

COMSOL INSTALLATION AND OPERATIONS GUIDE

VERSION 4.0 a



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COMSOL Installation and Operations Guide

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Introduction

This chapter provides an overview of the contents of the *COMSOL Installation and Operations Guide* and some general tips for installing and running the COMSOL software standalone to best utilize the available computer resources.

General Tips

Welcome to COMSOL® 4.0a! Use this *Installation and Operations Guide* to install your COMSOL software products and start working with the packages. In addition to this manual, we supply many other resources to help you get the most out of COMSOL products. Among them are:

COMSOL Release Notes

Accessible from the COMSOL Help Documentation, this electronic PDF document provides an overview of changes throughout the COMSOL product line since the previous release that require special attention with regards to backward compatibility.

Introduction to COMSOL Multiphysics and Online Help

To get an overview of COMSOL Multiphysics' capabilities and how to use them, see the *Introduction to COMSOL Multiphysics* document, included with the DVD media. It contains an overview of the major functionality in the 4.0a release and fully documented example models. Further, the full COMSOL documentation set is available on your computer in the COMSOL help resources and as a set of PDF files. You can also access context-sensitive dynamic help that provides help for all nodes in the Model Builder and windows on the COMSOL Desktop, including links to the full product documentation.

Technical Support

If any questions arise regarding COMSOL software products—whether concerning installation, licensing, modeling, applications, or other technical questions—do not hesitate to contact your local COMSOL representative or send your questions to support@comsol.com.

Further, at www.comsol.com/support you can find a broad range of technical support resources including the searchable COMSOL Knowledge Base.

Typographical Conventions

All COMSOL manuals use a set of consistent typographical conventions that should make it easy for you to follow the discussion, realize what you can expect to see on the

screen, and know which data you must enter into various data-entry fields. In particular, you should be aware of these conventions:

- A **boldface** font of the shown size and style indicates that the given word(s) appear exactly that way on the COMSOL Desktop (or, for toolbar buttons, in the corresponding tooltip). For instance, we often refer to the **Model Builder** window, which is the window that contains the model tree. As another example, the instructions might say to click the **Zoom Extents** button, and the boldface font indicates that you can expect to see a button with that exact label on the COMSOL Desktop.
- The names of other items on the COMSOL Desktop that do not have direct labels contain a leading uppercase letter. For instance, we often refer to the Main toolbar; this horizontal bar containing many icons appears on top of the user interface. However, nowhere on the screen will you see the term “Main” referring to this toolbar.
- The symbol **>** indicates a menu item. For example, **Options>Results** is equivalent to: From the **Options** menu, choose **Results**.
- A **Code** (monospace) font indicates keyboard entries in the user interface. You might see an instruction such as “Type **1.25** in the **Current density** edit field.” The monospace font also indicates code. This font also indicates variable names. An italic *code* (monospace) font indicates user inputs and parts of names that can vary or be defined by the user.
- An *italic* font indicates the introduction of important terminology. Expect to find an explanation in the same paragraph or in the Glossary. The names of books in the COMSOL documentation set also appear using an italic font.

Installing and Running on Windows

This chapter provides detailed instructions for installing and running the COMSOL software on Windows. You also find complete system requirements and license manager information. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Windows. Also see the COMSOL Support Knowledge Base on www.comsol.com for specific troubleshooting tips.

System Requirements

General Requirements

These requirements are common to all platforms:

- A DVD drive for installation
- TCP/IP activated
- 1 GB memory, preferably more
- 1-4 GB of disk space, depending on your licensed products and installation options
- Adobe Acrobat Reader 9.0 or later to view and print the COMSOL documentation in PDF format

FLOATING NETWORK LICENSES

Floating network licenses are supported on heterogeneous networks of Windows, Linux, and Mac computers. Both the license manager and the COMSOL application can run on either Windows, Linux, or Mac, and a single computer can run both of them.

System Requirements for Microsoft Windows

GENERAL SYSTEM REQUIREMENTS—WINDOWS

Use Automatic Updates to keep your Windows system up-to-date. You can access it and turn it on from the Control Panel.

SYSTEM REQUIREMENTS—32-BIT WINDOWS VERSION

- The following 32-bit Windows operating systems are supported:
 - Windows 7
 - Windows Server 2008
 - Windows Vista
 - Windows Server 2003 with Service Pack 2 or later
 - Windows XP with Service Pack 2 or later
- Intel Pentium IV or AMD Athlon processor or later.

SYSTEM REQUIREMENTS—64-BIT WINDOWS VERSION

- The following 64-bit Windows operating systems are supported:
 - Windows 7
 - Windows Server 2008
 - Windows HPC Server 2008
 - Windows Vista
 - Windows Server 2003 x64 Edition with Service Pack 2 or later
 - Windows Compute Cluster Server 2003 with Service Pack 1 or later
 - Windows XP Professional x64 Edition with Service Pack 2 or later
- A PC with one of these processors: AMD with AMD64 or Intel with EM64T.

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons: drivers supporting OpenGL version 1.3 or DirectX version 9 are required. Alternatively, use software rendering.

Optional LiveLink Interface for MATLAB Requirements

The LiveLink interface for MATLAB is compatible with MATLAB 2009b and MATLAB 2010a.

Optional Products for CAD Interoperability

The following products support import of 3D CAD files on Windows platforms:

TABLE 2-1: PRODUCTS FOR CAD INTEROPERABILITY ON WINDOWS

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCTS
CAD Import Module	ACIS (SAT), IGES, Inventor, Parasolid, Pro/E, SolidWorks, and STEP	COMSOL Multiphysics
LiveLink for SolidWorks	same as above	COMSOL Multiphysics
LiveLink for Inventor	same as above	COMSOL Multiphysics
LiveLink for Pro/ENGINEER	same as above	COMSOL Multiphysics
File Import for CATIA V5	CATIA V5	CAD Import Module, or a LiveLink product for a CAD package

LIVELINK INTERFACE FOR SOLIDWORKS

The LiveLink interface for SolidWorks requires SolidWorks 2009 or 2010.

LIVELINK INTERFACE FOR INVENTOR

The LiveLink interface for Autodesk Inventor requires Autodesk Inventor 2010 or Autodesk Inventor 2011.

LIVELINK INTERFACE FOR PRO/ENGINEER

The LiveLink interface for Pro/ENGINEER requires Wildfire 4.0 or Wildfire 5.0.

Parallel System Requirements

COMSOL 4.0a supports shared-memory parallelism and distributed-memory parallelism on 32-bit and 64-bit Windows. Distributed-memory parallelism requires Windows Compute Cluster Server 2003 with Service Pack 1 or Windows HPC Server 2008.

Internet Protocol Support

IPv4 and IPv6 are supported on all Windows platforms.

Installing COMSOL

Before You Begin

- Check that your system meets all applicable requirements (see “System Requirements for Microsoft Windows” on page 6).
- Have your passcode or license file ready. A passcode has a form similar to:

FFFFFF-CUSV-123456-1234567-123456789

You need a passcode or a license file to install COMSOL 4.0a. You should have received it in an email or letter from your sales representative. If you have not received a passcode or a license file, contact your local COMSOL representative.

Some COMSOL license types require that you also install a license manager before running a COMSOL software product. If you install COMSOL software with a passcode, no license manager is needed. If you install it with a license file, you need to install the license manager if the license file contains a line starting with the word `SERVER`. See “License Manager Installation” on page 20 for instructions. You can install your COMSOL software products and the license manager in any order.

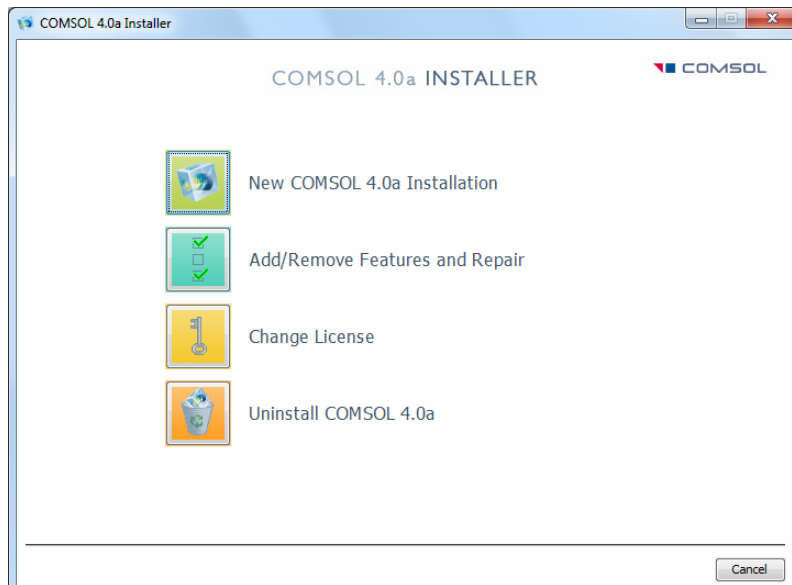
Other COMSOL license types require a dongle (hardware lock). If you have received a dongle to use with the COMSOL software, please refer to `dongle/readme.txt` on the DVD for installation instructions.

An installation of earlier COMSOL versions on your computer is not affected by the COMSOL 4.0a installation except that double-clicking a Model MPH-file created with an earlier version of COMSOL will open it in COMSOL 4.0a. You can continue to use earlier versions or uninstall them independently of the COMSOL 4.0a installation.

Note: In this manual, the term COMSOL 4.0a refers not only to COMSOL Multiphysics 4.0a but also to any other members of the COMSOL product line.

Installing COMSOL 4.0a

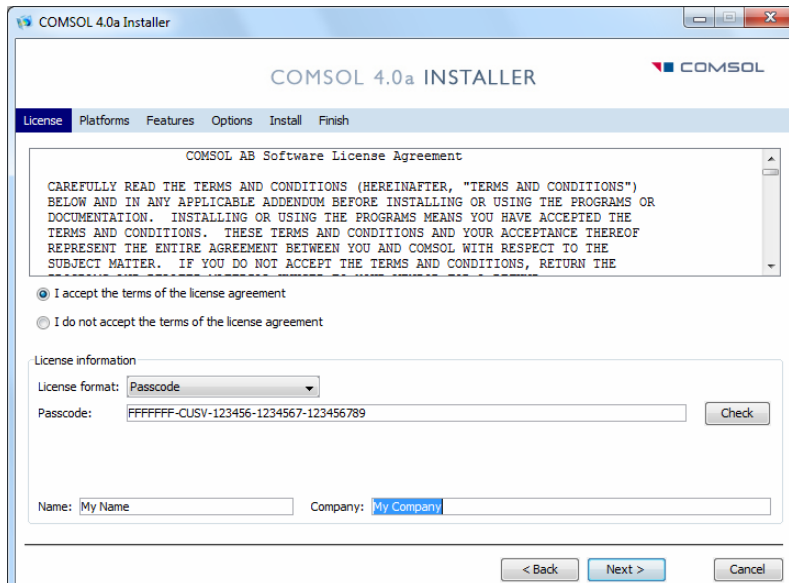
- I Insert the COMSOL 4.0a DVD into the DVD drive. The **COMSOL Setup** window should appear automatically; if not, run the file `setup.exe` on the installation DVD. When the **COMSOL 4.0a Installer** window appears:
- Click **New Installation** and proceed to Step 2 to make a new installation.
 - Click **Add/Remove Features** and proceed to Step 4 to change or repair an existing installation. For example, use **Add/Remove Features** when you add or remove documentation files for products installed or when you want to add or remove a product that your license includes.
 - Click **Change License** and proceed to Step 2 to update license of an existing installation. Use this option when you have COMSOL 4.0a installed and get a new license file. The installer then removes features/products not licensed any more and lets you go through the **Add/Remove Features** procedure to add or remove features for the new license. If your trial license has expired you can use the **Change License** option to re-enable the old (paid) license.
 - Click **Uninstall COMSOL 4.0a** to remove an existing installation.



Note: You can change the path to the existing installation by pressing the F1 key.

2 Once you have read the license agreement, click the **I accept the terms of the license agreement** button and specify the license. You can use one of the following license formats:

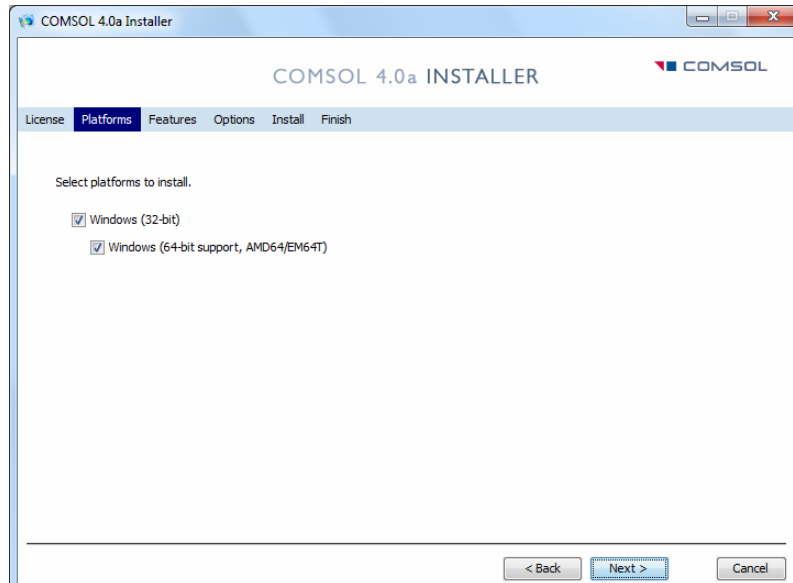
- **Passcode:** Enter your passcode, which is a series of characters and numbers that has a form similar to FFFFFFFF-CUSV-123456-1234567-123456789. The passcode is case sensitive.
- **License file:** Enter the path to an existing license file or click **Browse** to select the file `license.dat`.
- **Port number** and **Host name:** Enter the host name of an existing license server and its license server port number.
- **Three-server redundancy:** Enter the host names and license server port numbers of an existing three-server redundant configuration.



Note: If you clicked **Change License** in Step 1, you can choose to use an existing paid license or trial license, or you can choose to specify a new license. Click **Next** and proceed to Step 4 if you change the license to a license with different products. Otherwise, proceed to Step 9.

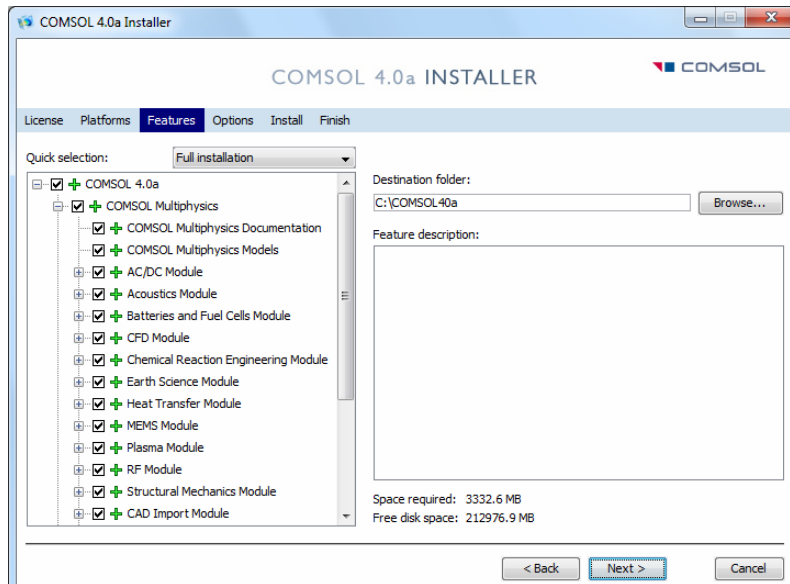
3 Click **Next**.

