



**ORCHESTRA V3.0**

Installation Procedure

*Version 1.0.0*

***Sintesi***  
ADVANCED IN MECHATRONICS

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# CHAPTER 1

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## ORCHESTRA V3.0 SUITE COMPONENTS

This chapter presents a brief overview of the Orchestra Control Engine suite components.

### FRAMEWORK

- **RTOS**  
Real-Time Operating System for x86 CPUs: hard realtime Linux kernel, RTAI, RTnet, Comedi and Comedilib.
- **CoreLib**  
GNU/Linux software library that provides XML and networking capabilities to Orchestra components.
- **HostSupervisor**  
GNU/Linux application that allows mutual discovering and communication among distributed Orchestra components and execution of host-specific tasks.
- **Conf**  
Graphical User Interface for configuring HostSupervisor (Orchestra components autorun services etc.).
- **Core**  
Hard real-time framework that allows the execution of motion control applications.
- **RTM**  
RunTimeManager: hard realtime framework for Orchestra soft-PLC solution.

### MOTION CONTROL

- **Cartesian Interpolation Modules**  
OrchestraCore modules for planning and generating linear/circular trajectories.
- **Kinematics Modules**  
OrchestraCore modules that implement direct and inverse kinematics.

- **Bspline and NURBS Interpolation Modules**  
OrchestraCore modules for planning and generating B-spline or NURBS trajectories.
- **CNC Framework**  
OrchestraCore modules designed for Control Loops with the most common CNC features.
- **Compensation Modules**  
OrchestraCore modules for machining head kinematics and 3D tool shape compensation.
- **Interpreter**  
RTAI application to interpret numerical control G-code programs and interact with OrchestraCore CNC Modules to execute machine works.

## DRIVERS

- **Sercos**  
RTDM-compliant driver for Sercans SCS-P11 PCI board, with a library to access Sercos functions from hard real-time user applications.
- **Mechatrolink**  
RTDM-compliant driver for Yaskawa NT110 PCI card, with a library to access Mechatrolink I/II functions from hard real-time user applications.
- **CanOpen**  
RTDM-compliant driver for Hilscher CIF-50 COM Master board, with a library to access CanOpen functions from hard real-time user applications.
- **Profibus**  
RTDM-compliant driver for Hilscher CIF-50 PB Master board, with a library to access Profibus functions from hard real-time user applications.
- **Ethercat**  
RTDM-compliant EtherCAT driver for NICs based on RealTek RTL8139, Intel PRO/100 or Intel PRO/1000 chipsets, with a library to access EtherCAT functions (CoE support included) from hard real-time user applications.

## HMI

- **HMI**  
Human Machine Interface for monitoring and interacting with Orchestra components.

## DEVELOPMENT TOOLS

- **LogicProgramming**  
Integrated Development Environment for programming hard realtime logic control applications in PLC languages (IEC61131-3) that run on RunTimeManager.

- **PLCLib**  
IEC 1131-3 standard function blocks helping the user who wants to develop logic control application.
- **Designer**  
Integrated Development Environment for editing, configuration and building of OrchestraCore Control Loops.
- **Builder**  
Development tool to generate C++ code and build OrchestraCore modules from Matlab/Simulink models by means of RTW/ERT toolbox.
- **CrossTools**  
Software tool for building OrchestraCore modules on Windows systems with Designer and Builder.

#### EXAMPLES

- **ExampleLibrary**  
OrchestraCore example control loop with PID regulator and Comedi I/O.
- **ExampleLibraryCNC**  
OrchestraCore example control loop with motion application for a 3 axes machine tools.
- **3D VRML HMI models**  
3D example models in VRML format ready to load in OrchestraHMI.
- **PLCDemo**  
PLC example projects ready to load in OrchestraLogicProgramming workspace.



# CHAPTER 2

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## ORCHESTRA V3.0 INSTALLATION PROCEDURE

This chapter explains how to install Orchestra Control Engine v3.0 on a PC.

### UBUNTU 8.04.4 INSTALLATION

First of all you have to install Ubuntu 8.04.4 LTS (Hardy Heron) “PC (Intel x86) desktop CD” edition on the PC:

- visit <https://help.ubuntu.com/8.04/installation-guide/i386/minimum-hardware-reqts.html> to know system requirements;
- visit <http://releases.ubuntu.com/8.04/> to get the .iso file (<http://releases.ubuntu.com/8.04/ubuntu-8.04.4-desktop-i386.iso>);
- write it to a CD with your favourite CD burning software (see <https://help.ubuntu.com/community/BurningIsoHowto> for a How-To);
- install Ubuntu booting from the CD (see <https://help.ubuntu.com/8.04/installation-guide/i386/index.html> for an installation guide).

