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1. INTRODUCTION

1.1 PURPOSE

This document contains the architectural and detail design of **Harps High Efficiency Fiber Shutter** control software for 3.6m Telescope. It is intended to provide all the necessary information for the implementation of the software and for the preparation of test procedures.

The document is intended for software developers, and other team member outside Software team who may participle in development and maintaining of the **HEFS** control software. The audience is supposed to be familiar with the **VLT Common Software**.

1.2 SCOPE

The present describes the design and the software for adapting the new **HEFS** (High Efficiency Fiber Shutter) into actual **HARPS** System. This implies a new software module **haihefs** will be created and several modules of templates, instrument mode will be affected as well.

1.3 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of this document to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this document, the contents of this document shall be considered a superseding requirement.

[1] 3M6-SPE-ESO-13100-0012, Issue 1.3, 14/12/2004 --- High Efficiency Mode Upgrade
[2] 3P6-DSD-ESO-60400-0002, Issue 1.0, 24/12/2004 --- Harps High Efficiency Fiber Shutter
[3] 3P6-TRE-ESO-70200-0001, Issue 1.0, 12/07/2004 --- High Efficiency Fiber Head for Harps

1.4 REFERENCE DOCUMENTS

The following documents are referenced in this document.

[4] VLT-MAN-ESO-17210-0364, Issue 2.0, 11/06/2002 --- Digital I/O Driver User Manual
[5] VLT-MAN-ESO-17240-2240, Issue 4.0, 31/03/2004 --- INS Common SW for Template User Manual
[6] VLT-MAN-ESO-17240-0934, Issue 5.0, 31/03/2004 --- INS Common SW Base ICS User Manual
[7] 3M6-MIN-ESO-33100-0009, 22/07/2002 --- IST meeting recommending EGGS
[8] 3M6-SPE-ESO-13100-0012, 05/03/2004 --- User Requirements
[9] 3P6-TRE-ESO-70200-001, 12/07/2004 --- PDR Document
[10] 3M6-MIN-HAR-33100-0031, 23/08/2005 --- Minutes of PDR and reviewer comments
[11] INS-04/17 --- Fiber Splicing test

1.5 ABBREVIATIONS AND ACRONYMS

The following abbreviations and acronyms are used in this document:

HARPS	High Accuracy Radial velocity Planet Searcher
EGGS	Extra Good General Spectroscopy
HEFS	High Efficiency Fiber Shutter
HAM	High Accuracy Mode
ICS	Instrument Control Software

OCS	Control Software
OLDB	Online Data Base
LSO	La Silla Observatory
N/A	Not Applicable
TBC	To Be Confirmed
TBD	To Be Defined

1.6 GLOSSARY

1.7 STYLISTIC CONVENTIONS

This subsection is optional. Use it if it makes sense. The following is just an example. Change it according to your needs.

The following styles are used:

Bold
: In the text, for commands, filenames, pre-suffixes as they have to be typed.

Italic
: In the text, for parts that have to be substituted with the real content before typing.

`Teletype`
: For examples.

`<name>`
: in the examples, for parts that have to be substituted with the real content before typing.

Bold and *italic* are also used to highlight words.

2. OVERVIEW

The inclusion of the new **HEFS** in the **HARPS** system implies that we need to change the actual control software of **HARPS** in order to support this new feature. The **VLTSW** standard shutter controller, **PULPO**, can only control one shutter at time. Therefore a mechanical/electronic [2] switch shall be implemented in order to redirect the **PULPO** commands to either **EGGS** or the **HAM** shutter. The feature to switch the shutters remotely will be done by the control software.

The new electronic device named "**HEFS** control box" [2] is in charge to switch between both shutters, so **PULPO** will not realized the presence of another shutter. To support this new feature, a new device should be added in order to interface the **ICS** and the **HEFS** control box.

Beside these low-level changes, high-level templates software modules should be updated as well in order to use this feature, specifically a new instrument mode, named **EGGS** mode, will be added, and the actual functionality will be called **HAM** mode.