4 On the **Platforms** page, you can typically accept the default settings.








5 Click **Next**.

- 6 Select the features to install and specify the path to the COMSOL installation directory.



Feature symbols:

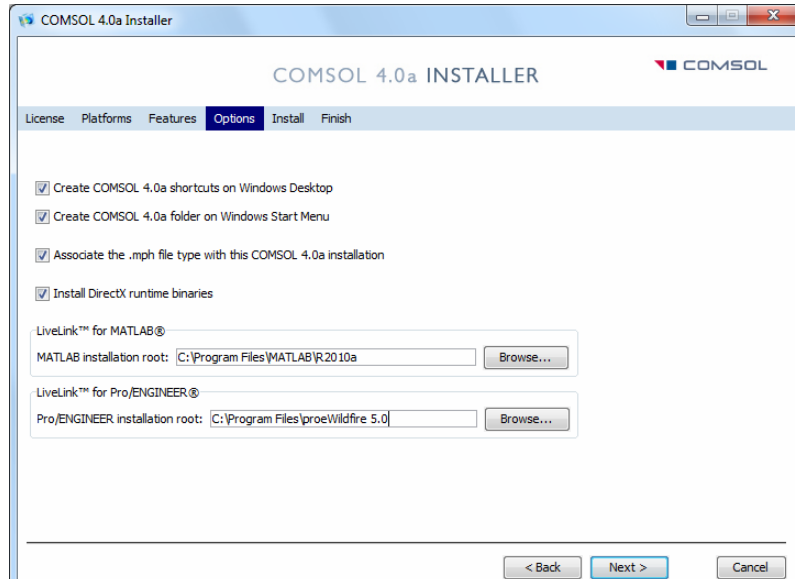
-  — not currently installed, will be installed
-  — not currently installed, will not be installed
-  — currently installed, will not be updated
-  — currently installed, will be updated
-  — currently installed, will be removed

Note: If you clicked **Add/Remove Features** or **Change License** in Step 1, the **Features** page includes a **Repair all selected features** check box.

- 7 Click **Next**.

8 Set the installation options:

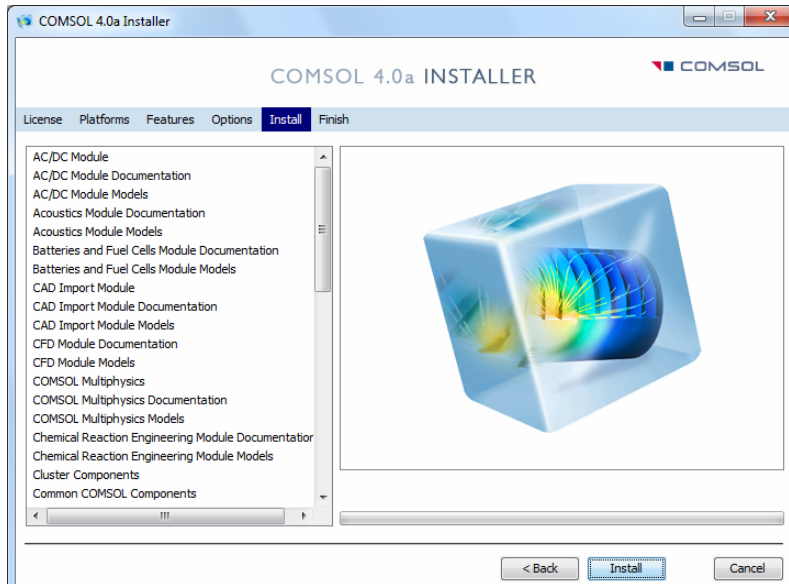
- Create COMSOL shortcuts on the Windows Desktop
- Create COMSOL shortcuts on the Windows Start Menu
- Associate the COMSOL Multiphysics model file type (.mph files) with the COMSOL installation. If you choose this option you can open COMSOL models by double-clicking them.



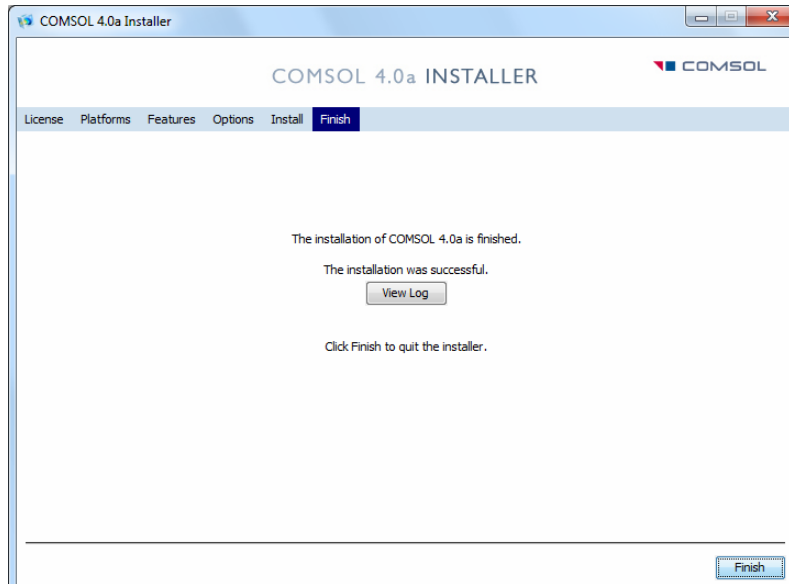
- For the LiveLink products for MATLAB and Pro/ENGINEER specify the path to the MATLAB and Pro/ENGINEER installations.

9 Click **Next**.

10 When you click **Install** the utility now installs or updates COMSOL. The installation process might take several minutes. The **Finish** page in Step 9 appears automatically when the installation process is finished.



- || This window appears when the installation is finished. Click **View Log** to open a window that shows the installation log. Click **Finish** to quit the installer.



Automated Installation

You can install COMSOL using an automated installation process with minimal user interaction. An answer file then responds to questions while the installer is running. The answer file is a text file with a specific format that contains predefined settings that the COMSOL installer uses. Start the installation by running

```
<path to DVD>\setup.exe -s <answer file path>
```

where *<answer file path>* is the path to your answer file. A template answer file, `setupconfig.ini`, with detailed usage information is available on the DVD.

Removing (Uninstalling) the COMSOL Installation

To remove a COMSOL installation from your system, use the COMSOL uninstaller.

Note: The uninstaller deletes all COMSOL 4.0a files and directories on the system that were installed by the COMSOL installer. Files and folders created after installation are not removed.

STARTING THE UNINSTALLER

To start the COMSOL uninstaller, insert the COMSOL DVD.

Click **Uninstall** to start removing the installation. Click **Finish** to quit the installer when the deinstallation is complete.

Note: If you run COMSOL Multiphysics with MATLAB, close MATLAB before starting the uninstaller. If MATLAB is active, the utility cannot remove certain files.

Automated Removal (Uninstallation) of COMSOL 4.0a

Similar to how you can automate the installation, you can also uninstall COMSOL using an answer file. The documentation on how to create such an answer file is in the template answer file, `setupconfig.ini`, which is available on the DVD. When you have created an answer file for uninstalling, you start the uninstallation by running

```
<path to DVD>\setup.exe -s <answer file path>
```

where *<answer file path>* is the path to your answer file.

Changing the Path to the MATLAB Installation

Edit the file `comsolserver.ini` and `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `C:\COMSOL40a`). In the file, change the line

```
-Dcs.mlroot=c:/program files/matlab/2010a
```

to point to the root directory of your MATLAB installation.

Adding the LiveLink Interface to SolidWorks

If you have bought the LiveLink product for SolidWorks, the COMSOL Installer adds an add-in to SolidWorks called the **LiveLink for COMSOL (4.0)**. This add-in should appear in the SolidWorks user interface, listed in the **Add-Ins** dialog box, accessible from the **Tools** menu.

The connection between COMSOL and SolidWorks can fail if SolidWorks is installed after COMSOL or if you make manual changes to the Windows registry. In the case of such a failure, it is possible to set up the connection as follows:

- 1 Close SolidWorks if it is running on your computer.
- 2 Click the Start menu symbol in the lower-left corner of your Windows desktop.
- 3 Type `cmd` in the **Start Search** field.
- 4 `cmd.exe` appears in the list of programs. Right-click on it and select **Run as administrator**.
- 5 In the command window that appears type one of the following, depending on your operative system
 - on 32-bit Windows: `regsvr32`
`C:\COMSOL40a\ext\plug-ins\SolidWorks\win32\cslivelinksw.dll`
 - on 64-bit Windows: `regsvr32`
`C:\COMSOL40a\ext\plug-ins\SolidWorks\win64\cslivelinksw.dll`In the above `C:\COMSOL40a` is the local path to your COMSOL installation.
- 6 Open SolidWorks and on the **Tools** menu select **Add-Ins**.
- 7 In the **Add-Ins** dialog box that opens, make sure that the **LiveLink for COMSOL (4.0)** item is active by checking the appropriate check boxes.

Adding the LiveLink Interface to Autodesk Inventor

If you have bought the LiveLink product for Inventor, the installer adds an add-in to Autodesk Inventor called the **LiveLink for COMSOL (4.0)**. This add-in should appear in the **Add-In Manager** dialog box which is accessible from the **Options** tab of the **Tools** panel in the Autodesk Inventor user interface.

In case the connection between COMSOL and Autodesk Inventor fails, it is possible to set up the connection as follows:

- 1 Close Autodesk Inventor if it is running on your computer.
- 2 Click the Start menu symbol in the lower-left corner of your Windows desktop.

- 3 Type `cmd` in the **Start Search** field.
- 4 `cmd.exe` appears in the list of programs. Right-click on it and select **Run as administrator**.
- 5 In the command window that appears type one of the following, depending on your operative system (note that you must write the complete command string on a single row):
 - on 32-bit Windows:


```
C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\RegAsm.exe
C:\COMSOL40a\ext\plug-ins\Inventor\win32\cslivelinkinv.dll /
codebase /
tlb:C:\COMSOL40a\ext\plug-ins\Inventor\win32\cslivelinkinv.tlb
```
 - on 64-bit Windows:


```
C:\WINDOWS\Microsoft.NET\Framework64\v2.0.50727\RegAsm.exe
C:\COMSOL40a\ext\plug-ins\Inventor\win64\cslivelinkinv.dll /
codebase /
tlb:C:\COMSOL40a\ext\plug-ins\Inventor\win64\cslivelinkinv.tlb
```

In the above `C:\COMSOL40a` is the local path to your COMSOL installation.
- 6 Open Autodesk Inventor and check that the add-in **LiveLink for COMSOL (4.0)** appears and is loaded in the **Add-In Manager** dialog box.

Changing the Path to the Pro/ENGINEER Installation

If you have bought the LiveLink product for Pro/ENGINEER, you need to provide the installation path for Pro/ENGINEER during the install process. After the installation you can configure the interface to work with a different Pro/ENGINEER installation. Edit the file `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `C:\COMSOL40a`). In the file, change the line starting with

```
-Dcs.proeroot
```

to point to the root directory of your Pro/ENGINEER installation, typically

```
-Dcs.proeroot=C:/Program Files/proeWildfire 5.0
```

License Manager Installation

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. We refer to the computer where the license manager is installed as the *license server* and any computers where the COMSOL applications are installed as *clients*. You can install COMSOL anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server *and* a client, holding both the license manager and COMSOL. The COMSOL license manager does *not* require a MATLAB license manager.

To install a license manager, start by following the instructions in the section “Before You Begin” that follows immediately.

You can install the license manager and COMSOL in any order. You cannot perform a full test of the installation until you have installed both.

COMSOL uses the FLEXnet™ license manager version 11 from Acresso Software Inc. for license management. (Note that FLEXnet was formerly called FLEXlm.)

Before You Begin

SYSTEM REQUIREMENTS

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager you need not consider memory and graphics requirements. The COMSOL license manager is completely independent of the MATLAB license manager.

OBTAINING A FLEXNET LICENSE FILE

To install a COMSOL license manager you need a FLEXnet license file, `license.dat`. It looks something like this:

```
SERVER <my_server> 00b0d05d1635 1718
USE_SERVER
VENDOR LMCMSOL
FEATURE SERIAL LMCMSOL 4.0a permanent uncounted \
  VENDOR_STRING=T,334000 HOSTID=DEMO SN=1234567 \
  SIGN=123456789ABC
```

```
INCREMENT COMSOL LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT COMSOLGUI LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT CHEM LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT ACDC LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT SME LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC
```

As noted earlier, you should have received a COMSOL `license.dat` file with the COMSOL package. If you have not received it, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name `<my_server>`, the hostid of the license server, and an optional port number.

Make sure that the license server name is the actual name of your license server; otherwise, change it by editing the file. You can also change the default port number (1718). This is necessary in the unlikely case that another program is already using that port number. If it becomes necessary to change the port number, any unused number between 1025 and 64,000 is valid.

The `VENDOR` line defines the name of the vendor daemon binary, `LMCOMSOL`.

Note: If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager. To implement this requirement, first edit the `VENDOR` line in the `license.dat` file to read `VENDOR LMCOMSOL port=1719` (the number can be any unused port number in the allowed range). Then configure your firewall to allow access to the chosen port numbers (in the example above, those numbers are 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, please contact your system administrator.

Note: Do not modify anything in the `license.dat` file except license server name and (if necessary) port numbers or your license will not work.

The **SERIAL** line contains license information.

The **INCREMENT** (can also be **FEATURE**) lines contain a product name, version, expiration date, and the number of available licenses. The example file just given shows that the user has a permanent COMSOL 4.0a license allowing ten concurrent users of COMSOL Multiphysics and five concurrent users of the Chemical Reaction Engineering Module, the AC/DC Module, and the Structural Mechanics Module. The number after “**SIGN=**” at the end of each **INCREMENT** line contains a license key. To break up long lines use the continuation character (`\`).

In the event you have not received the `license.dat` file, you must provide us with the hostid of your license server (see “Obtaining a Hostid” on page 25 for instructions) and preferably your license server name. Please have them ready when contacting your local COMSOL representative.

License Manager Installation on Windows

You only need to install the license manager if you have obtained a license file that starts with a line that contains the word **SERVER**.

The license server requires these components:

- COMSOL license manager files (FLEXnet)
- License file (`license.dat`)

COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of four components:

- License manager daemon (`lmgrd.exe`)
- Vendor daemon (`LMCOMSOL.exe`)
- FLEXnet utility program (`lmutil.exe`)
- FLEXnet Control Panel (`lmtools.exe`)

The two daemons (`lmgrd.exe` and `LMCOMSOL.exe`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd.exe` daemon. That daemon in turn makes a request to the vendor daemon (`LMCOMSOL.exe`), which releases licenses according to information in `license.dat`. The utility program and Control Panel handle license-server management. For more information on FLEXnet

management, see Chapter 7 in the *FLEXnet Licensing End Users Guide* available from the COMSOL Help Documentation.

INSTALLING THE LICENSE MANAGER FILES

Install the license manager only on the host(s) listed in `license.dat`.

If you want to install COMSOL on the same host as the license manager, first perform a complete COMSOL installation because that procedure installs the license manager files along with COMSOL. See the section “Installing COMSOL” on page 9 for installation instructions. When finished, skip the remainder of this section and continue with “Starting the License Manager” on page 23.

To install only the COMSOL license manager files, follow these instructions:

- 1** Insert the DVD into the DVD drive.
- 2** Follow the installation instructions starting on page 10 until you reach the **Features** screen in Step 4.
- 3** In the list of products to install, select only the **License Manager** check box.
- 4** Continue from the **Features** screen in the installation instructions to complete the license manager file installation.

Automated License Manager Installation

Alternatively, you can install the license manager using an automated installation process with minimal user interaction. See the section “Automated Installation” on page 16. Set `licmanager = 1` in the answer file to install the license manager.

