MONSOON ✔

- Pan processes and libraries used essentially unchanged. Two new gpx/ppx commands added to support hardware EEPROMs in Torrent.

- Currently running (E2V 4482) prototype systems, reviewCCD and basicCCD systems with the modified “orange” software.
3. Minimize image acquisition overheads.

- Can allow overlap of instrument configuration and Integration time with the data transfer to DHS.
- Setup times for complete change in observation parameters less than 2 secs. `startExp` command to integration start on order .25 secs.
- Data transfer DHE to PAN 1.25 secs for 4kx4k detector (32bit Pixels @ 50MBytes/sec) with no allowance for ADC and clocking delays. Total readout time for 4 output 4kx4k detector @ 150 kPix/sec <25 secs.
4. Store the board calibration values in the DHE not on external media.

- EEPROMs on AFE, LCB and PSM boards are loaded with calibration values during board testing.
- Torrent program “collector” reads configuration files and EEPROMs and constructs the system `.csv` file from this data.
- Faulty EEPROM values caught through CRC check on entire EEPROM. Additional error checking/correction could be added if deemed necessary.
- Allows swapping out a failed DHE controller and achieving identical performance from the new DHE controller.
5. Store the attribute default values with the Dewar not on external media!

- EEPROM on Transition module utility board is loaded with operating values during detector optimization
- “collector” reads TSM configuration file and EEPROM and constructs a DefaultSetup.mod file and a system SetVoltages.mod file
- Faulty EEPROM values caught through CRC check on entire EEPROM. Correct values can be obtained from a database if EEPROM not available.
6. Automate the configuration, testing, calibration and optimization of Torrent systems.

- Provide “sysConfig” tools to the system or detector engineer/scientist.
- Provide mborg test and focal plane optimization routines to do testing and calibration of boards and detector optimization.
- Keep track of, document configuration decisions and test & optimization results automatically.
7. Providing Automation Tools

- Automate the description of the hardware & firmware attributes, registers, functions.
  - “assimilate” an OO python program to read the VHDL source code files and produce system configuration files.
  - Assigns attributes to locations in module EEPROM memory space as needed.
  - Produces a template Config.csv file for testing.
  - Needs to be run once for each version of the FPGA firmware.
assimilate

FPGA Firmware Image
EEPROM Load Image

Torrent Firmware
Source Code Files

ISE .prj Project File
(list of source code used in FPGA)

Proprietary software
Synthesizes Firmware
version
7. Providing Automation Tools

• Automate the design & specification of Torrent controller configurations.
  – “sysConfig” tools – arrayDesc, fclPlnDesc, dewarDesc, dheDesc and sysConfig
  – Run once while designing a focal plane system. Produces “System Configuration Document”.
  – Run again if something is changed, i.e. a new array is installed, a new firmware version is released.
  – Can be used to track and document changes to default value settings.
  – Can create modified GUI display for borg & mborg.
Torrent System Design and Configuration

sysConfig and its ancestors

Manufacturer's detector description an specs

Engineer's input

arrayDesc GUI program

Dewar design

Engineer's input

dewDesc GUI program

Array Descriptor File by ArrayID

Dewar Descriptor file by name

Engineer's input

fcpfDesc GUI program

Manufacturer's detector description an specs

Engineer's input

arrayDesc GUI program

Engineer's input

fileDesc GUI program

Engineer's input

Dewar Desc file by name

Engineer's input

fcpfDesc GUI program

Engineer's input

Dewar Desc file by name

Engineer's input

DHE hardware Design description

Engineer's input

DHE Desc GUI program

Dewar Desc file by name

DHE Desc file by SerialNo.
sysConfig Tools

These tools are used to define, document and track:

- arrayDesc – Gui based tool to describe an detector. Signal Names and Signal types for pins by designation. Signal nominal, min and max safe values.

- fclPlnPDesc - Gui based tool to describe a focal plane. Number, type, unique Identifier and position in focal plane for each detector in focal plane. Connection points for focal plane functions, temperature Sensors, heaters, etc.