2.1 Architecture

Following **VLTSW** standard [6], the **ICS** software is divided into two parts, the Workstation part and the **LCU** part. In the Workstation part, the commands for this new feature should be added at the **ICS** panel, and the **HEFS** control box status should be shown at the **ICS** and **OS** panel. A new instrument mode should be added too, and templates should be updated in order to use this new feature. In the **LCU** part, low level control interface for the **HEFS** control box should be implemented. The communication between the LCU and the **HEFS** control box will be done via an **Acromag AVME 948x Digital I/O Board** [4]. Following the standard of **BOSS/ICB** [6], this new device should be considered as a special device.

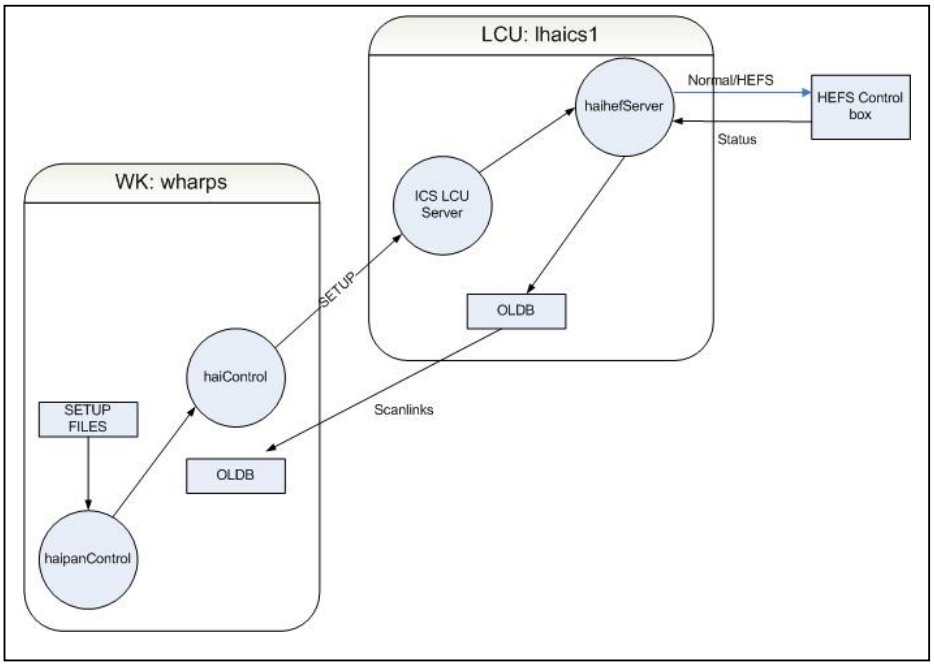

Figure 2.1: Architecture of the control software to support HEFS

As shown in the Figure 2.1, the new device will be controlled by the **haihefServer** in the **lhaics1** LCU.

2.1.1 Architecture of Workstation Part

The main modifications at this part will be:

- Templates: TSF, SEQ, REF, ISF, IP files
- Instrument Modes: HAM, EGGS
- ICS/OCS panels update.
- Scanlinks

The Workstation part will be described in detail in the section 3.

2.1.2 Architecture of LCU Part

The main modification at this part will be:

- Add new special device to interface the HEFS control box.
- OLDB.

The LCU part will be described in detail in the section 4.

3. WORKSTATION ARCHITECTURE

3.1 Instrument Modes

The introducing of the new device **hefs** implies that we must redefine the actual structure of Instrument Modes. Actually, **HARPS** has three Instrument Modes: **HARPS**, **CES**, and **DARK**. These modes should be updated in order to use the **HAM** shutter. In the other hand, a new Instrument mode named **EGGS** will be defined. Templates which use the **EGGS** mode will select to use the **EGGS** shutter and the high efficiency fiber (setting properly the fiber carriage position).

The **HARPS** instrument mode will be renamed as **HAM**.