STARTING THE LICENSE MANAGER

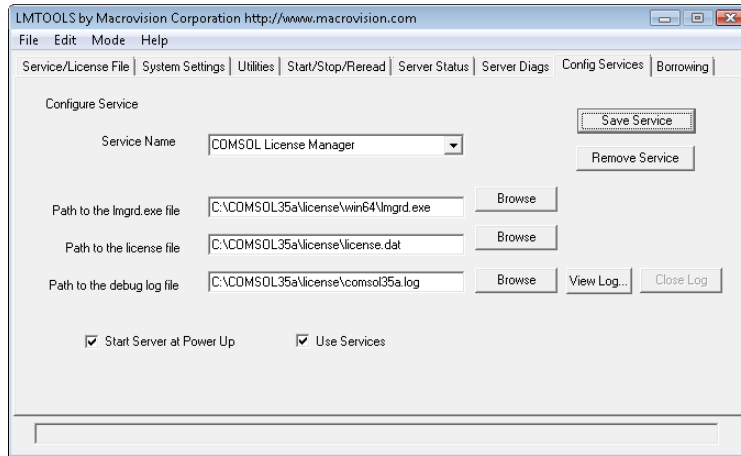
You can start the license manager manually, or it can run automatically as a service at boot.

Starting the Manager Automatically as a Service

To set up the license manager as a service from the FLEXnet Control Panel:

- 1** Locate the `COMSOL40a\license\win32` (32-bit Windows) or `COMSOL40a\license\win64` (64-bit Windows) directory and run `lmttools.exe`.
- 2** On the **Service/License File** page choose **Configuration using Services**. Note that you must perform this step every time you start the FLEXnet Control Panel.
- 3** Click the **Configure Services** tab.
- 4** Make an entry in the **Service Name** edit field, for example, `COMSOL License Manager`.

- Specify the full path to `lmgrd.exe`, `license.dat`, and the debug log file of your choice.
- Select the **Use Services** check box (this might not be possible on all platforms, but it is recommended) and then the **Start Server at Power Up** check box.



- Click **Save Service**. The license manager now starts at boot. If you prefer, start the license manager directly by choosing **Start Server** on the **Start/Stop/Reread** page.

Starting the Manager Manually

To start the license manager manually, change to the `license\win32` (Windows) or `license\win64` (64-bit Windows) directory. Now, in a command window enter

```
lmgrd -c ..\license.dat -l ..\comsol40a.log
```

The license manager is now ready to distribute licenses over the network. It writes debug information to the log file `COMSOL40a\license\comsol40a.log`.

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s), you can start using COMSOL.

Changing the License

If you have received a new license file—for example, when adding COMSOL products to an existing license—replace your current license file with the new one.

Double-check the contents of this file to make sure it lists the products that your license includes.

When you have changed the license file you must restart the license manager; otherwise, it will continue to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager, follow these steps:

- 1** In the Windows Start menu, choose **COMSOL4.0a>License Tools>LMTTOOLS**.
- 2** In the FLEXnet Control Panel, click, in turn, **Stop Server**, **ReRead License File**, and **Start Server**.

Obtaining a Hostid

If COMSOL is already installed on your license server, you can determine the hostid by executing the `lmhostid` command

```
COMSOL40a/license/$arch/lmhostid
```

where `$arch` is `win32` (32-bit Windows) or `win64` (64-bit Windows).

If COMSOL is not installed, you must obtain a hostid using the: `ipconfig /all` command on the license server (see section “Obtaining the Hostid” below).

All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

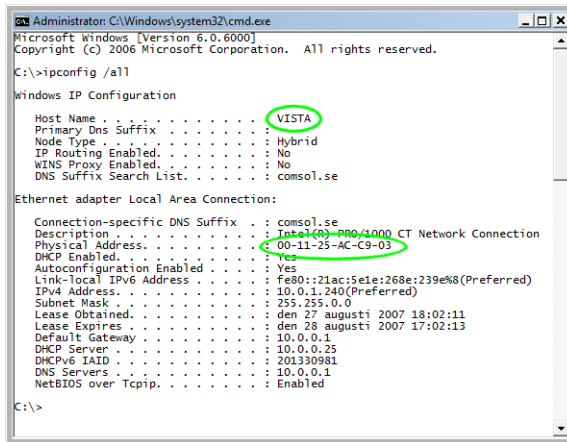
OBTAINING THE HOSTID

- 1** Open the Start menu and click **Run**.
- 2** Type `cmd` and click **OK** and the command window opens.
- 3** Type

```
ipconfig /all
```

and press Enter.

- 4 The FLEXnet hostid is equal to the **Physical Address**, which is displayed in the next image, with the hyphens removed. For example, 00-11-25-AC-C9-03 becomes the hostid 001125ACC903).



```
Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.0.6000]
Copyright (c) 2006 Microsoft Corporation. All rights reserved.

C:\>ipconfig /all

Windows IP Configuration

Host Name . . . . . VISTA
Primary Dns Suffix . . . . .
Node Type . . . . . Hybrid
IP Routing Enabled. . . . . No
WINS Proxy Enabled. . . . . No
DNS Suffix Search List. . . . . comsol.se

Ethernet adapter Local Area Connection:

Connection-specific DNS Suffix . : comsol.se
Description . . . . . Intel(R) PRO/1000 CT Network Connection
Physical Address. . . . . 00-11-25-AC-C9-03
Dhcp Enabled. . . . . Yes
Autoconfiguration Enabled . . . . . Yes
Link-local IPv6 Address . . . . . Fe80::21ac:5e1e:268e:239e%8(Prefe
IPv4 Address. . . . . 10.0.1.240(Prefe
Subnet Mask . . . . . 255.255.0.0
Lease Obtained. . . . . den 27 august 2007 18:02:11
Lease Expires . . . . . den 28 august 2007 17:02:13
Default Gateway . . . . . 10.0.0.1
Dhcp Server . . . . . 10.0.0.25
Dhcpv6 IAID . . . . . 201330981
DNS Servers . . . . . 10.0.0.1
NetBIOS over Tcpip. . . . . Enabled

C:\>
```


Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/support/knowledgebase for up-to-date information about installation and license issues.

TABLE 2-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com .
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: <code>C:\COMSOL40a\license\comsol40a.log</code> Please send the log file to support@comsol.com if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section “License Manager Installation” on page 20 for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the <code>lmgrd</code> daemon and the <code>LMCOMSOL</code> daemon. If the problems remain, send the license manager log file to support@comsol.com . The log file is usually placed here: <code>C:\COMSOL40a\license\comsol40a.log</code>

TABLE 2-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -15. Cannot connect to license server system.	<p>The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>a license manager is required. Please refer to the section “License Manager Installation” on page 20 for instructions how to install and start the COMSOL license manager.</p> <p>Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.</p> <p>Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.</p> <p>Check that the license.dat file on the COMSOL client computer points to the correct license server hostname. First, find the license.dat file in the COMSOL application folder:</p> <pre>C:\COMSOL40a\license\license.dat</pre> <p>Check that the first line has the correct license-server hostname. For example, if your license server hostname is mylicserver, the first row in the license.dat file should look like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>If the COMSOL client computer does not recognize mylicserver as a proper hostname, it might help to instead use the fully qualified domain name (mylicserver.mydomain.org) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.</p> <p>Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:</p> <pre>C:\COMSOL40a\license\comsol40a.log</pre> <p>NOTE: The log file is created by the license manager after it has been started.</p> <p>Please send the log file to support@comsol.com if you want help in interpreting the information.</p>

TABLE 2-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, LMCOMSOL .opt. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the license .dat file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The license .dat file is located in the COMSOL application folder: C:\COMSOL40a\license\license.dat
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: C:\COMSOL40a\license\comsol40a.log NOTE: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

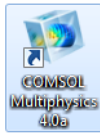
Running COMSOL

The installer adds the folder **COMSOL 4.0a** to the **Start** menu under the **Programs** item. That folder contains a selection of the items in the following list depending on the licensed COMSOL software products you have:

- **COMSOL Multiphysics:** Opens COMSOL Multiphysics. A corresponding shortcut is added to the desktop.
- **COMSOL with MATLAB:** Starts MATLAB 2009b/2010a and sets up all necessary paths. Also starts a COMSOL server connected to MATLAB. A corresponding shortcut is added to the desktop.
- **COMSOL Multiphysics Server:** Starts a COMSOL Multiphysics server that a COMSOL Multiphysics client can connect to (see the section “” on page 98).
- **Documentation:** A folder that contains COMSOL documentation shortcuts.

Running COMSOL Multiphysics

You can run COMSOL Multiphysics by double-clicking the **COMSOL Multiphysics 4.0a** icon on the desktop.



Alternatively, to activate COMSOL Multiphysics from the **Start** menu, point to **Programs**, then to **COMSOL 4.0a**, and then click **COMSOL Multiphysics**.

Running COMSOL on Multicore and Multiprocessor Computers

COMSOL uses all cores and all processors on your computer to run using shared-memory parallelism. It uses the system environment variable `NUMBER_OF_PROCESSORS` to determine the number of available cores and processors. See the section “Shared-Memory Options” on page 35 to override this behavior.

Running a Classkit License

The COMSOL installation program automatically installs a shortcut on the desktop that launches COMSOL using your classkit license. The shortcut launches COMSOL with the `-ckl` option.

Running COMSOL in Batch Mode

You can launch COMSOL jobs from the Desktop and the command line. In the Model Builder, right-click on a **Study** node and select **Batch** to create batch jobs. See the section “COMSOL Batch Commands” on page 38 for command-line options.

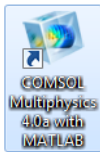
Running COMSOL on Clusters

You can launch COMSOL cluster jobs from the COMSOL Desktop and the command line. In the **Model Builder**, right-click a **Study** node and select **Cluster Computing** to create cluster jobs. See the section “COMSOL Cluster Commands” on page 39 for command-line options.

Note: Cluster computing requires an FNL (floating network) license.

Running COMSOL Multiphysics with MATLAB

To run COMSOL Multiphysics with MATLAB, double-click the **COMSOL 4.0a with MATLAB** icon on the desktop.



Alternatively, start COMSOL Multiphysics with MATLAB from the **Start** menu by pointing to **Programs**, then to **COMSOL 4.0a**, and then select **COMSOL with MATLAB**.

Note: Running COMSOL Multiphysics with MATLAB starts a COMSOL server and a MATLAB Desktop. No COMSOL graphical user interface is involved. For tutorial on using the LiveLink interface for MATLAB, see the *LiveLink for MATLAB User's Guide*.

In addition, you can start COMSOL with MATLAB in COMSOL 3.5a compatibility mode, by selecting **COMSOL with MATLAB (COMSOL 3.5a compatibility)** under **COMSOL 4.0a** from the start menu. See the section “Importing and Exporting a Model” on page 12 of the *LiveLink for MATLAB User's Guide*.

Note: Running COMSOL Multiphysics with MATLAB requires a LiveLink for MATLAB license.

COMSOL Commands

Use a COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL commands is

```
<command> [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. On windows there are several different commands (See *<command>* in the command syntax) that can be combined with optional targets to achieve various results. The table below lists the major available commands and targets.:

TABLE 2-3: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
comsol	Run standalone COMSOL Multiphysics	
comsolserver	Start COMSOL Multiphysics server	
comsol client	Run COMSOL Multiphysics client	
comsolbatch	Run a COMSOL MPH file or class file	
comsolcompile	Compile a Model Java file	
comsolcluster	Run COMSOL Desktop on a cluster	Requires a floating network license (FNL)
comsolclusterbatch	Run COMSOL cluster version in batch mode	Requires a floating network license (FNL)
comsolclusterserver	Run COMSOL cluster server	Requires a floating network license (FNL)
comsolserver matlab	Start MATLAB and connect to a COMSOL server	Requires a LiveLink for MATLAB license
comsol matlab	Start MATLAB and setup COMSOL paths	Requires a LiveLink for MATLAB license
comsol convertpre35a	Convert 3.0–3.5 models	

The commands are available in 32-bit versions in the subdirectory `bin\win32` in the COMSOL installation directory, and in 64-bit versions in the subdirectory `bin\win64` in the COMSOL installation directory. The COMSOL installer sets up a few of the possible commands on your start menu and your desktop. To create additional customized commands, you can create shortcuts including all argument and put them on your desktop. You can also issue COMSOL commands in a command window. To conveniently access the command in a command window, you need to set up the Windows path to include one the paths `bin\win32` or `bin\win64` in the COMSOL installation directory.

INI FILES

For each launcher file, there is a corresponding `.ini` file in the same directory. We may sometimes recommend that you edit these files. For example, you can add options to any of the above commands by modifying the corresponding ini file.

OPTIONS

You can enter various options after the COMSOL command and target. Table 2-4 lists the options (See [*options*]) in the command syntax) available for all `comsol` commands. Always issue these options between the command and the target (if any).

TABLE 2-4: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
<code>-h</code>	Print general help	
<code><target> -h</code>	Print target-specific help	
<code>-3drend ogl dx9 sw</code>	3D renderer: OpenGL, DirectX, or software rendering	
<code>-np <no. of processors></code>	Number of processors	See “Shared-Memory Options” on page 35
<code>-mpmode throughput turnaround owner</code>	Multiprocessor mode	See “Shared-Memory Options” on page 35
<code>-blas {auto} mkl acml path</code>	BLAS library to use	See “BLAS Options” on page 35
<code>-blaspath <path></code>	BLAS library path	See “BLAS Options” on page 35
<code>-ipv6</code>	Activate IPv6 support	
<code>-prefsdir <path></code>	Preference directory	
<code>-tmpdir <path></code>	Temporary file directory	

TABLE 2-4: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
-version	Print COMSOL version	
-version <target>	Print target version	
-ckl	Use class-kit license	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefdir` option specifies the directory where COMSOL should store the preference file.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. The following options are available:

TABLE 2-5: COMSOL BLAS OPTIONS

MPMODE OPTION	DESCRIPTION
throughput	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
turnaround	Typically provides the best performance when no other processes than COMSOL are active.
owner	Provides the highest performance in most cases.

You might need to experiment to determine what options works best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides for the following BLAS related options:

TABLE 2-6: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL for Intel processors, and ACML for AMD processors with SSE2 support, otherwise MKL. (This is the default option.)
mkl	Use the Intel MKL library

TABLE 2-6: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
acml	Use the AMD ACML library
path	Use a BLAS library specified using the option <code>-blaspath</code> or the environment variable <code>COMSOL_BLAS_PATH</code> . The library must support the standard FORTRAN BLAS interface.

Both MKL and ACML are distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where ARCH is the architecture (`win32` or `win64`) or somewhere in the standard search path. You must also provide the path to any sublibraries needed by the library. You can also set the search path to point to the directory where the library is installed. To do so, use the environment variable `PATH`.

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The Windows syntax for the COMSOL server command is

```
comsolserver [<options>] [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 2-7: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTION	DESCRIPTION
<code>-user <user></code>	Specify login name for a user
<code>-port <port></code>	Specify a TCP/IP port to listen for connect attempts.
<code>-passwd <reset/nostore></code>	Specify that you want to provide a new password. To avoid storing the new password on file use <code><nostore></code>
<code>-login <{info}/force/never></code>	Ask for login information. <code>info</code> means that only missing information is asked for.
<code>-multi on {off}</code>	Accept repeated client connections

TABLE 2-7: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTION	DESCRIPTION
-silent	Do not listen to standard input
-graphics	Start the server with graphics libraries. This will display plots on the server when you are connected with a client (that is, not with the COMSOL GUI).

