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Moving ESO VLT instrumentation to Linux: first results with the Test Camera on UT3/Melipal

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Abstract. The relatively new Linux operating system, thanks to attractive features like vendor independency, cost effectiveness and fast runtime, offers new opportunity and challenge also to the ESO VLT instrumentation.
In the framework of the long-standing collaboration between OAT/ATG (Astronomical Observatory of Trieste/Astrophysical Technologies Group) and ESO/VLT Software department-technical division, the pilot project of porting one of the VLT instruments - the Test Camera - from the "official" HP-UX platform to Linux has been committed to the ATG. On 23 and 24 January 2003 a successful field test was carried out with real observations at Paranal using the Test Camera (on UT3/Melipal) running on a Linux PC platform.
In this paper, after a brief description of the project, we present and discuss the results of the field test also in terms of performances between the two platforms.

Key words. Control Software – Linux – Operating systems (computer) – ESO VLT

1. Introduction

The relatively new Linux operating system has experienced an exponential growth in the last years, making it one of the most widely accepted operating systems not only in the scientific community but also in the computing industry. There are several reason for such a growth:

– it is open source - all the source code is freely available and modifiable under GPL (General Public License);

– it is free - it is possible to install it at no expense other than the hardware;

– it is powerful - the efficiency was one of the main design target of Linux;

– it runs on low-end, cheap hardware platform (e.g. x86 family CPUs).

Considering also that it is Unix-like with all benefits like stability, robustness etc. it becomes clear why Linux is having increasing support via both application and hardware compatibility. Several new

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scientific project apply it (e.g. ALMA) and many different versions (distributions) of Linux exist on the market (Red Hat, SuSE, Caldera, MandrakeSoft, Debian etc.).

For all this reasons and especially in view of vendor independency ESO is investigating the usage of the Linux PC platform as an alternative to the "official" HP-UX Unix platform. Of course, changing a well tested and trusted system with a completely new one must be carefully evaluated. As a pilot project, ESO decided therefore to port one of the VLT instruments - the Test Camera - to this new platform. In the framework of the very successful collaboration between OAT/ATG group and ESO/VLT Software department-technical division, the Linux project has been committed to the ATG and two consecutive nights were allocated at Paranal (on 23 and 24 January 2003) on UT3/Melipal to test the validity of the porting and to compare the performances between the two platforms in a real environment.

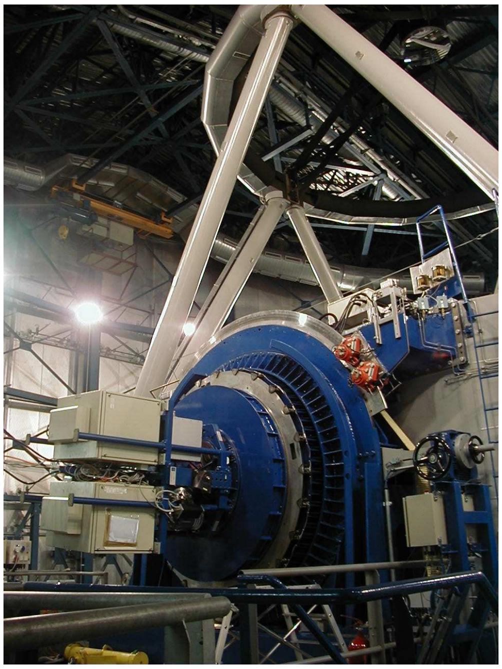

Fig. 1. The Test Camera on UT3/Melipal

2. The VLT Test Camera

The VLT Test Camera (TC) is one of the oldest ESO/VLT instruments used mainly during the integration and commissioning and for the science verifications of all the UTs. In addition, it is used whenever a detailed analysis of the overall optical performances of the UTs is required. It is a relatively simple instrument consisting of two basic modules. The first one contains a Tektronix 2048x2048 CCD read by the ESO standard FIERA controller intended for the recording of direct images with the VLT; the second one contains two technical CCD systems to record the telescope pupil image and as a wave front sensor using a Schack-Hartmann analyzer.

3. The ESO VLT Control software

The ESO VLT control software consists of all the software which is used to directly control the telescopes and all the associated instrumentation. It is a fully distributed system based on workstations (HP-UX) dedicated to the high level software that constitutes the interface with the operator/astronomer and VME based control units (LCU) which ensure the real-time control, management and diagnostics of the hardware components.

The main foundation body for the VLT control software is called VLT common software. It consists of a layer of software over the UNIX operating system, in case of workstations, and of top of the VxWorks operating system for the LCU. It provides mainly common services, like an architecture-independent message system, a real-time database, error and logging system and a huge number of utilities and tools.