### ORCHESTRA RTOS INSTALLATION

Then you have to install OrchestraRTOS<sup>1</sup>:

- download OrchestraRTOS from the Orchestra website (<http://www.orchestracontrol.com>);
- extract the .tar.bz2 file of OrchestraRTOS (graphically browse to your download folder, right-click on the .tar.bz2 file and choose “Extract Here”);

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<sup>1</sup>**ATTENTION:** the Linux kernel we provide has been compiled with ACPI disabled (for more details see <http://en.wikipedia.org/wiki/Acpi>). This can cause some computers to overheat and may damage them. Install OrchestraRTOS at your own risk!

- double-left-click on the extracted folder;
- double-left-click on the linux-image .deb file, left-click on “Install Package” and follow the installer instructions;
- double-left-click on the linux-headers .deb file, left-click on “Install Package” and follow the installer instructions;
- double-left-click on the rtai-base .deb file, left-click on “Install Package” and follow the installer instructions;
- reboot the PC (the HAL-patched kernel will be selected automatically).

## RTAI-COMPLIANCE PC CHECK

Now you must check if your PC hardware configuration is RTAI-compliant:

- open a Linux console (menu Applications → Accessories → Terminal);
- type `cd /usr/realtime/testsuite/user/latency` and press enter;
- type `sudo ./run` and press enter;
- keep the program running for about two minutes, then hit Ctrl+C;
- check the last column (“overruns”) values: all zeros mean that your PC is RTAI-compliant. If there are overruns, you can try<sup>2</sup> to type  
`sudo insmod /usr/realtime/modules/rtai_smi.ko`  
press enter and then rerun the latency test.

## AUTOMATIC ORCHESTRA SOLUTIONS INSTALLATION

If the check has been passed, you can install one of the Orchestra solutions:

- download the Orchestra Control Engine suite .tar.bz2 file;
- extract the downloaded file (graphically browse to your download folder, right-click on the .tar.bz2 file and choose “Extract Here”);
- double-left-click on the extracted folder;
- double-left-click on the OrchestraInstaller file, left-click on “Run” and follow the installer instructions (an Internet connection is needed). To choose what solution to install, notice that:

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<sup>2</sup>**ATTENTION:** this procedure disables the SMM interrupt (aka SMI, for more details see [http://en.wikipedia.org/wiki/System\\_Management\\_Mode](http://en.wikipedia.org/wiki/System_Management_Mode)). This can cause some computers to overheat and may damage them. Run the command at your own risk! If the procedure works for you, you have to modify the `/etc/init.d/OrchestraRTOS` script to automatically load the `rtai_smi.ko` module on boot.

- the **ENTIRE SUITE** solution contains: Bspline and NURBS Interpolation Modules, CanOpen, Cartesian Interpolation Modules, CNC Framework, Compensation Modules, Conf, Core, CoreLib, Designer, Ethercat, ExampleLibrary, ExampleLibraryCNC, HMI, HostSupervisor, Interpreter, Kinematics Modules, LogicProgramming, Mechatrolink, PLCLib, Profibus, RTM, Sercos, User’s Guides;
- the **MOTION FRAMEWORK** solution contains: Conf, Core, CoreLib, Designer, ExampleLibrary, HMI, HostSupervisor, User’s Guides;
- the **PLC** solution contains: CanOpen, Conf, Core, CoreLib, HMI, HostSupervisor, LogicProgramming, PLCLib, Profibus, RTM, User’s Guides;
- the **CNC BASIC** solution contains: Cartesian Interpolation Modules, CNC Framework, Compensation Modules, Conf, Core, CoreLib, Designer, ExampleLibrary, ExampleLibraryCNC, HMI, HostSupervisor, Interpreter, LogicProgramming, PLCLib, RTM, User’s Guides;
- the **CNC FULL** solution contains: Bspline and NURBS Interpolation Modules, CanOpen, Cartesian Interpolation Modules, CNC Framework, Compensation Modules, Conf, Core, CoreLib, Designer, Ethercat, ExampleLibrary, ExampleLibraryCNC, HMI, HostSupervisor, Interpreter, LogicProgramming, Mechatrolink, PLCLib, Profibus, RTM, Sercos, User’s Guides;
- the installation is now completed and (if you want) you can delete the downloaded file and the extracted folder.

You have to close your graphical session (menu System→Out...→Log Out) and relogin to see the “Orchestra” entry under the Applications menu.

The installation directory of Orchestra is `/usr/local/Orchestra`.

## MANUAL ORCHESTRA PACKAGES INSTALLATION/UPGRADE

In fig. 2.1 you can see a graph representing the internal dependencies among the various .deb packages of the Orchestra Control Engine suite v3.0. The head of each arrow points towards the package needed by the tail-attached one, i.e.  $A \rightarrow B$  means “package A needs package B”.