Accessing the COMSOL Server Computer

You can access the server computer in several ways. If it is dedicated to a single person, you can sit down at that machine and log in on it. You can also connect to the server computer by using Remote Desktop. Start the COMSOL server from the **Start** menu. If several people want to access a single Windows computer to run the COMSOL server, you must use Windows Terminal Server or another tool that allows multiple users to log in on the same Windows server. In some Windows versions, Microsoft provides a Telnet Server with which you can log in through a terminal window. When using a terminal window to log in on Windows, use the `comsolserver` command to start the COMSOL server.

Login Information

When you start a COMSOL Multiphysics server for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password in the **Connect to Server** dialog box. The software writes this login information in the subdirectory `.comsol/ver40a/login.properties` in your Windows home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Always make sure that untrusted users cannot access the COMSOL login information. Thus you must protect the file `.comsol/ver40a/login.properties` in your home directory. This is important when using COMSOL Multiphysics' client/server feature.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the

COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [<options>] client [<target arguments>]
```

The following target arguments are available for a COMSOL client command.

TABLE 2-8: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
-port <port>	Specify a TCP/IP port to connect to
-server <server name>	Specify server to connect to

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. You can run both Model MPH-files and Model Java-files with the COMSOL batch command. Model Java files need to be compiled before running.

The Windows syntax for the COMSOL batch command is

```
comsolbatch [<options>] [<target arguments>]
```

Its detailed target arguments are:

TABLE 2-9: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
-inputfile <file name>	Run a Model MPH-file or class file
-outputfile <file name>	Save a Model MPH-file using the given file name. If output is not given, the input file will be overwritten with the output
-job <job name>	The batch job to run

TABLE 2-9: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
-study <study name>	The study to compute
-pname <parameter name>	Comma-separated list of parameter names
-plist <parameter value>	Comma-separated list of parameter values
-batchlog <file name>	File to store log in
-client	Run as client
-host	Connect to host
-port	Connect to port
-graphics	Start COMSOL batch with graphics libraries. This will display plots during postprocessing.

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsol batch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the out.mph.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compile a model Java file for use by the COMSOL batch command or for loading class files into the GUI. The Windows syntax for the COMSOL compile command is

```
comsolcompile [<options>] [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available⁴

TABLE 2-10: COMSOL CLUSTER TARGET ARGUMENTS

COMSOL COMPILE TARGET ARGUMENTS	DESCRIPTION
-jdkroot <path>	Path to the JDK root
-classpathadd <classpath>	Additional classpath
-verbose	Verbose output

COMSOL CLUSTER COMMANDS

Use COMSOL cluster commands to run COMSOL on clusters. You can run both Model MPH-files and Model Java files with the COMSOL cluster batch command. Model Java files need to be compiled before running. You can also start a COMSOL

server on a cluster node. Running COMSOL server on a cluster requires that you have TCP/IP access to the node on the cluster where the COMSOL server is started. If you have access to the displays of the cluster nodes, you can also start the COMSOL Desktop on the cluster. All COMSOL cluster commands require a floating network license.

The Windows syntax for the COMSOL cluster command is

```
mpiexec -n <no. of nodes> <command> [<options>] [<target arguments>]
```

The following cluster commands are available:

TABLE 2-11: COMSOL CLUSTER TARGETS

COMSOL CLUSTER COMMANDS	DESCRIPTION
comsolclusterbatch	Run COMSOL on a cluster in batch mode
comsolclusterserver	Run COMSOL server on a cluster
comsolcluster	Run COMSOL Desktop on a cluster

Prefer starting COMSOL jobs from the Job node in the COMSOL Desktop. If you need to start COMSOL jobs from the command line, prefer using the `comsolclusterbatch` command since the `comsolclusterserver` and `comsolcluster` command require non-typical cluster configurations.

Running on Windows

Make sure that you have installed Windows HPC Server 2008 or Windows Compute Cluster Server 2003. Running distributed COMSOL on other Windows versions is not supported.

On Windows we recommend that you start COMSOL from the Compute Cluster Job Manager. By default COMSOL uses as many processors as are available on each physical node for shared-memory parallelism on Windows. Therefore it is best to explicitly set the number of processors. Make sure that you set the Windows HPC Server 2008 working directory to point to the `comsol` command directory (*<path to COMSOL install directory>\bin*). The install directory must be shared between the nodes on your cluster. Also make sure that the Microsoft Visual Studio 2005 and 2008 Runtimes are installed on all nodes. You can install them from the root directory of the DVD using the `clusrun` command for instance. They are called `vcredist_*.exe`. Also make sure that all nodes that you intend to run COMSOL on have access to the license manager and that you can start COMSOL running in non-distributed mode. The nodes require access to the license manager in order to check out licenses; otherwise the start process is aborted.

Example of the COMSOL Batch Command

Schedule a job with one of the commands

```
mpiexec -n -1 comsolbatch.exe -np 1 -inputfile <filename>  
mpiexec -n -1 comsolbatch64.exe -np 1 -inputfile <filename>
```

to run a COMSOL batch on a number of computational nodes given by `mpiexec`. For further information about the `mpiexec` command and Windows HPC Server 2008, consult the documentation that was shipped with the product and the online manuals.

Example of the COMSOL Server Command

When you create a COMSOL server cluster job, you must set a preference directory reachable from all nodes to avoid problems with the server login; see “COMSOL Commands” on page 33 and “Login Information” on page 37. You can generate the preferences by starting COMSOL server once on the head node using the command

```
comsolserver.exe -prefsdir <prefsdir>
```

where `<prefsdir>` is a preference directory *common* to all nodes.

When you start the COMSOL server on the cluster, the port number will be written to standard output, so you must set a standard output file and a standard error file for the cluster job. To start a COMSOL server, schedule a job with one of the following commands:

```
mpiexec -n -1 comsolserver.exe -np 1 -prefsdir <prefsdir>  
mpiexec -n -1 comsolserver64.exe -np 1 -prefsdir <prefsdir>
```

The argument `-1` indicates that the number of computational nodes is decided at the `mpiexec` launch. You must be able to access the IP address of the COMSOL server from your COMSOL client computer.

COMSOL MPI Options

The COMSOL cluster target arguments specify what MPI library to use and what Scalapack version to use. There are several implementations of MPI. COMSOL by default uses the Windows HPC Server 2008 or Windows CCS 2003 MPI libraries. COMSOL also supports most MPI implementations based on MPICH2. We recommend that you use the default library. COMSOL also has a compatibility mode that you can activate by adding the option `-mpi mpich2`. When using this option both the variables `PATH` and `LD_LIBRARY_PATH` must include your MPI implementation. It is also possible to use other MPI libraries based on MPICH2 using the option

-mpipath <path to shared library>. The following target arguments are available for a COMSOL cluster commands.

TABLE 2-12: COMSOL CLUSTER TARGET ARGUMENTS

COMSOL BATCH TARGET ARGUMENTS	DESCRIPTION
-mpi {auto} mpich2 wccs2003 whpc2008 user path	MPI library to use
-mpipath <path>	MPI library path
-scalapack {auto} mpich2 wccs2003 whpc2008 user path	Scalapack library to use
-scalapackpath <path>	Scalapack library path

The Cluster Computing study allows you to setup a batch job for submission to a Windows HPC Server 2008 job scheduler or Windows Compute Cluster Server 2003 job scheduler. There are several settings that you can configure in the `comsol.ini` file in order to get default settings:

- Dcs.scheduler=<IP or network address>
- Dcs.clusteruser=<Username on cluster>
- Dcs.rundir=<Where the model file is located on the cluster>
- Dcs.comsoldir=<Installation path to comsol on the cluster>

Additionally you can configure the commands:

- Dcs.precmd=<Command line>
- Dcs.postcmd=<Command line>

This will add commands prior to the `comsol` command and after the `comsol` command. You can add `{nn}` or `{perhost}` to any of these pre- or postcommands. This configures the Cluster Computing study to use the number of nodes and number of nodes on each host from the corresponding settings for the Cluster Computing study. For more information see the documentation for the Cluster Computing study in the *COMSOL Multiphysics Reference Guide*.

COMSOL MATLAB COMMANDS

Use the COMSOL MATLAB commands to access the COMSOL API through MATLAB. The LiveLink interface for MATLAB requires that MATLAB runs connected to a COMSOL server. The easiest way to start COMSOL with MATLAB is to use the command:

```
comsolserver matlab [<options>]
```


This command launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server. To create a model object you need to type

```
model = com.comsol.model.ModelUtil.create(<name>);
```

in MATLAB. After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The command

```
comsol matlab [<options>]
```

starts MATLAB with paths ready to communicate with a COMSOL server. To connect to a server work with a model, and close the server connect type, type

```
com.comsol.model.ModelUtil.connect(<host>,<port>);
model = com.comsol.model.ModelUtil.create(<name>);
% work with your model
com.comsol.model.ModelUtil.disconnect;
```

After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The following options are available for the `comsol matlab` command.⁴

TABLE 2-13: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
<code>-mlroot <path></code>	MATLAB installation directory
<code>-host <hostname></code>	Connect to host
<code>-port <hostname></code>	Connect to port
<code>-desktop</code>	Start with Desktop
<code>-nodesktop</code>	Start without Desktop
<code>-compat</code>	Run in COMSOL 3.5a compatibility mode
<code>-c35aroot</code>	The COMSOL 3.5a root directory path
<code>-graphics</code>	Start the server with graphics libraries. This enables plotting on the server. Available only when running <code>comsolserver matlab [<options>]</code> .

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, type

```
comsol [options] <input directory> <output directory> [log file]
```

where <input directory> is the input directory, <output directory> is the output directory, and [log file] is an optional log file. If you do not provide the third argument, the log is printed on standard output.

TABLE 2-14: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
-c35aroot <path>	Installation path of COMSOL 3.5a

Installing and Running on Linux

This chapter provides detailed instructions for installing and running the COMSOL software on Linux. You also find complete system requirements and license manager information. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Linux. Also see the COMSOL Support Knowledge Base on www.comsol.com for specific troubleshooting tips.

System Requirements

General Requirements

These requirements are common to all platforms:

- A DVD drive for installation
- TCP/IP activated
- 1 GB memory, preferably more
- 1-4 GB of disk space, depending on your licensed products and installation options
- Adobe Acrobat Reader 9.0 or later to view and print the COMSOL documentation in PDF format

FLOATING NETWORK LICENSES

Floating network licenses are supported on heterogeneous networks of Windows, Linux, and Mac computers. Both the license manager and the COMSOL application can run on either Windows, Linux, or Mac OS X, and a single computer can run both of them.

COMSOL Multiphysics System Requirements for Linux

SYSTEM REQUIREMENTS—32-BIT LINUX

- GNU C Library version 2.3.6 or later
- Linux kernel 2.6.18 or later
- Intel Pentium IV or AMD Athlon processor or later.

SYSTEM REQUIREMENTS—64-BIT LINUX

- GNU C Library version 2.3.6 or later
- Linux kernel 2.6.18 or later
- A PC with one of these processors: AMD with AMD64 or Intel with EM64T.

OFFICIALLY SUPPORTED LINUX DISTRIBUTIONS

The following Linux distributions are officially supported by COMSOL:

PLATFORM	DISTRIBUTION
32-bit Linux	Debian 4.0, 5.0, RedHat Enterprise 5, Fedora Core 10, OpenSUSE 11.1
64-bit Linux	Debian 4.0, 5.0, RedHat Enterprise 5, Fedora Core 10, OpenSUSE 11.1

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons. Drivers supporting OpenGL version 1.3 are required. Alternatively, use software rendering; see “Options” on page 65.

Optional LiveLink Interface for MATLAB Requirements

The LiveLink interface for MATLAB is compatible with MATLAB 2009b and 2010a. Using MATLAB functions is not supported in MATLAB 2009b.

Optional Products for CAD Interoperability

The following products support import of 3D CAD files on Linux platforms:

TABLE 3-1: PRODUCTS FOR CAD INTEROPERABILITY ON LINUX

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCT
CAD Import Module	ACIS (SAT), IGES, Parasolid, Pro/E, and STEP	COMSOL Multiphysics

Parallel System Requirements

COMSOL 4.0a supports shared-memory parallelism and distributed-memory parallelism for 32-bit and 64-bit Linux. For distributed-memory parallelism, COMSOL 4.0a supports Red Hat Enterprise Linux 5, and all computers in the cluster must use the same Linux version and should have similar hardware.

Internet Protocol Support

IPv4 and IPv6 are supported on all Linux platforms.

Installing COMSOL

Before You Begin

Check that you have a license file `license.dat`, which you should have received by email. If you have not received a license file, contact your local COMSOL representative.

The license manager must be installed and started before running a COMSOL software product with the exception of trial licenses, which do not require a license manager. See “License Manager Installation” on page 51 for instructions. You can install your COMSOL software products and the license manager in any order.

The installation program is an X-Windows application and needs access to an X-Windows display to run. Make sure that your `DISPLAY` variable is set up correctly and that you have access to an X-Windows display. Try the command `xclock` to test that the X-Windows display is working properly. To install your COMSOL software products in a system directory such as `/usr/local`, you might need to run the installation program as the root user. The COMSOL installer for Linux does not modify any files on your system outside the COMSOL installation directory.

Installing COMSOL 4.0a

- 1 Insert the COMSOL 4.0a DVD into the DVD drive.
- 2 If the DVD is not mounted automatically by your operating system, use the `mount` command to mount it.
- 3 To start the installation, enter the command

```
sh drivepath/setup
```

where *drivepath* is the mount point of the DVD drive, for example, `/media/cdrom`.
- 4 When the installer window appears, click **New Installation**.
- 5 Read the license agreement, select **I accept the terms of the license agreement**, specify **License information**, and then click **Next**.

Note: If you have a Named Single User License and you are installing the software on the license server a dialog box will open up at this point and you will be asked to enter the user to bind the license to.

- 6** Select the platforms that you want to install and click **Next**.
- 7** Select the features to install and specify the path to the COMSOL installation directory.
- 8** Click **Next**.
- 9** Specify the MATLAB root folder. MATLAB versions 2009b and 2010a work with COMSOL 4.0a.
- 10** Click **Next**.
- 11** Click **Install** to start the installation.
- 12** When the installation process is finished the **Finish** window appears. If errors arose during installation, this window issues a notification. The installer also writes a log entry into the text file `comsolsetup.log`, which resides in the specified installation directory. Click **Finish** to quit the installer. Use the `unmount` and `eject` commands to unmount and eject the DVD. Some Linux configurations automatically unmount and eject the DVD when you press the DVD drive button.

The file `browser` in the `doc` directory attempts to start common web browsers. Edit the file in any text editor to adjust it for your preferred web browser. The variable `BROWSERS` in this file contains a list of web browsers in order of preference. The default list contains the following web browsers:

- 1** Mozilla
- 2** Firefox
- 3** Konqueror
- 4** Opera
- 5** Netscape

If you, for example, want to make Opera the preferred web browser, put it first in the list.

Note: To make sure all users can easily start COMSOL, include the `comsol40a/bin` directory in all users' paths or make a symbolic link from `/usr/local/bin/comsol` to the `comsol` command (see the `ln` command).

Removing (Uninstalling) the COMSOL Installation

The COMSOL 4.0a installation adds files only in the `comsol40a` directory. To remove the COMSOL installation, simply delete the `comsol40a` directory including all subdirectories.

Automated Installation

You can supply an answer file to the installer to run an unattended installation or to avoid the need of a display during the installation. The documentation on how to create an answer file is available in the template answer file, `setupconfig.ini`, which you find on the DVD. When you have created an answer file, start the installation by running

```
<path to DVD>/setup -s <answer file path>
```

where `<answer file path>` is the path to your answer file.

Changing the Path to the MATLAB Installation

Edit the file `comsolserver.ini` and `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `/usr/local/comsol40a`). In the file, change the line

```
-Dcs.mlroot=/usr/local/matlab2010a
```

to point to the root directory of your MATLAB installation.