The modification of the instrument modes will be done in the **hamcfgINS.cfg** configuration file at **hamcfg** module.

```
#
# Instrument modes
#
OCS.MODE1.NAME       "HAM";
OCS.MODE1.SETUP      "-function INS.OPTI2.NAME HARPS INS.HEFS.ST F";
OCS.MODE1.SUBSYST    "FIERA ICS 3P6";
OCS.MODE1.PATH       "DEFAULT";

OCS.MODE2.NAME       "EGGS”;
OCS.MODE2.SETUP      "-function INS.OPTI2.NAME HARPS INS.HEFS.ST T";
OCS.MODE2.SUBSYST    "FIERA ICS 3P6";
OCS.MODE2.PATH       "DEFAULT";

OCS.MODE3.NAME       "CES";
OCS.MODE3.SETUP      "-function INS.OPTI2.NAME CES";
OCS.MODE3.SUBSYST    "FIERA ICS 3P6";
OCS.MODE3.PATH       "DEFAULT";

OCS.MODE4.NAME       "DARK";
OCS.MODE4.SETUP      "-function INS.ADC OFF INS.OPTI2.NAME PARK INS.COVER IN INS
                      .LAMP OFF INS.SHUT1.ST F"
OCS.MODE4.SUBSYST    "FIERA ICS 3P6";
OCS.MODE4.PATH       "DEFAULT";
```

3.2 Device Configuration

The new device hefs should be defined at **hamcfg/config/hamcfgINS.cfg** configuration file. Note that the prefix of the hefs device is “INS.HEFS”, it means that all keywords related to the hefs device will appear in the fits header using its prefix.

```
HIERARCH ESO INS HEFS ST = T / High eff. fiber shutter selected
```

Also the setup command will be

```
SETUP –function HEFS.ST T


# HEFS: high efficiency fiber switch

INS.DIG2.DEVNAME        "hefs";
INS.DIG2.DEVDESC        "High Efficiency Fiber Shutter Switch";
```

```
INS.DIG2.PREFIX         "INS.HEFS";
INS.DIG2.PARAM          "ST";
INS.DIG2.LCUID          1; # Id. of the LCU managing the device
INS.DIG2.SWSIM          F; # If T, function is software simulated
INS.DIG2.TIMEOUT        5; # Motion timeout
INS.DIG2.SIGDEV         "/acro0";
INS.DIG2.OUTBIT         10;
INS.DIG2.OUTLOW         T;

INS.DIG2.INNAME1        "Local";
INS.DIG2.INBIT1         11;
INS.DIG2.INLOW1         T; # T=handset F=remote

INS.DIG2.INNAME2        "ShutterOpen";
INS.DIG2.INBIT2         12;
INS.DIG2.INLOW1         T; # T=open; F=close

INS.DIG2.INNAME3        "HEFSopMode";
INS.DIG2.INBIT3         13;
INS.DIG2.INLOW1         T;  # T= HEFS; F=HA

INS.DIG2.POSID1         "OFF"; # position 1: ST=F
INS.DIG2.OUTVAL1        0;
INS.DIG2.INVAL11        0;

INS.DIG2.POSID2         "ON"; # position 2: ST=T
INS.DIG2.OUTVAL2        1;
INS.DIG2.INVAL21        1;
```

3.3 Keywords and Dictionary

New keywords to support the new device and the new instrument mode will be added at **dicHARPS** module.

The following is a list of new keywords which should be created, after their acceptance by Garching:

```
INSi.HEFS.DEVNAME       %19s  Name of the ICS device (c)
INSi.HEFS.DEVDESC       %19s  Description of the ICS device (c)
INSi.HEFS.DEVTYPE       %30s  ICS device Type (c)
INSi.HEFS.PREFIX        %15s  Device FITS prefix (c)
INSi.HEFS.LCUID         %d    Id of the LCU managing the device (c)
INSi.HEFS.AVAIL         %c    Device available flag (c)
INSi.HEFS.SWSIM         %c    If T, function is software simulated (c)
INSi.HEFS.PARAM         %8s   Parameter name (default: Name) (c)
INSi.HEFS.ST            %c    HEFS activated (c)
```

3.4 Templates

Since the changes in the instrument modes, all the templates should be adapted. This will be done following the below rules:

- Duplicate all template signature files (*.tsf), in this way users will see two sets of templates: one for the **EGGS** mode and other for **HAM** mode.
- Avoid duplication of the sequence files (*.seq) whenever is possible, in order to minimize the amount of maintenance works.