- dewarDesc – Gui tool to describe a Dewar. Number and type of Connectors. Number of Pins in each connector. Name of each connector and pin.

- dheDesc - Gui tool to describe a DHE. Number, type and serial number of boards. Voltage settings for vHv+, vHv-, vCb+,vCb-, vAna+, vAna-, vBb for system. Names of connections for AFE signals and TSM utility board signals.
Pulling it all together

• “sysConfig” – a GUI engineer’s assistant.
  The engineer:
  – Selects the Focal plane, Dewar and DHE for system.
  – Connects the focal plane signals to Dewar connectors and then to DHE signals.
  – Selects default settings for focal plane attributes.
  – Prints a wire list for the ‘tech’ assembling the system.
  – Prints and stores the System documentation records.
  – Prints and stores a attribute default values Document.
  – Stores an TSM EEPROM mirror file
  – Creates a ucode sequencer source code template.
  – Can creates a GUI display file for borg or mborg
7. Providing Automation Tools

- Automate the connection of the user attribute-value pairs to the hardware descriptions.
  - "sysConfig" creates a system software.cfg file that is used by collector to assign user names to the hardware attributes.
  - "sysConfig" creates a system ucode Template to connect the signals to bits in the ucode.
  - "sysConfig" creates a system defaults file relating user attribute names to default values.
  - "sysConfig" creates a system "ini" file to handle startup issues.
- At this point there is sufficient information to start a system for checkout.
7. Providing Automation Tools

- Automate the documentation of Torrent controller configurations. ✓
  - “sysConfig” tracks and stores the system configuration document.
  - “sysConfig” allows printing a formatted document for the system documentation package.
  - “sysConfig” allows the user to modify the configuration if a detector or board is changed out.
7. Providing Automation Tools

- Automate the startup & initialization of the PAN software when used with Torrent systems.
  - "collector" – run before the standard MONSOON startup script for the system.
    - Reads the FPGA .cfg files,
    - Reads the EEPROMs in the DHE
    - And Creates
      - a sysName_Config.csv file,
      - a sysName_DefaultSetup.mod and
      - a sysName_SetVoltages.mod file from the EEPROM data.
  - Starts the Execution of the standard MONSOON startup script for the system.
Torrent Automated Configuration Processes

**collector** - System Startup

**System Start script**
Executes the collector program on the PAN system

**collector**
Read `sysType` from DHE

- Is system a Torrent
  - Yes: Run MONSDON System startup script
    - Write the `sysName_Config.csv` file
    - Write the `sysName_DefaultSetup.mod` file
    - Write the `sysName_SetVoltages.mod` file
  - No: Read 5 Module EEPROMs
    - LCB EEPROM
    - PSM EEPROM
    - CCD1 EEPROM
    - CCD2 EEPROM
    - TSM EEPROM

**Configuration Records**
- torrent_LCB_V118.cfg
- torrent_PSM_V118.cfg
- torrent_PIX_V118.cfg
- torrent_CFG_V118.cfg
- torrent_CLK_V118.cfg
- torrent_CCD1_V118.cfg
- torrent_CCD2_V118.cfg
- torrent_SYS_V118.cfg
- torrent_SFTW_V118.cfg
- sysName_SFTW.cfg

Run MONSDON System startup script
borg and mborg GUI

The BORG is running an OUV system (testdira) on thrice-a using localMTS DHS

Stop Logging     Display Log

OK: ppxAsyncResp: Success. \
OK: ppxSetAVP: Success. \modeFd: set to >Monsoon/config/\nOK: ppxSetAVP: Success. \model name set to testdira\nOK: ppxSetMode: Success. \File/Monsoon/config/testdira/\nOK: ppxSetMode: Success. \File (us:Monsoon/config/testdira/\nOK: ppxSetMemCfg: Success \Downloaded File Austin\Monsoon/config/\nOK: ppxSetAVP: Success. \mchSeqEnable set to 0.000<0-\nOK: ppxSetAVP: Success. \mchTime set to 0.000<0-\nasyncMsg: OK: Board ID check Passed \@ 20100623.0906