License Manager Installation

Introduction

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. We refer to the computer where the license manager is installed as the *license server* and any computers where the COMSOL applications are installed as *clients*. You can install COMSOL anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server *and* a client, holding both the license manager and COMSOL. The COMSOL license manager does *not* require a MATLAB license manager.

To install a license manager, start by following the instructions in the section “Before You Begin” that follows immediately.

You can install the license manager and COMSOL in any order. You cannot perform a full test of the installation until you have installed both.

COMSOL uses the FLEXnet™ license manager version 11 from Acresso Software Inc. for license management. (Note that FLEXnet was formerly called FLEXlm.)

Before You Begin

SYSTEM REQUIREMENTS

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager you need not consider memory and graphics requirements. The COMSOL license manager is completely independent of the MATLAB license manager.

OBTAINING A FLEXNET LICENSE FILE

To install a COMSOL license manager you need a FLEXnet license file, `license.dat`. It looks something like this:

```
SERVER <my_server> 00b0d05d1635 1718
USE_SERVER
VENDOR LMCOMSOL
FEATURE SERIAL LMCOMSOL 4.0a permanent uncounted \
```

```
VENDOR_STRING=T,334000 HOSTID=DEMO SN=1234567 \  
SIGN=123456789ABC  
INCREMENT COMSOL LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT COMSOLGUI LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT CHEM LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT ACDC LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT SME LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC
```

As noted earlier, you should have received a COMSOL `license.dat` file with the COMSOL package. If you have not received it, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name `<my_server>`, the `hostid` of the license server, and an optional port number.

Make sure that the license server name is the actual name of your license server; otherwise, change it by editing the file. You can also change the default port number (1718). This is necessary in the unlikely case that another program is already using that port number. If it becomes necessary to change the port number, any unused number between 1025 and 64,000 is valid.

The `VENDOR` line defines the name of the vendor daemon binary, `LMCOMSOL`.

Note: If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager. To implement this requirement, first edit the `VENDOR` line in the `license.dat` file to read `VENDOR LMCOMSOL port=1719` (the number can be any unused port number in the allowed range). Then configure your firewall to allow access to the chosen port numbers (in the example above, those numbers are 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, please contact your system administrator.

Note: Do not modify anything in the `license.dat` file except license server name and (if necessary) port numbers or your license will not work.

The `SERIAL` line contains license information.

The `INCREMENT` (can also be `FEATURE`) lines contain a product name, version, expiration date, and the number of available licenses. The example file just given shows that the user has a permanent COMSOL 4.0a license allowing ten concurrent users of COMSOL Multiphysics and five concurrent users of the Chemical Reaction Engineering Module, the AC/DC Module, and the Structural Mechanics Module. The number after “`SIGN=`” at the end of each `INCREMENT` line contains a license key. To break up long lines use the continuation character (`\`).

In the event you have not received the `license.dat` file, you must provide us with the `hostid` of your license server (see “Obtaining a Hostid” on page 58 for instructions) and preferably your license server name. Please have them ready when contacting your local COMSOL representative.

License Manager Installation on Linux

You do not need to install the license manager if you are installing a trial version. The full version, however, always requires a running license manager on Linux.

You need the following components on the license server:

- COMSOL License Manager files (FLEXnet)
- License file (`license.dat`).

COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of three components:

- License manager daemon (`lmgrd`)
- Vendor daemon (`LMCOMSOL`)
- FLEXnet utility programs (`lmutil` and others)

The two daemons (`lmgrd` and `LMCOMSOL`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd` daemon. The `lmgrd` daemon in turn makes a request to the vendor daemon (`LMCOMSOL`) to release a license. The vendor

daemon releases licenses according to information contained in `license.dat`. The utility programs are used for license-server management. For more information on FLEXnet management, see Chapter 7 in the *FLEXnet Licensing End Users Guide*, which is available on the COMSOL 4.0a Help Documentation.

INSTALLING THE LICENSE MANAGER FILES

The license manager should be installed only on the host(s) listed in `license.dat`.

If you want to install COMSOL on the same host as the license manager, first perform a complete COMSOL installation because that procedure automatically installs the license manager files along with COMSOL (see the section “Installing COMSOL” on page 48). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 56.

If you want to install only the COMSOL license manager files, follow these instructions:

- 1 Insert the DVD into the DVD drive.
- 2 To start the installation, enter the following command:

```
/media/cdrom/setup
```

depending on where `/media/cdrom` is the mount point of the DVD drive.
- 3 Continue according to the installation instructions on page 10 until the step where you see the **Features** screen.
- 4 In the list of products to install, select only the **License Manager** check box.
- 5 Resume the installation instructions with the **Features** screen to complete the license manager file installation.

Automated License Manager Installation

Alternatively, you can install the license manager using an automated installation process with minimal user interaction. See the section “Automated Installation” on page 50. Set `licmanager = 1` in the answer file to install the license manager.

LICENSE FILES FOR NAMED SINGLE USER LICENSE

If you have a *Named Single User License* the installer automatically creates an *options file* that binds the license to the named user. This section describes the format of the options file and how the `license.dat` file points to the options file.

Below is an example of an options file, `LMCOMSOL.opt`, for a user “philip” who has access to COMSOL Multiphysics, the Structural Mechanics Module, and the CAD

Import Module. Notice that to access COMSOL Multiphysics, the options file must include both the COMSOL and the COMSOLGUI features.

```
INCLUDE COMSOL USER philip
INCLUDE COMSOLGUI USER philip
INCLUDE CADIMPORT USER philip
INCLUDE CADREADER USER philip
INCLUDE SME USER philip
```

Each INCLUDE row in the LMCOMSOL .opt file has a corresponding FEATURE row in the license.dat file (with the USER_BASED keyword). The second item on each FEATURE row is the name of the feature for which you have a license.

The following table contains the feature names for all products in the COMSOL 4.0a product family:

TABLE 3-2: COMSOL 4.0A PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAMES
COMSOL Multiphysics	COMSOL
COMSOL Multiphysics GUI	COMSOLGUI
COMSOL Multiphysics floating network license	CLIENTSERVER, CLUSTERNODE
AC/DC Module	ACDC
Acoustics Module	ACO
Batteries and Fuel Cells Module	BFC
CAD Import Module	CADIMPORT, CADREADER
CFD Module	CFD
Chemical Reaction Engineering Module	CHEM
Earth Science Module	ES
Heat Transfer Module	HT
MEMS Module	MEMS
RF Module	RF
Plasma Module	PLASMA
Structural Mechanics Module	SME
Optimization Module	OPTLAB
LiveLink for MATLAB	LLMATLAB
LiveLink for SolidWorks	LLSW

TABLE 3-2: COMSOL 4.0A PRODUCTS AND THEIR FEATURE NAMES

PRODUCT/FEATURE	FEATURE NAMES
LiveLink for Inventor	LLInventor
LiveLink for Pro/ENGINEER	LLProE

The license.dat file needs to point to the options file. The path to the options file is indicated by the “options” keyword. If your options file is placed here:

```
/usr/local/comsol40a/license/LMCOMSOL.opt
```

then the VENDOR row in license.dat should read

```
VENDOR LMCOMSOL options=/usr/local/comsol40a/license/LMCOMSOL.opt
```

STARTING THE LICENSE MANAGER

You can start the license manager manually or it can run automatically at boot.

Starting the License Manager Manually

To start the license manager manually, make the license/\$arch directory the current directory and enter

```
./lmgrd -c ../license.dat -l /var/tmp/comsol40a.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file /var/tmp/comsol40a.log.

Starting the License Manager Automatically at Boot

Add Bourne shell commands to the appropriate boot script. You must be a superuser (root) to edit boot scripts.

Note: For security reasons, we recommend that you do not start the daemons as root. Instead, use a dedicated username to start the license manager.

The procedure for editing boot scripts on each platform appears in the following table

TABLE 3-3: BOOT SCRIPT PROCEDURES

PLATFORM	PROCEDURE
SuSE Linux	<p>The following instructions should work for SuSE Linux distributions, where \$arch is either glnx86 (32-bit Linux), or glnxa64 (64-bit Linux).</p> <p>In the <code>comsol40a/license/\$arch</code> directory, type the commands</p> <pre>cp rc.lm /etc/init.d/comsol40alm chmod 755 /etc/init.d/comsol40alm</pre> <p>Edit <code>/etc/init.d/comsol40alm</code>, replacing <code>dir</code> with the full path to the \$arch platform directory, and replace <code>username</code> with an actual username.</p> <p>Now create the following link</p> <pre>cd /etc/init.d/rc5.d ln -s ../comsol40alm S91comsol40alm</pre>
Debian Linux	<p>The following instructions should work for Debian Linux distributions, where \$arch is either glnx86 (32-bit Linux), or glnxa64 (64-bit Linux).</p> <p>Copy the file <code>comsol40a/license/\$arch/lm_comsol</code> to <code>/etc/init.d</code></p> <p>Edit <code>/etc/init.d/lm_comsol</code>. Update the <code>FP</code> and <code>MYUSER</code> variables as indicated in the file. Use the utility <code>update-rc.d</code> to automatically update the system's init script links:</p> <pre>update-rc.d lm_comsol start 99 2 3 4 5 . stop 1 0 1 6 .</pre> <p>This means that the COMSOL license manager is started by runlevels 2, 3, 4, and 5, and stopped by runlevels 0, 1, and 6. Type <code>man update-rc.d</code> for more information on init scripts.</p>
Linux	<p>The following instructions should work for most Linux distributions, where \$arch is either glnx86 (32-bit Linux) or glnxa64 (64-bit Linux).</p> <p>Copy the file <code>comsol40a/license/\$arch/rc.lm</code> and paste it at the end of <code>/etc/rc.d/rc.local</code>.</p> <p>Replace 'dir' in the code fragment with the full path to the \$arch platform directory, and replace 'username' with an actual username.</p>

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s) you can start using COMSOL.

Changing the License

If you have received a new license file—for example, when adding COMSOL products to an existing license—replace your current license file with the new one.

Double-check the contents of this file to make sure it lists the products that your license includes.

When you have changed the license file you must restart the license manager; otherwise, it will continue to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager, make the `license/$arch` directory under the COMSOL installation directory the current directory, then enter the following commands:

```
./lmdown -c ../license.dat
./lmgrd -c ../license.dat -l /var/tmp/comsol140a.log
```

Obtaining a Hostid

If COMSOL is already installed on your license server, you can determine the hostid by executing the `lmhostid` command

```
comsol140a/license/$arch/lmhostid
```

where `$arch` is `glnx86` (32-bit Linux) or `glnxa64` (64-bit Linux).

If COMSOL is not installed, you must obtain a hostid using the following command on the license server: `/sbin/ifconfig eth0`. Then remove colons from, for example, `HWaddr 00:40:05:16:E5:25` (do not use the `hostid` command). All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/support/knowledgebase for up-to-date information about installation and license issues.

TABLE 3-4: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com .
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: <code>/var/tmp/comsol140a.log</code> Please send the log file to support@comsol.com if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section “License Manager Installation” on page 51 for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the <code>lmgrd</code> daemon and the <code>LMCOMSOL</code> daemon. If the problems remain, send the license manager log file to support@comsol.com . The log file is usually placed here: <code>/var/tmp/comsol140a.log</code>

TABLE 3-4: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -15. Cannot connect to license server system.	<p>The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>a license manager is required. Please refer to the section “License Manager Installation” on page 51 for instructions how to install and start the COMSOL license manager.</p> <p>Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.</p> <p>Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.</p> <p>Check that the license.dat file on the COMSOL client computer points to the correct license server hostname. First, find the license.dat file in the COMSOL application folder:</p> <pre>/usr/local/comsol40a/license/license.dat</pre> <p>Check that the first line has the correct license-server hostname. For example, if your license server hostname is mylicserver, the first row in the license.dat file should look like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>If the COMSOL client computer does not recognize mylicserver as a proper hostname, it might help to instead use the fully qualified domain name (mylicserver.mydomain.org) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.</p> <p>Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:</p> <pre>/var/tmp/comsol40a.log</pre> <p>NOTE: The log file is created by the license manager after it has been started.</p> <p>Please send the log file to support@comsol.com if you want help in interpreting the information.</p>

TABLE 3-4: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, LMCOMSOL .opt. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the license .dat file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The license .dat file is located in the COMSOL application folder: <code>/usr/local/comsol40a/license/license.dat</code>
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: <code>/var/tmp/comsol40a.log</code> Note: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

Running COMSOL

Running COMSOL Multiphysics

Run the `comsol` command. If it is not available, ask your system manager to make it available to you. The `comsol` command is located in the `bin` folder in the COMSOL installation directory.

Running COMSOL on Multicore and Multiprocessor Computers

COMSOL uses all cores and all processors on your computer to run using shared-memory parallelism. See the section “Shared-Memory Parallel COMSOL” on page 96 to override this behavior.

Running a Classkit License

To start COMSOL using a classkit license, start COMSOL using the `-ckl` option, for example

```
comsol -ckl
```

Running COMSOL in Batch Mode

You can launch COMSOL jobs from the Desktop and the command line. In the Model Builder, right click on a study and select **Add Batch** to create batch jobs. See the section “COMSOL Batch Commands” on page 69 for command-line options.

Running COMSOL on Clusters

You can launch COMSOL cluster jobs from the COMSOL Desktop and the command line. In the **Model Builder**, right-click a **Study** node and select **Cluster Computing** to create cluster jobs. See the section “COMSOL Cluster Commands” on page 71 for command-line options.

Note: Cluster computing requires an FNL (floating network) license.

Running COMSOL Multiphysics with MATLAB

Run the command

```
comsol server matlab
```

to launch MATLAB and connect it to a COMSOL server.

Note: Running COMSOL Multiphysics with MATLAB starts a COMSOL server and a MATLAB Desktop. No COMSOL graphical user interface is involved. For tutorial on using the LiveLink interface for MATLAB, see the *LiveLink for MATLAB User's Guide*.

The COMSOL Command

Use the COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL command is

```
comsol [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. The comsol command can be combined with optional targets to achieve various results. The table below lists the command and targets.:

TABLE 3-5: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
comsol	Run standalone COMSOL Multiphysics	
comsol server	Start COMSOL Multiphysics server	
comsol client	Run COMSOL Multiphysics client	
comsol batch	Run a COMSOL MPH file or class file	
comsol compile	Compile a Model Java file	
comsol server matlab	Start MATLAB and connect to a COMSOL server	Requires LiveLink for MATLAB license
comsol matlab	Start MATLAB and setup COMSOL paths	Requires LiveLink for MATLAB license
comsol convertpre35a	Convert 3.0–3.5 models	
comsol mpd	Run the COMSOL multiprocessing daemon	Requires CLUSTERNODE license

The comsol command is located in the bin folder in the COMSOL installation directory.

INI FILES

There is a number of .ini files in the subdirectories glnx86 and glnx64 in the bin directory. We may sometimes recommend that you edit these files. For example, you

can add options to any of the above commands by modifying the corresponding ini file.

OPTIONS

You can enter various options after the COMSOL command and target. Table 3-6 lists the options (See [*<options>*] in the command syntax) available for all comsol commands. Always issue these options between the command and the target (if any).