Due the modification of template signature files and the instrument summary file, the Instrument Package of **Harps**, should be updated too.

3.4.1 Template Signature Files (TSF)

The **Harps**'s template signature files are located at **haotsf** and **hamtsf** modules.

The following tsf files should be created. They will be based on the old tsf file, only their names and the corresponding Instrument Mode should be updated for each one of them.

```
haotsf/config
            |- HARPS_eggs_acq_I2cell.tsf
            |- HARPS_eggs_acq_objA.tsf
            |- HARPS_eggs_acq_objAB.tsf
            |- HARPS_eggs_acq_thosimult.tsf
            |- HARPS_eggs_cal_I2AB.tsf
            |- HARPS_eggs_cal_I2AthoB.tsf
            |- HARPS_eggs_cal_bias.tsf
            |- HARPS_eggs_cal_dark.tsf
            |- HARPS_eggs_cal_focus.tsf
            |- HARPS_eggs_cal_thoAB.tsf
            |- HARPS_eggs_cal_tun.tsf
            |- HARPS_eggs_cal_tunAB.tsf
            |- HARPS_eggs_cal_tunAI2.tsf
            |- HARPS_eggs_obs_all.tsf

            |- HARPS_ham_acq_I2cell.tsf
            |- HARPS_ham_acq_objA.tsf
            |- HARPS_ham_acq_objAB.tsf
            |- HARPS_ham_acq_thosimult.tsf
            |- HARPS_ham_cal_I2AB.tsf
            |- HARPS_ham_cal_I2AthoB.tsf
            |- HARPS_ham_cal_bias.tsf
            |- HARPS_ham_cal_dark.tsf
            |- HARPS_ham_cal_focus.tsf
            |- HARPS_ham_cal_thoAB.tsf
            |- HARPS_ham_cal_tun.tsf
            |- HARPS_ham_cal_tunAB.tsf
            |- HARPS_ham_cal_tunAI2.tsf
            |- HARPS_ham_obs_all.tsf


hamtsf/config
            |- HARPS_eggs_tec_eff.tsf
            |- HARPS_eggs_tec_free.tsf
            |- HARPS_eggs_tec_led.tsf
            |- HARPS_eggs_tec_thoA.tsf
            |- HARPS_eggs_tec_thoAB.tsf
            |- HARPS_eggs_tec_thoB.tsf
            |- HARPS_eggs_tec_tunA.tsf
            |- HARPS_eggs_tec_tunAB.tsf
            |- HARPS_eggs_tec_tunB.tsf
            |- HARPS_eggs_tec_TestAll.tsf


            |- HARPS_ham_tec_eff.tsf
            |- HARPS_ham_tec_free.tsf
            |- HARPS_ham_tec_led.tsf
            |- HARPS_ham_tec_thoA.tsf
            |- HARPS_ham_tec_thoAB.tsf
            |- HARPS_ham_tec_thoB.tsf
            |- HARPS_ham_tec_tunA.tsf
            |- HARPS_ham_tec_tunAB.tsf
```

```
            |- HARPS_ham_tec_tunB.tsf
            |- HARPS_ham_tec_TestAll.tsf
```

3.4.2 Instrument Summary File (ISF)

The Instrument Summary file of **HARPS** (haotsf/config/HARPS.isf) should be updated too, in order to support the new instrument modes.

MODES "EGGS HAM CES DARK"

3.4.3 Reference Setup File (REF)

The reference setup files should be duplicated and updated with the corresponded instrument mode.