If you want to install or upgrade some package manually, you have to follow this procedure:

- menu System → Administration → Synaptic Package Manager, click on “Reload” button, then close Synaptic;

- install each needed Orchestra .deb file (double-left-click, then “Install Package”) according to the dependencies order, starting from the ones without outgoing arrows.

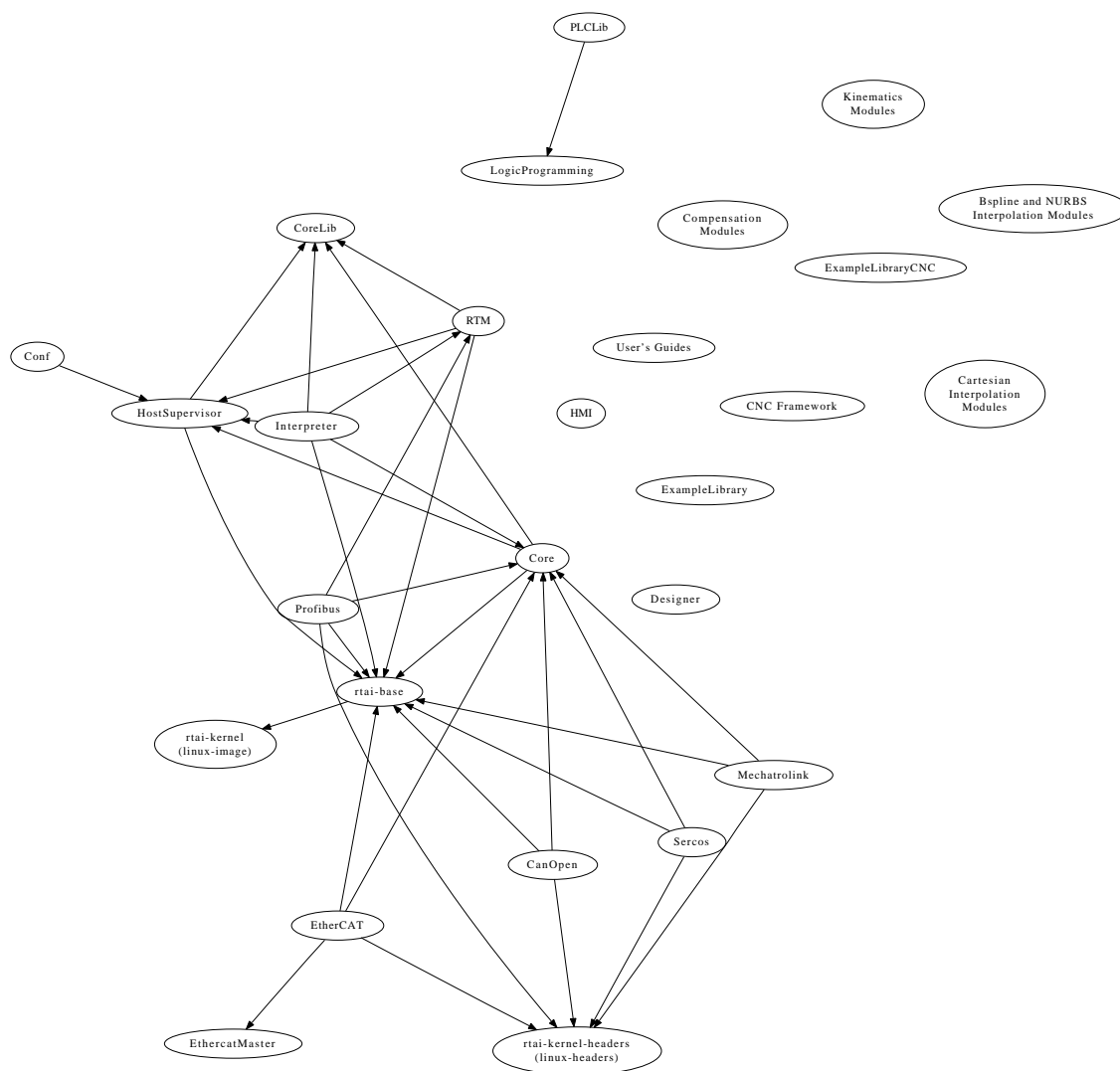


Figure 2.1: Internal dependencies of Orchestra .deb packages.

The installation procedure of OrchestraBuilder is different from those of the other components; please refer to its User’s Guide for detailed instructions. If you want to install OrchestraHMI, OrchestraDesigner and/or OrchestraLogicProgramming under Microsoft Windows XP, please refer to their User’s Guides.

## ORCHESTRA v3.0 LIVE CD

On the Orchestra website (<http://www.orchestracontrol.com>) you can download an ISO file (ready to be burned on a CD) containing a custom live Ubuntu distribution with Orchestra v3.0 preinstalled, with which you can easily try and/or install the RTOS and the entire suite.