TABLE 3-6: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
-h	Print general help	
<i><target></i> -h	Print target-specific help	
-32	Run 32-bit COMSOL	
-64	Run 64-bit COMSOL	
-3drend ogl sw	3D renderer: OpenGL or software rendering	
-np <i><no. of processors></i>	Number of processors	See “Shared-Memory Options” on page 66
-mpmode throughput turnaround owner	Multiprocessor mode	See “Shared-Memory Options” on page 66
-blas {auto} mkl acml path	BLAS library to use	See “BLAS Options” on page 67
-blaspath <i><path></i>	BLAS library path	See “BLAS Options” on page 67
-ipv6	Activate IPv6 support	
-nn <i><no. of processors></i>	Number of nodes	See “COMSOL Cluster Commands” on page 71
-nnhost <i><no. of processors></i>	Number of nodes on each host	See “COMSOL Cluster Commands” on page 71
-mpi {auto} intel mpich2 wccs2003 whpc2008 user path	MPI library to use	See “COMSOL Cluster Commands” on page 71
-mpipath <i><path></i>	MPI library path	See “COMSOL Cluster Commands” on page 71
-mpiroot <i><path></i>	MPI library root path	See “COMSOL Cluster Commands” on page 71
-mpirsh {rsh} ssh	Use rsh or ssh when booting MPD	See “COMSOL Cluster Commands” on page 71

TABLE 3-6: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
-scalapack {auto} mpich2 wccs2003 whpc2008 user path	Scalapack library to use	See “COMSOL Cluster Commands” on page 71
-scalapackpath <path>	Scalapack library path	See “COMSOL Cluster Commands” on page 71
-prefmdir <path>	Preference directory	
-tmpdir <path>	Temporary file directory	
-version	Print COMSOL version	
-version <target>	Print target version	
-ckl	Use class-kit license	
-forcegcc	Force load of GCC libraries	
-forcecomsolgcc	Force load of GCC libraries shipped with COMSOL	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefmdir` option specifies the directory where COMSOL should store the preference file.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. The following options are available:

TABLE 3-7: COMSOL BLAS OPTIONS

MPMODE OPTION	DESCRIPTION
throughput	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
turnaround	Typically provides the best performance when no other processes than COMSOL are active.
owner	Provides the highest performance in most cases.

You might need to experiment to determine what options works best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides for the following BLAS related options:

TABLE 3-8: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL for Intel processors, and ACML for AMD processors with SSE2 support, otherwise MKL. (This is the default option.)
mkl	Use the Intel MKL library
acml	Use the AMD ACML library
path	Use a BLAS library specified using the option <code>-blaspath</code> or the environment variable <code>COMSOL_BLAS_PATH</code> . The library must support the standard FORTRAN BLAS interface.

Both MKL and ACML are distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where ARCH is the architecture (`glnx86` or `glnxa64`) or somewhere in the standard search path. You must also provide the path to any sublibraries needed by the library. You can also set the search path to point to the directory where the library is installed. To do so, use the environment variable `LD_LIBRARY_PATH`.

GCC Options

By default COMSOL uses the GCC libraries installed on the system. If COMSOL is unable to start, COMSOL will attempt to use the GCC libraries shipped with COMSOL. To force COMSOL to use the shipped GCC libraries, use the `-forcecomsolgcc` option. The option `-forcegcc` is mainly intended for use together with the LiveLink interface for MATLAB; use it if you are unable to make function call backs to MATLAB.

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The syntax for the COMSOL server command is

```
comsol [<options>] server [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 3-9: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTIONS	DESCRIPTION
-user <user>	Specify login name for a user
-port <port>	Specify a TCP/IP port to listen for connect attempts.
-passwd <reset/nostore>	Specify that you want to provide a new password. To avoid storing the new password on file use <nostore>
-login <{info}/force/never>	Ask for login information. info means that only missing information is asked for.
-multi on {off}	Accept repeated client connections
-silent	Do not listen to standard input
-graphics	Start the server with graphics libraries. This will display plots on the server when you are connected with a client (that is, not with the COMSOL GUI).

Accessing the COMSOL Server Computer

To access the computer running the COMSOL server simply log in on the server computer by using ssh or a similar command, then enter the `comsol server` command.

Login Information

When you start a COMSOL Multiphysics server for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password in the **Connect to Server** dialog box. The software writes this login information in the subdirectory `.comsol/ver40a/login.properties` in your home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Always make sure that untrusted users cannot access the COMSOL login information. Thus you must protect the file `.comsol/ver40a/login.properties` in your home directory. This is important when using COMSOL Multiphysics' client/server feature.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [<options>] client [<target arguments>]
```

The following target arguments are available for a COMSOL client command.

TABLE 3-10: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
-port <port>	Specify a TCP/IP port to connect to
-server <server name>	Specify server to connect to

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. You can run both Model MPH files and Model Java files with the COMSOL batch command. Model Java files need to be compiled before running.

The syntax for the COMSOL batch command is

```
comsol [<options>] batch [<target arguments>]
```

Its detailed target arguments are:

TABLE 3-11: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH OPTIONS	DESCRIPTION
-inputfile <file name>	Run a Model MPH-file or class file
-outputfile <file name>	Save a Model MPH-file using the given file name. If output is not given, the input file will be overwritten with the output
-job <job name>	The batch job to run
-study <study name>	The study to compute
-pname <parameter name>	Comma separated list of parameter names
-plist <parameter value>	Comma separated list of parameter values
-batchlog <file name>	File to store log in
-client	Run as client
-host	Connect to host
-port	Connect to port
-graphics	Start COMSOL batch with graphics libraries. This will display plots during postprocessing.

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsol batch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the out.mph.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compile a model Java file for use by the COMSOL batch command or for loading class files into the GUI. The syntax for the COMSOL compile command is

```
comsol [<options>] compile [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available⁴

TABLE 3-12: COMSOL COMPILE OPTIONS

COMSOL COMPILE OPTIONS	DESCRIPTION
-jdkroot <path>	Path to the JDK root
-classpathadd <classpath>	Additional classpath
-verbose	Verbose output

COMSOL CLUSTER COMMANDS

Use the COMSOL command with the option -nn <no. of nodes> to run COMSOL on clusters. You can run both Model MPH files and Model Java files with the COMSOL cluster batch command. Model Java files need to be compiled before running. You can also start a COMSOL server on a cluster node. Running COMSOL server on a cluster requires that you have TCP/IP access to the node on the cluster where the COMSOL server is started. If you have access to the displays of the cluster nodes, you can also start the COMSOL Desktop on the cluster. All COMSOL cluster commands require a floating network license.

The syntax for the COMSOL cluster command is

```
comsol -nn <no. of nodes> [<options>] [<target>] [<target arguments>]
```

The following cluster commands are available:

TABLE 3-13: COMSOL CLUSTER TARGETS

COMSOL CLUSTER COMMANDS	DESCRIPTION
comsol -nn <nn> batch	Run COMSOL on a cluster in batch mode
comsol -nn <nn> server	Run COMSOL server on a cluster
comsol -nn <nn>	Run COMSOL Desktop on a cluster

Prefer starting COMSOL jobs from the Job node in the COMSOL Desktop. If you need to start COMSOL jobs from the command line, prefer using the `comsol -nn <nn> batch` command since the `comsol -nn <nn> server` and `comsol -nn <nn>` command require non-typical cluster configurations.

Running on Linux

In order to start Intel MPI, have a file named `.mpd.conf` in your home directory to which you alone have access. This file should contain the single line

```
secretword = <your secret word here>
```

Before you start COMSOL, you must initialize the MPI environment. A so called multiprocessing daemon (MPD) must run on each computer node that you intend to use. To start MPD on several computer nodes, type

```
comsol -nn <number of computer nodes> mpd boot -f <filename>
```

The file *<filename>* should contain the names of the computer nodes that you intend to use. The file may contain more computer nodes than you actually intend to use. As an alternative to using the `-f <filename>` option, you can put the list of computer nodes in a file named `mpd.hosts` in your home directory. You can set the protocol that is used for connecting using the switch `-mpirsh`. The valid options are `rsh` and `ssh`. This is important if the cluster only supports `ssh` because `rsh` is the default protocol used. Start distributed COMSOL with the `-nn` option. For example, type

```
comsol -nn <number of computational nodes> server
```

to start a COMSOL server running on a specific number of computational nodes. The number of computational nodes can exceed the number of computer nodes. Use the `-nnhost` option if you want to force several computational nodes on a computer node. Avoid starting more computational nodes than the total number of processors that you have available. When you have finished using distributed COMSOL, you should take down the all MPDs. Type the command

```
comsol mpd allexit
```

to stop all MPDs. To obtain more information about the `comsol mpd` commands, add the `-h` option to the commands, for example, `comsol mpd boot -h`.

Start MPD on a single computer with the command

```
comsol mpd mpd &
```

This is useful when running all computational nodes on a single multiprocessor computer or when you have difficulties attaching computational nodes because of firewalls. In the second case you can start an MPD on each node and attach them by specifying the main port and host. Use

```
comsol mpd trace -l
```

and

```
comsol mpd mpd --port <the port number reported> --host <the  
hostname reported>
```

You can also start COMSOL with the `-clustersimple` option. This option automatically starts and terminates the MPD daemon. It uses the `mpd.hosts` file in your home directory to determine what computational nodes to use.

Usually COMSOL only uses a display for one of the processes. However, if possible, the `-clusterdisplay` option starts a display for every process.

Starting Distributed COMSOL—Linux Examples

Make sure that `comsol` is able to start on all nodes where you intend to run `comsol`. Note that each node requires access to the license manager. If the node is unable to check out a license, it will abort the startup process. Start an MPD on a single computer. Then start distributed COMSOL on two computational nodes each using three processors, and finally stop the MPD:

```
comsol mpd mpd &
comsol -nn 2 -np 3
comsol mpd allexit
```

Start three MPDs on computer nodes with names defined in the file `myhosts`. Each line in the file should specify the host address or IP-address of a node. Then start a distributed COMSOL server on three computational nodes, and finally stop the MPDs. First make sure that you can connect to all the computers with `ssh` without having to use your password (see the man pages for `ssh`). Also make sure that all computers have access to the same COMSOL installation and that they are using the same Linux version.

```
comsol -nn 3 mpd boot -f myhosts
comsol -nn 3 server
comsol mpd allexit
```

Start four computational nodes on hosts listed in the file `mpd.hosts` using distributed COMSOL and simplified start:

```
comsol -nn 4 -clustersimple
```

MPI Options

There are several implementations of MPI. COMSOL is shipped with the Intel MPI library but should also support most MPI implementations based on MPICH2. We recommend that you use the default Intel MPI library. For running COMSOL on a computer that has MPICH2 installed, COMSOL also has a compatibility mode that you can activate by adding the option `-mpi mpich2`. When using this option both the variables `PATH` and `LD_LIBRARY_PATH` must include your MPI implementation. It is also possible to use other MPI libraries based on MPICH2 using the option `-mpipath <path to shared library>` and `-mpiroot <path to root of mpi library installation>`. The table Table 3-6, COMSOL options (curly brackets indicate default values), on page 3-65 lists the MPI related options, `-mpi`, `-mpipath`, `-scalapack`, and `-scalapackpath`. Additionally the `comsol` MPI arguments are

configurable inside the `comsol` start script. To configure `comsol` to work with a job scheduler through the Cluster Computing study you can set the options

```
-Dcs.precmd=<Command line>
```

```
-Dcs.postcmd=<Command line>
```

in the `comsol.ini` file. This will add commands prior to the `comsol` command and after the `comsol` command. You can add `{nn}` or `{perhost}` to any of these pre- or postcommands. This configures the Cluster Computing study to use the number of nodes and number of nodes on each host from the corresponding settings for the Cluster Computing study. For more information see the documentation for the Cluster Computing study in the *COMSOL Multiphysics Reference Guide*.

Troubleshooting MPI

The MPD daemon can be used in several ways to troubleshoot problems with the `comsol` MPI environment. The syntax for MPD commands is

```
comsol [<options>] mpd [<MPD command>] [<target arguments>]
```

TABLE 3-14: COMSOL MPD COMMANDS

COMSOL MPD COMMANDS	DESCRIPTION
<code>boot</code>	Run <code>mpdboot</code> command
<code>mpd</code>	Run <code>mpd</code> command
<code>exit</code>	Run <code>mpdexit</code> command
<code>allexit</code>	Run <code>mpdallexit</code> command
<code>cleanup</code>	Run <code>mpdcleanup</code> command
<code>trace</code>	Run <code>mpdtrace</code> command
<code>check</code>	Run <code>mpdcheck</code> command
<code>ringtest</code>	Run <code>mpdringtest</code> command
<code>listjobs</code>	Run <code>mpdlistjobs</code> command
<code>sigjob</code>	Run <code>mpdsigjob</code> command
<code>killjobs</code>	Run <code>mpdkilljobs</code> command
<code>tune</code>	Run <code>mpdtune</code> command
<code>help</code>	Run <code>mpdhelp</code> command

Use `-h` switch for more information about each command.

`Comsol` is shipped with the Intel MPI library, but should be compatible with most MPICH2 compatible MPI libraries. To download the latest version of Intel MPI library runtime visit <http://software.intel.com/en-us/intel-mpi-library/>. To run

comsol with another version of Intel MPI or other MPI library set `-mpiroot` to the root path of the MPI library and `-mpipath` to the dynamically loaded library that should be used. The default of the Intel MPI library is to use `rsh` as communication protocol. If you require `ssh` use the option `-mpirsh ssh`. If you are using a scheduler the Intel MPI library is often able to detect the environments it is running from using the `-clustersimple` switch and you do not need to setup a hosts file. The Intel MPI library will automatically try to detect the best option for communication and will use Infiniband if it detects it. For more verbose information about the startup process from the MPD daemon use the `-v` and/or `-d` switches or set the environment variable `I_MPI_DEBUG` to a value greater than 0. Use `comsol mpd check` command to display important information. If the MPD is booted and `comsol` is not starting make sure that the MPI environment is working for instance by running the `comsol mpd tune` command. If `comsol` aborts during start make sure that all nodes are able to access the license manager and that `comsol` can be started on each node when not running distributed.

COMSOL MATLAB COMMANDS

Use the COMSOL MATLAB commands to access the COMSOL API through MATLAB. The LiveLink interface for MATLAB requires that MATLAB runs connected to a COMSOL server. The easiest way to start COMSOL with MATLAB is to use the command:

```
comsol server matlab [<options>]
```

This command launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server. To create a model object you need to type

```
model = com.comsol.model.ModelUtil.create(<name>);
```

in MATLAB. After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The command

```
comsol matlab [<options>]
```

starts MATLAB with paths ready to communicate with a COMSOL server. To connect to a server work with a model, and close the server connect type, type

```
com.comsol.model.ModelUtil.connect(<host>,<port>);  
model = com.comsol.model.ModelUtil.create(<name>);  
% work with your model  
com.comsol.model.ModelUtil.disconnect;
```

After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The following options are available for the `comsol matlab` command.

TABLE 3-15: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
<code>-mlroot <path></code>	MATLAB installation directory
<code>-host <hostname></code>	Connect to host
<code>-port <hostname></code>	Connect to port
<code>-desktop</code>	Start with Desktop
<code>-nodesktop</code>	Start without Desktop
<code>-compat</code>	Run in COMSOL 3.5a compatibility mode
<code>-c35aroot</code>	The COMSOL 3.5a root directory path
<code>-graphics</code>	Start the server with graphics libraries. This enables plotting on the server. Available only when running <code>comsol server matlab [<options>]</code> .

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, type