The following reference setup files should be created.

```
haotsf/config
            |- HARPS_eggs_acq_I2cell.ref
            |- HARPS_eggs_acq_objA.ref
            |- HARPS_eggs_acq_objAB.ref
            |- HARPS_eggs_acq_thosimult.ref
            |- HARPS_eggs_cal_I2AB.ref
            |- HARPS_eggs_cal_I2AthoB.ref
            |- HARPS_eggs_cal_bias.ref
            |- HARPS_eggs_cal_dark.ref
            |- HARPS_eggs_cal_focus.ref
            |- HARPS_eggs_cal_thoAB.ref
            |- HARPS_eggs_cal_tun.ref
            |- HARPS_eggs_cal_tunAB.ref
            |- HARPS_eggs_cal_tunAI2.ref
            |- HARPS_eggs_obs_all.ref

            |- HARPS_ham_acq_I2cell.ref
            |- HARPS_ham_acq_objA.ref
            |- HARPS_ham_acq_objAB.ref
            |- HARPS_ham_acq_thosimult.ref
            |- HARPS_ham_cal_I2AB.ref
            |- HARPS_ham_cal_I2AthoB.ref
            |- HARPS_ham_cal_bias.ref
            |- HARPS_ham_cal_dark.ref
            |- HARPS_ham_cal_focus.ref
            |- HARPS_ham_cal_thoAB.ref
            |- HARPS_ham_cal_tun.ref
            |- HARPS_ham_cal_tunAB.ref
            |- HARPS_ham_cal_tunAI2.ref
            |- HARPS_ham_obs_all.ref
```

3.4.4 Template script (SEQ)

The actual set of template scripts can be remain untouched, and shared between both **HAM** and **EGGS** instrument modes, but according to the naming standard defined at [5] names of these scripts should be updated. The following script files should be created.

```
haoseq/src
            |- HARPS_acq_I2cell.seq
            |- HARPS_acq_objA.seq
            |- HARPS_acq_objAB.seq
```

```
|- HARPS_acq_thosimult.seq
|- HARPS_cal_I2AB.seq
|- HARPS_cal_I2AthoB.seq
|- HARPS_cal_bias.seq
|- HARPS_cal_dark.seq
|- HARPS_cal_focus.seq
|- HARPS_cal_thoAB.seq
|- HARPS_cal_tun.seq
|- HARPS_cal_tunAB.seq
|- HARPS_cal_tunAI2.seq
|- HARPS_cal_tunUSER.seq
|- HARPS_obs_all.seq
```

3.5 Panels

Panels should be updated to control the new device, show the new device's status, and show the new instrument modes whenever they are used by a template.

3.5.1 ICS

In the ICS panel (**haipan/src/haipanControl.pan**) a new section to control the new device **hefs** will be added.