Help:

DHE Control     Encalplane Ctrl    Sequencer Dis

Connect & Initialize

Exposure Parameters
Image Directory
Image File
Image Count
Integration Time
Exposure Type
ZERO     DARK     OBJECT    FLAT     FOCUS

Number of exposures: 1

Exposure Sequence Control
Start     Pause     Resume

Disconnect from Pan and Exit BORG
Mborg Optimization Tools

- pteTest – a test to determine the serial and parallel photon transfer efficiency for a CCD.

- noiseTest - a test to determine the system noise for a CCD or IR system.

- features - a test to determine the location and extent of “hot” and “bad” pixels, rows, columns.

- optimize – a series of sequences to ease the task of optimizing a focal plane or detector TBD

- eepEdit – this tool allows the engineer to write the optimization voltage values to the TSM EEPROM and/or edit the EEPROM values by hand
  - Done after engineer is satisfied with optimization results
  - Hand editing is “possible but not recommended.”
Mborg Diagnostic tools

• Provide software to automate the diagnostic testing of Torrent Boards at the Telescope.
  – *lcbTest* – tests the functionality of an LCB board
  – *afeTest* – tests the functionality of each AFE
    • *recalibrate* will run a calibration test on the clock rails, high and low voltage biases
  – *preAmpTest* – tests the functionality of a transition module preAmp board
  – *utilTest* - tests the functionality of a transition module utility board
  – *psmTest* – tests the functionality of the PSM
## Runtime Failure Mode Analysis

- **“collector”** cannot connect to DHE!
  - System in [SIM] mode.
  - Informs user and suggests corrective actions.
  - Sends report to responsible maintenance tech/engineer.
- **“collector”** detects a “not Torrent” DHE!
  - Executes the normal MONSOON startup script for the system and exits.
- **“collector”** detects a “bad” EEPROM on LCB, PSM or AFE!
  - Collector checks that power supply voltages are in range.
  - Checks for an existing set of “.ini”, “.csv” and “.mod” files.
  - Request that the user contact maintenance.
  - Asks maintenance for permission to use the existing files.
    - If answer is “YES” execute the normal startup script and exit.
    - If answer is “NO” exit.
  - Sends report to responsible maintenance tech/engineer.
Runtime Failure Mode Analysis (cont)

• “collector” detects a “bad” EEPROM on TSM!
  - Request user to contact maintenance.
  - Asks maintenance if correct system is connected.
  - If a previous sysName_setVoltages.mod file exist.
    - Yes; Asks for maintenance permission to startup using previous file.
    - If No exits without starting system
  - Sends report to responsible maintenance tech/engineer.

• PAN processes fail to connect to DHE

  - PAN goes into [SIM] mode
  - “client” software informs user of problem and suggests corrective action.
  - Suggest user contact maintenance.

• PAN processes connect & get errors during operations

  - “client” software informs user of problem and suggests corrective action.
  - Suggest user contact maintenance.
A “client” system (borg, NOCS, MOP) finds voltages have been incorrectly set before detector powerOn sequence.

- During Initialization “client” Informs user of failure.
- Requests that the user contact maintenance.
- Sends report to responsible maintenance tech/engineer

A “client” system finds some voltages have been incorrectly set after detector powerOn sequence.

- During Initialization “client”
  - executes detector powerOff sequence.
  - Informs user of failure.
  - Requests that the user contact maintenance.
- During normal operations “client”.
  - Postpones start Exposure command
  - Informs user of failure. Asks if user wishes to continue.
  - In user “client” programs that can use it the ‘alarm’ level will execute a detector powerOff sequence
    - Requests that user contact maintenance.
  - Sends report to responsible maintenance tech/engineer.
Conclusion

• Questions?
• Answers!
  – 42 ✓
  – NCC-1701-E
  – The Dumbbell Nebula
  – It’s a hardware problem