```
comsol [options] <input directory> <output directory> [log file]
```

where `<input directory>` is the input directory, `<output directory>` is the output directory, and `[log file]` is an optional log file. If you do not provide the third argument, the log is printed on standard output.

TABLE 3-16: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
<code>-c35aroot <path></code>	Installation path of COMSOL 3.5a

Installing and Running on Mac OS X

This chapter provides detailed instructions for installing the COMSOL software on Mac OS X. You also find license manager information and options for running COMSOL. For most installations, the *COMSOL Quick Installation Guide* that comes bundled with the DVD provides the basic instructions for installation on Mac OS X. Also see the COMSOL Support Knowledge Base on www.comsol.com for specific troubleshooting tips.

System Requirements

General Requirements

These requirements are common to all platforms:

- A DVD drive for installation
- TCP/IP activated
- 1 GB memory, preferably more
- 1-4 GB of disk space, depending on your licensed products and installation options
- Adobe Acrobat Reader 9.0 or later to view and print the COMSOL documentation in PDF format

FLOATING NETWORK LICENSES

Floating network licenses are supported on heterogeneous networks of Windows, Linux, and Mac computers. Both the license manager and the COMSOL application can run on either Windows, Linux, or Mac OS X, and a single computer can run both of them.

COMSOL Multiphysics System Requirements for Mac OS X

SYSTEM REQUIREMENTS—INTEL 32-BIT PROCESSOR

- Mac OS X 10.5 or later
- Java 1.5 or later (part of the Mac OS X installation)

SYSTEM REQUIREMENTS—INTEL 64-BIT PROCESSOR

- Mac OS X 10.5 or later
- Java 1.5 or later (part of the Mac OS X installation)

GRAPHICS SYSTEM REQUIREMENTS

Prefer hardware rendering for performance reasons: drivers supporting OpenGL version 1.3 are required. Alternatively, use software rendering.

Optional LiveLink Interface for MATLAB Requirements

The LiveLink interface for MATLAB is compatible with MATLAB 2009b and 2010a for Mac OS X on 32-bit and 64-bit Intel processors.

Optional Products for CAD Interoperability

The following products support import of 3D CAD files on OS X:

TABLE 4-1: PRODUCTS FOR CAD INTEROPERABILITY ON OS X

PRODUCT	SUPPORTED FILE FORMATS	REQUIRED PRODUCT
CAD Import Module	ACIS (SAT), IGES, Parasolid, Pro/E, and STEP	COMSOL Multiphysics

Note that the CAD Import Module requires 64-bit Mac OS X.

Parallel System Requirements

COMSOL 4.0a supports shared-memory parallelism on 32-bit and 64-bit Mac OS X. Distributed-memory parallelism is not supported.

Internet Protocol Support

IPv4 is supported on all Mac OS X platforms.

Installing COMSOL

Before You Begin

- Check that your system meets all applicable requirements (see “COMSOL Multiphysics System Requirements for Mac OS X” on page 78).
- Have your passcode or license file ready. A passcode has a form similar to:

FFFFFFF-CUSV-123456-1234567-123456789

New users can find the passcode or the license file in an email or letter from your sales representative. If you have not received a passcode or a license file, contact your local COMSOL representative.

Some COMSOL license types require that you also install a license manager before running a COMSOL software product. If you install COMSOL software with a passcode, no license manager is needed. If you install it with a license file, you need to install the license manager if the license file contains a line starting with the word SERVER. See “License Manager Installation” on page 82 for instructions. You can install your COMSOL software products and the license manager in any order.

If your Macintosh contains an old COMSOL (FEMLAB) installation, the COMSOL 4.0a installer does not remove it; it merely removes the MATLAB path to the old COMSOL version. You can keep the old version if desired as well as uninstall it before or after installing COMSOL 4.0a.

Installing COMSOL 4.0a

Note: COMSOL does not work if the path to the COMSOL folder, or the name of the COMSOL folder itself, contain spaces.

- 1 Insert the COMSOL 4.0a DVD into the DVD drive. Launch the **COMSOL Installer** application from the Finder. The **COMSOL 4.0a Installer** window appears.
- 2 To proceed, see the instructions for Windows in the section “Installing COMSOL 4.0a” on page 10. The procedure is the same for Mac OS X.

Note: You cannot browse to the MATLAB installation directory directly. You need to enter it manually.

Removing (Uninstalling) the COMSOL Installation

The COMSOL 4.0a installation adds files only in the COMSOL40a folder. To remove the COMSOL installation, simply delete the COMSOL40a folder including all subfolders.

Automated Installation

You can install COMSOL using an automated installation process with minimal user interaction. The documentation on how to create an answer file is available in the template answer file, `setupconfig.ini`, which you find on the DVD. When you have created an answer file, start the installation by running

```
<path to DVD>/setup -s <answer file path>
```

where `<answer file path>` is the path to your answer file.

Changing the Path to the MATLAB Installation

Edit the file `comsolserver.ini` and `comsol.ini` in the `bin/<platform>` directory under the COMSOL installation directory (typically `/Applications/COMSOL40a`). In the file, change the line

```
-Dcs.mlroot=/Applications/MATLAB_R2010a.app
```

to point to the root directory of your MATLAB installation.

License Manager Installation

The license manager supports a heterogeneous network of Windows, Linux, and Mac OS X computers. Both the license manager and a COMSOL application can run on either Windows, Linux, or Mac platforms. We refer to the computer where the license manager is installed as the *license server* and any computers where the COMSOL applications are installed as *clients*. You can install COMSOL anywhere, typically on a local PC or on a file server where users access the program over a network. A single computer can function as a license server *and* a client, holding both the license manager and COMSOL. The COMSOL license manager does *not* require a MATLAB license manager.

To install a license manager, start by following the instructions in the section “Before You Begin” that follows immediately.

You can install the license manager and COMSOL in any order. You cannot perform a full test of the installation until you have installed both.

COMSOL uses the FLEXnet™ license manager version 11 from Acresso Software Inc. for license management. (Note that FLEXnet was formerly called FLEXlm.)

Before You Begin

SYSTEM REQUIREMENTS

Before starting the installation process, check that your system meets all necessary requirements. They are crucial for the COMSOL application, whereas the license manager only needs the correct hardware and operating system—for the license manager you need not consider memory and graphics requirements. The COMSOL license manager is completely independent of the MATLAB license manager.

OBTAINING A FLEXNET LICENSE FILE

To install a COMSOL license manager you need a FLEXnet license file, `license.dat`. It looks something like this:

```
SERVER <my_server> 00b0d05d1635 1718
USE_SERVER
VENDOR LMCOMSOL
FEATURE SERIAL LMCOMSOL 4.0a permanent uncounted \
  VENDOR_STRING=T,334000 HOSTID=DEMO SN=1234567 \
  SIGN=123456789ABC
```



```
INCREMENT COMSOL LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT COMSOLGUI LMCOMSOL 4.0a permanent 10 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT CHEM LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT ACDC LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC  
INCREMENT SME LMCOMSOL 4.0a permanent 5 DUP_GROUP=UH \  
SIGN=123456789ABC
```

As noted earlier, you should have received a COMSOL `license.dat` file with the COMSOL package. If you have not received it, contact your local COMSOL representative or send a request to support@comsol.com.

In the `license.dat` file, the text on the `SERVER` line should contain the license server name `<my_server>`, the hostid of the license server, and an optional port number.

Make sure that the license server name is the actual name of your license server; otherwise, change it by editing the file. You can also change the default port number (1718). This is necessary in the unlikely case that another program is already using that port number. If it becomes necessary to change the port number, any unused number between 1025 and 64,000 is valid.

The `VENDOR` line defines the name of the vendor daemon binary, `LMCOMSOL`.

Note: If the COMSOL license manager is running on a computer with an active firewall and the COMSOL Multiphysics client is outside of that firewall, at least two port numbers must be opened up in the license server's firewall to allow client computers to connect to the COMSOL license manager. To implement this requirement, first edit the `VENDOR` line in the `license.dat` file to read `VENDOR LMCOMSOL port=1719` (the number can be any unused port number in the allowed range). Then configure your firewall to allow access to the chosen port numbers (in the example above, those numbers are 1718 and 1719). If you are unsure about which port numbers are free or how to enable firewall port access, please contact your system administrator.

Note: Do not modify anything in the `license.dat` file except license server name and (if necessary) port numbers or your license will not work.

The `SERIAL` line contains license information.

The `INCREMENT` (can also be `FEATURE`) lines contain a product name, version, expiration date, and the number of available licenses. The example file just given shows that the user has a permanent COMSOL 4.0a license allowing ten concurrent users of COMSOL Multiphysics and five concurrent users of the Chemical Reaction Engineering Module, the AC/DC Module, and the Structural Mechanics Module. The number after “`SIGN=`” at the end of each `INCREMENT` line contains a license key. To break up long lines use the continuation character (`\`).

In the event you have not received the `license.dat` file, you must provide us with the `hostid` of your license server (see “Obtaining a Hostid” on page 87 for instructions) and preferably your license server name. Please have them ready when contacting your local COMSOL representative.

License Manager Installation on Mac OS X

You only need to install the license manager if you have obtained a license file that starts with a line that contains the word `SERVER`.

You need the following components on the license server:

- COMSOL License Manager files (FLEXnet)
- License file (`license.dat`)

COMSOL LICENSE MANAGER FILES (FLEXNET)

The license manager consists of three components:

- License manager daemon (`lmgrd`)
- Vendor daemon (`LMCOMSOL`)
- FLEXnet utility programs (`lmutil` and others)

The two daemons (`lmgrd` and `LMCOMSOL`) run on the license server. When a user starts COMSOL on a client computer, communication is established through the network from the client to the license server and the `lmgrd` daemon. The `lmgrd` daemon in turn makes a request to the daemon (`LMCOMSOL`) to release a license. The vendor daemon releases licenses according to the information contained in `license.dat`. The utility programs are used for license-server management. For more information on FLEXnet management, see Chapter 7 in the *FLEXnet Licensing End Users Guide*, available as a part of the FLEXnet documentation and from the COMSOL Help Desk.

INSTALLING THE LICENSE MANAGER FILES

You should install the license manager only on the host(s) listed in `license.dat`.

If you want to install COMSOL on the same host as the license manager, first perform a complete COMSOL installation because that procedure automatically installs the license manager files along with COMSOL (see the section “Installing COMSOL” on page 80). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 85.

If you want to install only the COMSOL license manager files, follow these instructions:

- 1 Insert the COMSOL 4.0a DVD into the DVD drive.
- 2 Follow the installation instructions starting on page 80 until you reach the **Features** screen.
- 3 In the list of products to install, select only the **License Manager** check box.
- 4 Continue from the **Features** screen in the installation instructions (page 10) to complete the license manager file installation.

Automated License Manager Installation

Alternatively, you can install the license manager using an automated installation process with minimal user interaction. See the section “Automated Installation” on page 81. Set `licmanager = 1` in the answer file to install the license manager.

STARTING THE LICENSE MANAGER

You can either start the license manager manually or let it run automatically at startup.

Starting the License Manager Manually

To start the license manager manually, perform these steps:

- 1 Launch the **Terminal** application.
- 2 Change directory to the `license/maci32` directory
`cd /Applications/COMSOL40a/license/maci32`
- 3 Then enter
`./lmgrd -c ../license.dat -l /var/tmp/comsol40a.log`

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol40a.log`.

Starting the License Manager Automatically at Startup

A folder `COMSOL_Lmgr` located in the folder `COMSOL40a/license/maci32` holds a script that can automatically start the license manager when you start the computer. By installing and configuring this folder, there is no need to start the license manager manually.

- 1 Go to the top level `/Library` folder on your startup disk.
- 2 In the `Library` folder, create a folder `StartupItems` if it does not already exist.
- 3 Move or copy the folder `COMSOL_Lmgr` to the `StartupItems` folder.
- 4 Open the file `COMSOL_Lmgr` in a text editor, for example, `TextEdit`.
- 5 Edit the line

```
FP=<COMSOLPATH>
```

by replacing `<COMSOLPATH>` with the path to the `COMSOL` folder. If `COMSOL` is installed in the `Applications` folder this path is

```
FP=/Applications/COMSOL40a
```

- 6 Edit the line

```
USERNAME=<username>
```

by replacing `<username>` with your username.

To test the license manager installation restart the computer. During startup a message **Starting COMSOL License Manager** should appear.

STARTING COMSOL

After the installation is complete and the license manager daemons are running on the license server(s) you can start using `COMSOL`.

Changing the License

If you have received a new license file—for example, when adding `COMSOL` products to an existing license—replace your current license file with the new one.

Double-check the contents of this file to make sure it lists the products that your license includes.

When you have changed the license file you must restart the license manager; otherwise, it will continue to use the old license file still in memory.

RESTARTING THE LICENSE MANAGER

To restart the license manager, do as follows:

- 1 Launch the **Terminal** application.
- 2 Change directory to the `license/maci32` directory

```
cd /Applications/COMSOL40a/license/maci32
```
- 3 Enter the commands

```
./lmdown -c ../license.dat  
./lmgrd -c ../license.dat -l /var/tmp/comsol40a.log
```

Obtaining a Hostid

If COMSOL is already installed on your license server, you can determine the hostid by executing the `lmhostid` command