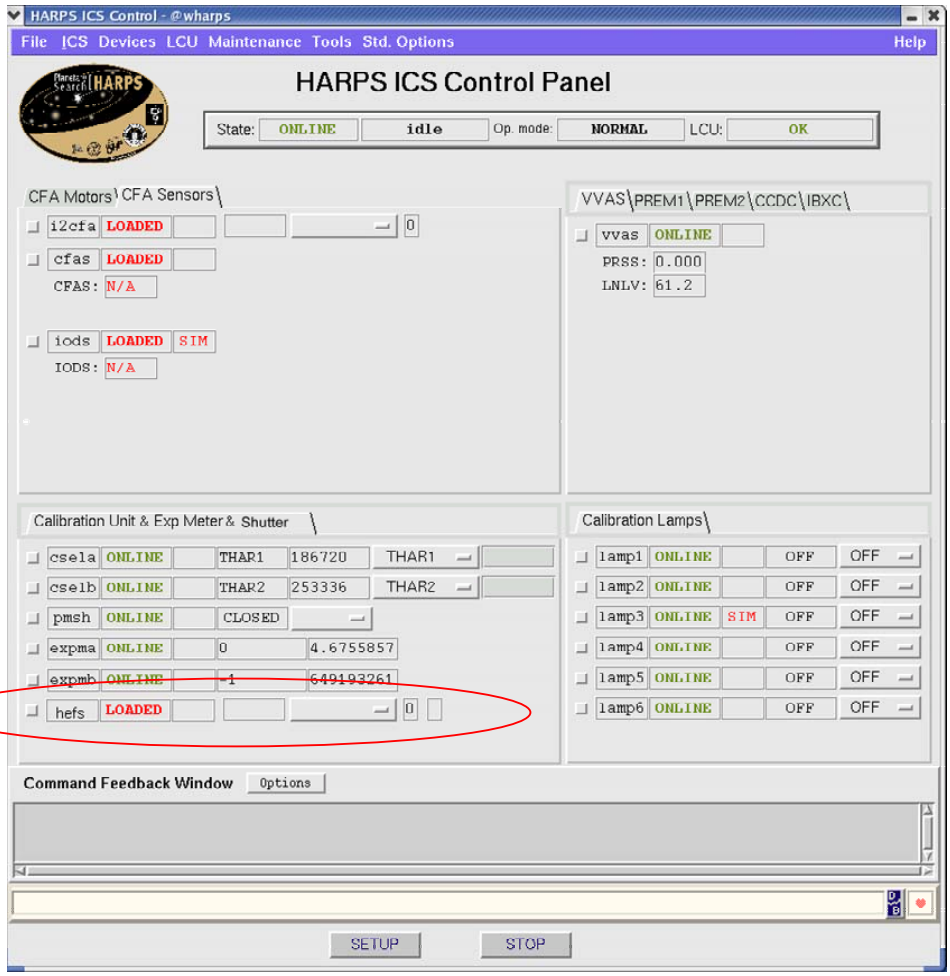

Figure 3.1: New section in **ICS** panel to control the **hefs** device.

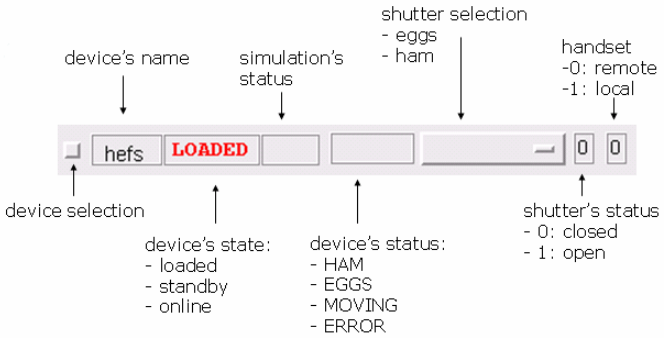

Figure 3.2: **hefs** device control section.

3.5.2 OCS

In the OCS panel (haopanControl) a new section to show the actual selected shutter will be added. And new instrument modes' options will be added to the option button.