The ESO software architecture foresees that the instruments have to be controlled by two fundamentals software packages (based on the common software layer described above): the OS (Observation soft-

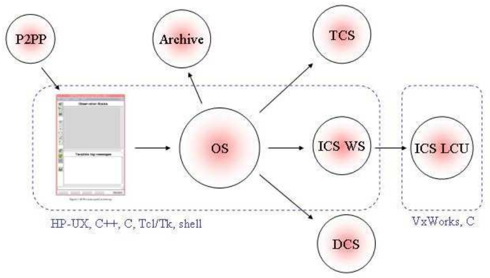

Fig. 2. The ESO Control Software Architecture; see text for detailed description

ware) and the ICS (Instrument Control software).

The OS is a high level component: it manages single or simultaneous exposures, the interface to the telescope, the interface to the user and the interface to the archive. Operations are performed via Bob (Broker for Observation block - OB) which executes the internals of OBs. They contain all the information needed to perform an observation (e.g. the pointing data, the instrument setup, the detector setup) and are composed by a set of templates to define single exposures. The OBs are built with the Phase 2 Preparation Tool (P2PP).

The ICS is the low-level counterpart responsible for controlling and handling of all the hardware components (motors, lamps, sensors).

OS and ICS are written mainly in C++ and C, whereas for the GUIs the Tcl/Tk language is used.

4. Test camera port to Linux

4.1. Preparation

Moving to new platform the first task is to establish the hardware configuration and the type and version of the operating system. Based on a set of test carried out at ESO the Linux distribution Red Hat 7.3 was selected to be executed on a DELL PC (specifically a Dell Optiplex GX240, with Intel P4 1.6 GHz CPU, 256 MB of Ram, HD ATA 100 20 Gb). It is worth to stress the cost of such a system which was less then 1500 Euro.

The actual porting to this new platform took place in two phases; first ESO ported all the base software layers (the VLT common software) to the chosen Linux distribution, then we did the same for the specific TC software packages (mainly OS and ICS). Even if care was taken by ESO since the beginning of the whole VLT project and all the software is almost completely ANSI C/C++ compliant several thing were changed/updated in order to successful complete the porting. Specifically:

- the official 2.4.18 kernel was customized in order to adapt the VLT message system;
- all applications dealing with images and/or single bytes were modified to overcome the byte-swapping problem between the two platforms;
- some shell script were modified in order to deal with operating system commands having different syntax and/or behaviour;
- modifications were required to take in account different path for finding and compiling libraries.

The only show-stopper was the lack of a reliable cross-compiler Linux-VxWorks (at the time the porting was carried out). The problem was solved by compiling all the VxWorks specific code on the native HP workstation [1].

After the successful porting we developed a test suite to be carried out at Paranal. The aim of the tests was firstly to verify and validate the completeness of the TC control software on a Linux platform and secondly to compare the performances in an operational environment. The test suite comprised several parts like, installation tests (retrieve, build, install and configure all the TC control software),validation tests (test of all functionalities of the instrument), various performance tests (OBs execution time, CCD

[1] this problem will disappear, as soon as a new cross compiler will be available

transfer and read-out time, GUIs startup etc.).

4.2. Field test

The field test took place on 23 and 24 January 2003 at Paranal. The TC was mounted on the Nasmyth focus A of UT3/Melipal. In order to validate the porting and to compare performances between both platform we set-up the connection P2PP → Bob → OS → Archive on both the Linux PC (see above for the PC characteristics) and on the "official" HP Instrument Workstation (specifically an HP Visualize J5600, with a Dual PA-8600 Risc CPU at 522 MHz, 1 GB 120 MHz SDRAM, HD Ultra 2 SCSI LVD 9GB/18GB; note that a cost of such a system is as higher as 22000 Euro).

4.3. Results

The main objectives of the test field as outlined above were completely fulfilled. Approximately 400 calibration images were taken and archived without any downtime. The main results of the tests carried out on HP and on Linux platform are summarized in Table 1, where times for retrieving and compiling all the TC software ("build" phase), starting of all environments and processes ("start" phase) and running templates ("run" phase) are compared.

Table 1. Field test Result

	Linux	**HP**	**Gain**
Build	1071 s	2420 s	≈56%
Start	498 s	565 s	≈12%
Run	1419 s	1427 s	≈0.6%

5. Conclusions

Comparing the performances between Linux and HP platform the following conclusion were drawn:

- the software installation and compilation is much faster on the Linux platform (gain > 50%);
- the starting and running of processes and GUIs is faster on Linux even though the differences are not so big (gain < 10%);
- the performances of CCDs are comparable on both platforms (gain ≈1%);
- the time for template execution (exposures) is similar (gain ≈1%);

We can conclude that in a development environment, where the compilation time is important, the Linux PC platform is really an advisable choice (also in terms of costs). In an operational environment the gain is lower (but still apparent), making the Linux platform globally really a valid choice.

It is worth to stress that the reliability respect to the HP-UX platform is still under investigation (two nights are for sure not enough to extrapolate some final conclusions). Further long term reliability test are therefore planned in La Silla in order to evaluate also this aspect.

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