```
COMSOL40a/license/$arch/lmhostid
```

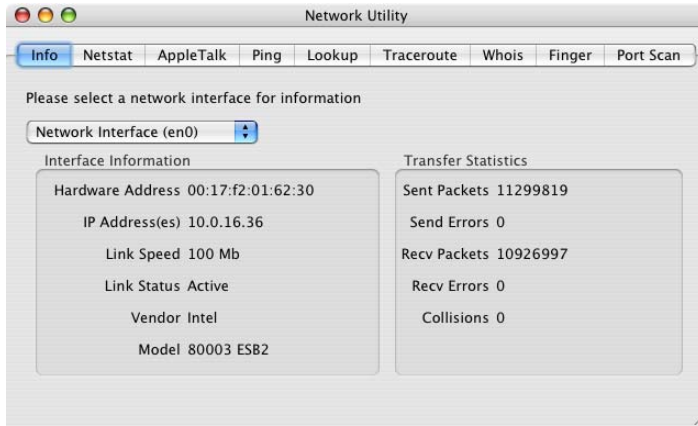
where `$arch` is `maci32` (32-bit Mac OS X) or `maci64` (64-bit Mac OS X).

If COMSOL is not installed, you must obtain a hostid using the procedure in section “Obtaining the Hostid on Mac OS X” below. All machine architectures use an Ethernet address (also called a MAC address) as the hostid. An Ethernet address has six bytes, each with two hexadecimal digits. Be sure to specify all twelve hex digits when using an Ethernet address as a hostid. For example, if the Ethernet address is `8:0:20:0:5:ac` specify `0800200005ac` as the hostid.

OBTAINING THE HOSTID ON MAC OS X

- 1 Launch the application **Network Utility** found in the **Applications/Utilities** folder.
- 2 Click the **Info** tab to the left.
- 3 Select **Network Interface (en0)**. This corresponds to your Ethernet card.
- 4 The hostid is the **Hardware Address**, which is displayed in the following image, with the colons removed. If you plan to install on a Mac laptop with a wireless network

card, please report the hardware address for both **Network Interface (en0)** and **Network Interface (en1)**.



Troubleshooting License Errors

This section summarizes the most common post-installation error messages generated by COMSOL, and it gives some advice how to troubleshoot them. Also check the COMSOL Support Knowledge Base at www.comsol.com/support/knowledgebase for up-to-date information about installation and license issues.

TABLE 4-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error	A general license error has occurred. Check the error message for details that might help solve the problem. If you need help in interpreting the information, send the complete error message to support@comsol.com .
License error: -5. No such feature exists.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: <code>/var/tmp/comsol140a.log</code> Please send the log file to support@comsol.com if you want help in interpreting the information. NOTE: The license manager creates the log file. If there is no log file, make sure to first start the license manager. Please refer to the section “License Manager Installation” on page 82 for instructions how to install and start the COMSOL license manager.
License error: -12. Invalid returned data from license server system.	Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps. Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager, or the connection from the <code>lmgrd</code> daemon and the <code>LMCOMSOL</code> daemon. If the problems remain, send the license manager log file to support@comsol.com . The log file is usually placed here: <code>/var/tmp/comsol140a.log</code>

TABLE 4-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -15. Cannot connect to license server system.	<p>The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>a license manager is required. Please refer to the section “License Manager Installation” on page 82 for instructions how to install and start the COMSOL license manager.</p> <p>Check that no firewall on the COMSOL client is preventing the connection from the COMSOL client to the license server. Temporarily disable any firewall on the COMSOL client to see if that helps.</p> <p>Check that no firewall on the license server is preventing the connection from the COMSOL client computer to the license manager.</p> <p>Check that the license.dat file on the COMSOL client computer points to the correct license server hostname. First, find the license.dat file in the COMSOL application folder:</p> <pre>/Applications/COMSOL40a/license/license.dat</pre> <p>Check that the first line has the correct license-server hostname. For example, if your license server hostname is mylicserver, the first row in the license.dat file should look like this:</p> <pre>SERVER mylicserver 000123456789 1716</pre> <p>If the COMSOL client computer does not recognize mylicserver as a proper hostname, it might help to instead use the fully qualified domain name (mylicserver.mydomain.org) or the IP address. If neither of these work, there might be a problem with DNS or the HOSTS file on the client. Please ask your system administrator for advice on how to connect with TCP/IP to the license server.</p> <p>Finally, the license manager might have encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here:</p> <pre>/var/tmp/comsol40a.log</pre> <p>NOTE: The log file is created by the license manager after it has been started.</p> <p>Please send the log file to support@comsol.com if you want help in interpreting the information.</p>

TABLE 4-2: GENERAL ERROR MESSAGES

ERROR MESSAGE	EXPLANATION
License error: -39. User/host not on INCLUDE list for feature.	This error can only occur for the Named Single User License (NSL) license type. The error means that your username does not match the one listed in the license-manager options file, LMCOMSOL .opt. To get access to COMSOL, ask your license/system administrator for help. When the username in the options file is changed, the license manager must be shut down and restarted to give the new user immediate access to COMSOL.
License error: -88. System clock has been set back.	The software has detected that a system clock has been set back. Please make sure that your computer's clock is set to the current local time and date. If the problem remains check that there are no files on your hard drive that are dated in the future.
License error: -96. License server machine is down or not responding.	Please make sure that the SERVER hostname in the license .dat file is valid and that the TCP/IP network connection between the application computer and the license server is working properly. The license .dat file is located in the COMSOL application folder: /Applications/COMSOL40a/license/license.dat
License error: -97. The desired vendor daemon is down.	The license manager has encountered a problem during startup. Check the license manager log file for error messages. The log file is usually placed here: /var/tmp/comsol40a.log Note: The log file is created by the license manager after it has been started. Please send the log file to support@comsol.com if you want help in interpreting the information.

Running COMSOL

The COMSOL Applications

The following applications provide different ways to run COMSOL:

- **COMSOL Multiphysics** application
This is the primary application to run the software. It launches COMSOL Multiphysics as a standalone application.
 - **COMSOL with MATLAB** application
Use this application when you license the interface between COMSOL Multiphysics and MATLAB.
-

Note: The COMSOL with MATLAB application requires that you use Apple’s X11 application together with MATLAB. The X-Windows application OroborOSX is not supported.

- **COMSOL Multiphysics Server** application
This application launches the **Terminal** application and starts a COMSOL Multiphysics server in a terminal window (see “” on page 98).
-

Note: None of the COMSOL applications work if you move them outside the COMSOL folder. Create an alias if, for example, you want a desktop icon.

Running COMSOL from a Terminal Window

You can also launch COMSOL from a terminal window using the shell script `COMSOL40a/bin/comsol`.

To run the `comsol` command more easily, include the `COMSOL40a/bin` directory in the path or make a symbolic link from `/usr/bin/comsol` to the `comsol` script. Those with administrator privileges can create a symbolic link with the command

```
sudo ln -s /Applications/COMSOL40a/bin/comsol /usr/bin/comsol
```

(assuming COMSOL is installed in the Applications folder). This command asks for a password before creating the link.

Note: The `comsol` command must not be moved from the `COMSOL40a/bin` folder. The COMSOL applications also use this script.

Note: The **COMSOL with MATLAB** application requires that you use Apple's X11 application together with MATLAB. The X-Windows application OroborOSX is not supported.

Running a Classkit License

To start COMSOL using a classkit license, start COMSOL using the `-ck1` option, for example

```
comsol -ck1
```

Running COMSOL on Multicore and Multiprocessor Computers

COMSOL uses all cores and all processors on your computer to run using shared-memory parallelism. See the section “Shared-Memory Options” on page 95 to override this behavior.

Running COMSOL in Batch Mode

You can launch COMSOL jobs from the Desktop and the command line. In the Model Builder, right click on a study and select **Add Batch** to create batch jobs. See the section “COMSOL Batch Commands” on page 98 for command-line options.

The COMSOL Command

Use the COMSOL command to start COMSOL products with detailed start-up options.

The general syntax of the COMSOL command is

```
comsol [<target>] [<options>] [<target arguments>]
```

where square brackets indicate optional arguments. The comsol command can be combined with optional targets to achieve various results. The table below lists the command and targets.:

TABLE 4-3: COMSOL COMMANDS TARGETS

COMMAND AND TARGET	DESCRIPTION	AVAILABILITY
comsol	Run standalone COMSOL Multiphysics	
comsol server	Start COMSOL Multiphysics server	
comsol client	Run COMSOL Multiphysics client	
comsol batch	Run a COMSOL MPH file or class file	
comsol compile	Compile a Model Java file	
comsol server matlab	Start MATLAB and connect to a COMSOL server	Requires LiveLink for MATLAB license
comsol matlab	Start MATLAB and setup COMSOL paths	Requires LiveLink for MATLAB license
comsol convertpre35a	Convert 3.0–3.5 models	

The comsol command is located in the bin folder in the COMSOL installation directory.

INI FILES

There is a number of .ini files in the subdirectories maci32 and maci64 in the bin directory. We may sometimes recommend that you edit these files. For example, you can add options to any of the above commands by modifying the corresponding ini file.

OPTIONS

You can enter various options after the COMSOL command and target. Table 4-4 lists the options (See [*options*]) in the command syntax) available for all comsol commands. Always issue these options between the command and the target (if any).

TABLE 4-4: COMSOL OPTIONS (CURLY BRACKETS INDICATE DEFAULT VALUES)

COMSOL OPTION	DESCRIPTION	REFERENCE
-h	Print general help	
<target> -h	Print target-specific help	
-32	Run 32-bit COMSOL	
-64	Run 64-bit COMSOL	
-3drend ogl sw	3D renderer: OpenGL or software rendering	
-np <no. of processors>	Number of processors	See “Shared-Memory Options” on page 95
-mpmode throughput turnaround owner	Multiprocessor mode	See “Shared-Memory Options” on page 95
-blas {auto} mkl acml path	BLAS library to use	See “BLAS Options” on page 96
-blaspath <path>	BLAS library path	See “BLAS Options” on page 96
-ipv6	Activate IPv6 support	
-prefsdir <path>	Preference directory	
-tmpdir <path>	Temporary file directory	
-version	Print COMSOL version	
-version <target>	Print target version	
-ckl	Use class-kit license	

For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files. The `-prefsdir` option specifies the directory where COMSOL should store the preference file.

Shared-Memory Options

Use the option `-np` to control the number of core and processors used. The default is to use all available cores and processors.

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. The following options are available::

TABLE 4-5: COMSOL BLAS OPTIONS

MPMODE OPTION	DESCRIPTION
throughput	Is expected to give the best performance when several different processes are running actively at the same time as COMSOL.
turnaround	Typically provides the best performance when no other processes than COMSOL are active.
owner	Provides the highest performance in most cases.

You might need to experiment to determine what options works best for your configuration.

BLAS Options

BLAS is a set of functions for basic linear algebra operations. A large portion of the computational engine in COMSOL relies on BLAS. COMSOL provides the following BLAS-related options:

TABLE 4-6: COMSOL BLAS OPTIONS

BLAS OPTION	DESCRIPTION
auto	Determine BLAS library automatically: MKL.
mkl	Use the Intel MKL library
path	Use a BLAS library specified using the option <code>-blaspath</code> or the environment variable <code>COMSOL_BLAS_PATH</code> . The library must support the standard FORTRAN BLAS interface.

MKL is distributed along with COMSOL.

If you want to use a different BLAS library than the default, make sure that COMSOL can find the library. The simplest way for COMSOL to find a library is to put it in `/lib/ARCH` where ARCH is the architecture (`maci32` or `maci64`) or somewhere in the standard search path. You must also provide the path to any sublibraries needed by the library. You can also set the search path to point to the directory where the library is installed. To do so, use the environment variable `DYLD_LIBRARY_PATH`.

COMSOL SERVER COMMANDS

Use a COMSOL server command to start a COMSOL process ready to process computational requests. A COMSOL server listens for TCP/IP connections from COMSOL clients. A COMSOL Desktop can become a COMSOL client by

connecting to a COMSOL server. The LiveLink interface for MATLAB also needs to connect to a COMSOL server.

The syntax for the COMSOL server command is

```
comsol [<options>] server [<target arguments>]
```

The following target arguments are available for a COMSOL server command.

TABLE 4-7: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL SERVER OPTIONS	DESCRIPTION
-user <user>	Specify login name for a user
-port <port>	Specify a TCP/IP port to listen for connect attempts.
-passwd <reset/nostore>	Specify that you want to provide a new password. To avoid storing the new password on file use <nostore>
-login <{info}/force/never>	Ask for login information. info means that only missing information is asked for.
-multi on {off}	Accept repeated client connections
-silent	Do not listen to standard input
-graphics	Start the server with graphics libraries. This will display plots on the server when you are connected with a client (that is, not with the COMSOL GUI).

Accessing the COMSOL Server Computer

To access the computer running the COMSOL server simply log in on the server computer by using ssh or a similar command, then enter the `comsol server` command.

Login Information

When you start a COMSOL Multiphysics server for the first time, you are asked for a user name and password. Select a user name and a password, which COMSOL Multiphysics then uses in communications between the COMSOL Multiphysics client and the server. You must also specify a matching user name and password on the **Settings** page in the **Model Navigator**, which opens when you start the COMSOL Multiphysics client. The software writes this login information in the file `login.properties`. The login information is located in `Library/Preferences/COMSOL/ver40a/login.properties` in your home directory.

Client/Server Security Issues

COMSOL Multiphysics can operate in a client/server mode where COMSOL Multiphysics runs as a separate client and a server. COMSOL Multiphysics uses a TCP/IP connection to send data between the server and the client.

Always make sure that untrusted users cannot access the COMSOL login information. You must protect the file `Library/Preferences/COMSOL/ver40a/login.properties`. This is important when using COMSOL Multiphysics' client/server feature.

Once you start a COMSOL Multiphysics server, a person with access to your login information could potentially connect to your COMSOL Multiphysics server. When a COMSOL Multiphysics client connects or disconnects from a remote computer, the COMSOL Multiphysics server displays a message. The connection from the client to the server is made with the TCP protocol.

The server and client are mutually authenticated using a challenge handshake authentication protocol, which means that login information cannot be easily obtained by someone eavesdropping on the network communication. The TCP connection between the client and the server is otherwise not encrypted. If you require encryption of the TCP connection, you can use third-party software based on protocols such as SSH or IPSEC.

COMSOL CLIENT COMMANDS

Use a COMSOL client command to start a COMSOL Desktop with a the Connect to Server dialog box open.

The syntax for the COMSOL client command is

```
comsol [options] client [target arguments]
```

The following target arguments are available for a COMSOL client command.

TABLE 4-8: COMSOL TARGET COMMAND-LINE ARGUMENTS

COMSOL CLIENT OPTIONS	DESCRIPTION
-port <port>	Specify a TCP/IP port to connect to
-server <server name>	Specify server to connect to

COMSOL BATCH COMMANDS

Use the COMSOL batch command to run COMSOL jobs without a GUI. You can run both Model MPH files and Model Java files with the COMSOL batch command. Model Java files need to be compiled before running.

The syntax for the COMSOL batch command is

```
comsol [<options>] batch [<target arguments>]
```

Its detailed target arguments are:

TABLE 4-9: COMSOL BATCH-SPECIFIC ARGUMENTS

COMSOL BATCH OPTIONS	DESCRIPTION
-inputfile <file name>	Run a Model MPH-file or class file
-outputfile <file name>	Save a Model MPH-file using the given file name. If output is not given, the input file will be overwritten with the output
-job <job name>	The batch job to run
-study <study name>	The study to compute
-pname <parameter name>	Comma separated list of parameter names
-plist <parameter value>	Comma separated list of parameter values
-batchlog <file name>	File to store log in
-client	Run as client
-host	Connect to host
-port	Connect to port
-graphics	Start COMSOL batch with graphics libraries. This will display plots during postprocessing.

Example

To use the COMSOL Batch mode to solve a model, run the following command:

```
comsol batch -inputfile in.mph -outputfile out.mph -job b3 -pname v -plist 10
```

This command starts COMSOL Batch, solves the model in the Model MPH-file with the given file name using the active solver settings in the model, and stores the solution in the out.mph.

THE COMSOL COMPILE COMMAND

The COMSOL compile command compile a model Java file for use by the COMSOL batch command or for loading class files into the GUI. The syntax for the COMSOL compile command is

```
comsol [<options>] compile [<target arguments>] <file>.java
```

The Java file is mandatory. The following optional target arguments are available⁴

TABLE 4-10: COMSOL COMPILE OPTIONS

COMSOL COMPILE OPTIONS	DESCRIPTION
-jdkroot <path>	Path to the JDK root
-classpathadd <classpath>	Additional classpath
-verbose	Verbose output

COMSOL MATLAB COMMANDS

Use the COMSOL MATLAB commands to access the COMSOL API through MATLAB. The LiveLink interface for MATLAB requires that MATLAB runs connected to a COMSOL server. The easiest way to start COMSOL with MATLAB is to use the command:

```
comsol server matlab [<options>]
```

This command launches a COMSOL server in a console window, starts MATLAB, and connects MATLAB to the COMSOL server. To create a model object you need to type

```
model = com.comsol.model.ModelUtil.create(<name>);
```

in MATLAB. After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The command

```
comsol matlab [<options>]
```

starts MATLAB with paths ready to communicate with a COMSOL server. To connect to a server work with a model, and close the server connect type, type

```
com.comsol.model.ModelUtil.connect(<host>,<port>);
model = com.comsol.model.ModelUtil.create(<name>);
% work with your model
com.comsol.model.ModelUtil.disconnect;
```

After finishing working with MATLAB, you can stop the server by typing `close` in its console window.

The following options are available for the `comsol matlab` command.⁴

TABLE 4-11: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
-mlroot <path>	MATLAB installation directory
-host <hostname>	Connect to host
-port <hostname>	Connect to port

TABLE 4-11: COMSOL MATLAB OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
-desktop	Start with Desktop
-nodesktop	Start without Desktop
-compat	Run in COMSOL 3.5a compatibility mode
-c35aroot	The COMSOL 3.5a root directory path
-graphics	Start the server with graphics libraries. This enables plotting on the server. Available only when running <code>comsolserver matlab [<options>]</code> .

COMSOL CONVERTPRE35A COMMAND

Use the `comsol convertpre35a` to convert a directory with models made in COMSOL 3.0–3.5 to COMSOL 3.5a. To use the command, type

```
comsol [options] <input directory> <output directory> [log file]
```

where `<input directory>` is the input directory, `<output directory>` is the output directory, and `[log file]` is an optional log file. If you do not provide the third argument, the log is printed on standard output.

TABLE 4-12: COMSOL CONVERTPRE35A OPTIONS

COMSOL MATLAB OPTIONS	DESCRIPTION
-c35aroot <i><path></i>	Installation path of COMSOL 3.5a

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