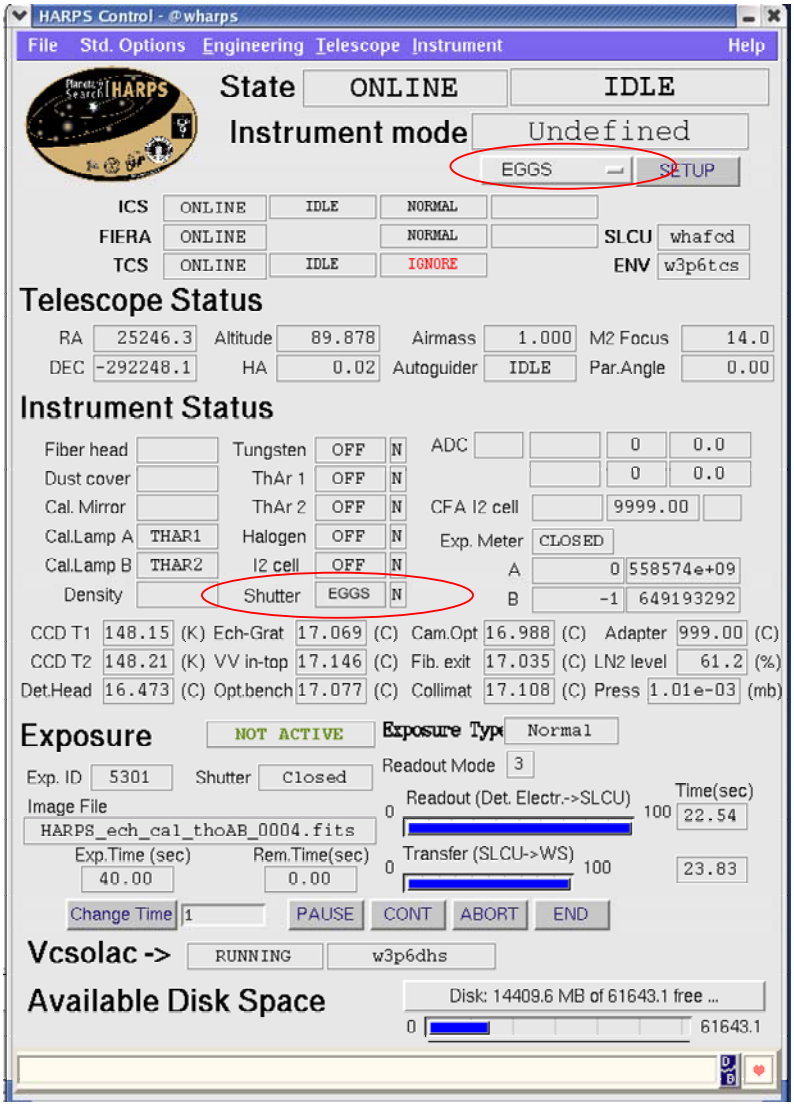

Figure 3.3: New section to show the shutter in use, and changes in instrument mode option button.

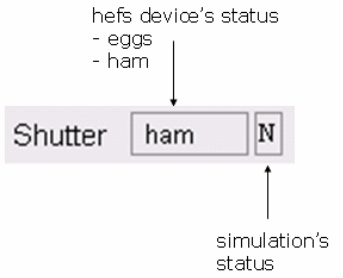

Figure 3.4: hefs device status in the OS panel.

3.6 Scanlinks

The Status of the new device which is saved at **lhaics1**'s OLDB should be mapped by scanlinks into wharps' OLDB.

The following points should be added at **hai/config/lhaics1.scan** file.

```
#
# HEFS: High Efficiency Fiber Switch
#

<alias>HEFS.state       <alias>HEFS.state       SRBX  2
<alias>HEFS.simulation  <alias>HEFS.simulation  SRBX  2
<alias>HEFS.handset     <alias>HEFS.localI      SRBX  2
<alias>HEFS.status0     <alias>HEFS.status0     SRBX  2
<alias>HEFS.value1I     <alias>HEFS.value1I     SRBX  2
<alias>HEFS.value2I     <alias>HEFS.value2I     SRBX  2
```

4. LCU ARCHITECTURE

4.1 HEFS device

To control the HEFS control box, an Acromag Digital I/O board will be used. In [2] we can find the user requirement defined for the HEFS control box, which is shown below:

Bit position	Name	Description	Type
SIGBIT+0	shutterSwitchO	switch between HA and HE shutter	Output
SIGBIT+1	localI	active, the shutter is set to local control	Input
SIGBIT+2	shutterOpenI	shutter feedback: active if shutter is open (either HA or HE)	Input
SIGBIT+3	HEFSopModeI	HEFS operation mode: active if it is Manual, otherwise is via PULPO cmds.	Input

Table 4.1: Bits needed to interface the HEFS control box

This implies that we need four free ports in the **Acromag Digital I/O** board which can be found at LCU **lhaics1**. The value of **SIGBIT** chosen for **hefs** is 30, it means that bit 30, 31, 32, 33 should be reserved.

4.2 Special Device Server: haihefServer

Unfortunately, the new device does not fall into any standard device's categories, so a special device **hefs** and its corresponded server **haihefServer** will be created from scratch. In the table 4.2 the command interface of the **haihefServer** is shown. These commands should only be sent to ICS front-end server **haiControl**, this server instead will forward the command to **lcu0Server** in the **LCU**, and finally the command will be forwarded to **haihefSever.**

Command	Parameter	Description
INIT	-function	Load persistent attributes of the /acro0 board to the LCU's OLDB
STANDBY	-function	Initialize and configure ports used by the hefs device in the /acro0 board
ONLINE	-function	Bring device to ONLINE state and ready to receive SETUP command
SIMULAT	-function	Enabled device HW simulation on the LCU.
SETUP	-function	Switch between HAM and EGGS shutter

Table 4.2: Command Interface

For example to select the **HA** shutter, the following command should be sent to the **haiControl** Server.

```
> SETUP -function INS.HEFS.ST F
```

And to select the **HE** shutter, the following command should be sent

```
> SETUP -function INS.HEFS.ST T
```

4.3 OLDB

In order to keep track of the status of the **HEFS** control box, the value of each bit defined at table 4.1 will be mapped into the **lhaics1's OLDB**, so the following class and DB point are defined. The new device will be controlled by the **haihefsServer**.

```
CLASS icbDEVICE_BASE haihefsDEVICE
BEGIN
    // server managing this device type
    ATTRIBUTE bytes32 server "haihefServer"
    ATTRIBUTE bytes16 param "ST"

    // configuration attributes
    ATTRIBUTE bytes16 port
    ATTRIBUTE int32   outbit
    ATTRIBUTE int32   outlow
    ATTRIBUTE Table inbits(3,
        bytes16 name,
        int32   inbit,
        int32   inlow)

    ATTRIBUTE Table positions(2,
        bytes16 id,
        bytes16 name,
        int32  outval,
        int32  inval1,
        int32  inval2,
        int32  options)

    ATTRIBUTE int32   localbit
    ATTRIBUTE logical locallow

    ATTRIBUTE int32   timeout

    // output digital signal
    ATTRIBUTE uint32  valueO
    ATTRIBUTE logical valueO_status

    // input digital signals
    ATTRIBUTE uint32  value1I
    ATTRIBUTE logical value1I_status
    ATTRIBUTE uint32  value2I
    ATTRIBUTE logical value2I_status
    ATTRIBUTE uint32  localI
    ATTRIBUTE logical localI_status

     // simulated signal
    ATTRIBUTE uint32 value_sim

   // HW initialised flag
    ATTRIBUTE logical hwInitialised

    // misc. attr. (do not delete)
    ATTRIBUTE int32 substate
    ATTRIBUTE int32 error

    // status
    // Status
    // From positions table: Id and Name
    //-----------------------------------------------------------------
    ATTRIBUTE bytes20 status0
    ATTRIBUTE bytes20 status1

END

POINT haihefsDEVICE :Appl_data:HARPS:ICS:DEVICES:HEFS
```

```
BEGIN
    ALIAS HEFS

    // name and desc. of the device,
    // prefix of the FITS keywords
    // and LCU managing the device
    //
    ATTRIBUTE bytes20 device "hefs"
    ATTRIBUTE bytes20 description "High Efficiency Fiber Switch"
    ATTRIBUTE bytes16 prefix "INS.HEFS"
    ATTRIBUTE int32   lcuId   1

END
```

4.4 New Software Modules

The new server **haihefServer** will be implemented in the module **haihef**, this module will base on the **xxidev** template module of the **XXX** instrument [6].

APPENDIX

ANNEX 1: PROJECT STATISTICS AND PLANNING

This section provides project statistic so far and estimations for necessary actions to finish this project successfully.

***Following definition is used for 1 FTE: 1 FTE correspond to the man-work of one SWC team member during 1 year. i.e. 52 man-weeks of 26 shifts of 73.5 working hours eac*h**.

Following project states and activities can be identified from software point of view.

1. Analysis & Design
    a. Feasibility study (0.25 shifts)
    b. First approach to design description (0.25 shifts)
    c. Refining of the Design Description (0.5 shifts)
3. Implementation
    a. LCU software (1 shift)
    b. WS software (1 shift)
4. Testing and verification
    a. Design verification tests, includes writing test plan (0.25 shifts)
    b. On-line verification on telescope and writing test report (0.25 shifts)
5. Training and Documentation
    a. Training of operational personnel (0.25 shifts)
    b. Update Harps User/Maintenance Manuals (0.75 shift)

Total: 4.5 shifts = 0.18 FTE
Done: 1 shift = 0.04 FTE
Left: 3.5 shifts = 0.14 FTE

The calculations are made using real or estimated working hours. In practice working 100% for one project is impossible due to software support, other projects and activities.

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