Chapter 1: Installing the COMSOL Software

General Tips .......................... 2
COMSOL Multiphysics Quick Start and Online Help .................. 2
Technical Support ...................... 2
Typographical Conventions ............. 2

System Requirements .................. 4
General Requirements .................. 4
COMSOL Multiphysics System Requirements for Microsoft Windows ........ 4
COMSOL Multiphysics System Requirements for Linux and Sun .......... 5
COMSOL Multiphysics System Requirements for Mac .................. 6
Optional MATLAB Add-On Requirements .................. 7
CAD Import Modules Platform Support .................. 7
COMSOL Script System Requirements ............. 8

Installing COMSOL on Windows .......... 9
Before You Begin ...................... 9
Installing COMSOL 3.4 .................. 9
Automated Installation of COMSOL 3.4 .................. 16
Removing (Uninstalling) the COMSOL Installation .................. 16
Automated Removal (Uninstallation) of COMSOL 3.4 ............. 18
Changing the Path to the MATLAB Installation .................. 18
Adding the SolidWorks Live Connection to the CAD Import Module .... 18

Installing COMSOL on Linux and Sun .......... 19
Before You Begin ...................... 19
Installing COMSOL 3.4 .................. 19
Removing (Uninstalling) the COMSOL Installation .................. 21
Using the Unattended Installer and Installing Without a Display .... 21
Changing the Path to the MATLAB Installation .................. 21

Installing COMSOL on Macintosh .......... 22
Before You Begin ...................... 22
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installing Java 3D and Java Advanced Imaging</td>
<td>22</td>
</tr>
<tr>
<td>Installing COMSOL 3.4</td>
<td>23</td>
</tr>
<tr>
<td>Removing (Uninstalling) the COMSOL Installation</td>
<td>23</td>
</tr>
<tr>
<td>Changing the Path to the MATLAB Installation</td>
<td>23</td>
</tr>
<tr>
<td>License Manager Installation</td>
<td>24</td>
</tr>
<tr>
<td>Before You Begin</td>
<td>24</td>
</tr>
<tr>
<td>License Manager Installation on Windows</td>
<td>26</td>
</tr>
<tr>
<td>License Manager Installation on Linux and Sun</td>
<td>28</td>
</tr>
<tr>
<td>License Manager Installation on the Mac</td>
<td>33</td>
</tr>
<tr>
<td>Obtaining a Hostid</td>
<td>35</td>
</tr>
<tr>
<td>Troubleshooting License Errors</td>
<td>38</td>
</tr>
</tbody>
</table>

**Chapter 2: Running COMSOL**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running COMSOL on Windows</td>
<td>42</td>
</tr>
<tr>
<td>Running COMSOL Multiphysics</td>
<td>42</td>
</tr>
<tr>
<td>Running COMSOL Script</td>
<td>43</td>
</tr>
<tr>
<td>Running COMSOL Multiphysics with MATLAB</td>
<td>43</td>
</tr>
<tr>
<td>Running COMSOL on Linux/Sun</td>
<td>44</td>
</tr>
<tr>
<td>Running COMSOL Multiphysics</td>
<td>44</td>
</tr>
<tr>
<td>Running COMSOL Script</td>
<td>44</td>
</tr>
<tr>
<td>Running COMSOL Multiphysics with MATLAB</td>
<td>44</td>
</tr>
<tr>
<td>Considerations on Linux</td>
<td>45</td>
</tr>
<tr>
<td>Running COMSOL on Mac OS X</td>
<td>46</td>
</tr>
<tr>
<td>The COMSOL Applications</td>
<td>46</td>
</tr>
<tr>
<td>Running COMSOL Multiphysics from a Terminal Window</td>
<td>47</td>
</tr>
<tr>
<td>The COMSOL Command</td>
<td>48</td>
</tr>
<tr>
<td>The COMSOL Multiphysics Client/Server Architecture</td>
<td>53</td>
</tr>
<tr>
<td>Standalone COMSOL Multiphysics</td>
<td>53</td>
</tr>
<tr>
<td>Running COMSOL Script</td>
<td>53</td>
</tr>
</tbody>
</table>
Installing the COMSOL Software

This chapter provides detailed instructions for installing the COMSOL software for all different platforms and license types. You also find complete system requirements and license manager information. For most installations, the COMSOL Quick Installation Guide that comes bundled with the DVD/CDs provides the basic instructions for installation on the Windows, Mac, and Linux/Sun platforms. Also see the COMSOL Support Knowledge Base on www.comsol.com for specific troubleshooting tips.
General Tips

Welcome to COMSOL® 3.4! 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 Multiphysics Quick Start and Online Help

The easiest way for new users to get an overview of COMSOL Multiphysics’ capabilities and how to use them is to read the COMSOL Multiphysics Quick Start and Quick Reference manual. Also see the COMSOL 3.4 New Feature Highlights document, included with the DVD/CD media, for an overview of the major new features in the 3.4 release. Further, the full COMSOL documentation set is available on your computer in the COMSOL help resources and as a set of PDF files. To get started with COMSOL Script, have a look at the COMSOL Script User’s Guide.

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 graphical user interface (for toolbar buttons in the corresponding tooltip). For instance, we often refer to the Model Navigator, which is the window that appears when you start a new modeling session in
COMSOL; the corresponding window on the screen has the title **Model Navigator**. As another example, the instructions might say to click the **Multiphysics** button, and the boldface font indicates that you can expect to see a button with that exact label on the COMSOL user interface.

- The names of other items on the graphical user interface that do not have direct labels contain a leading uppercase letter. For instance, we often refer to the Draw toolbar; this vertical bar containing many icons appears on the left side of the user interface during geometry modeling. However, nowhere on the screen will you see the term “Draw” referring to this toolbar (if it were on the screen, we would print it in this manual as the **Draw** menu).

- The symbol > indicates a menu item or an item in a folder in the **Model Navigator**. For example, **Physics>Equation System>Subdomain Settings** is equivalent to: On the **Physics** menu, point to **Equation System** and then click **Subdomain Settings**. **COMSOL Multiphysics>Heat Transfer>Conduction** means: Open the **COMSOL Multiphysics** folder, open the **Heat Transfer** folder, and select **Conduction**.

- 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 COMSOL Script codes.

- 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.
System Requirements

General Requirements

These requirements are common to all platforms:

- A CD-ROM or DVD drive for installation
- TCP/IP on all platforms when using a license server
- Adobe Acrobat Reader 5.0 or greater to view and print the COMSOL documentation in PDF format

The actual disk space needed varies with the size of the partition and the optional installation of online help files. The COMSOL installer informs you of hard-disk space requirements for a particular installation.

General System Recommendations

We recommend at least 1 GB of memory. The solutions of a few examples in the Model Library require substantially more than 1 GB of memory and some even a 64-bit platform.

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

COMSOL Multiphysics System Requirements for Microsoft Windows

System Requirements—32-bit Windows Version

- Windows 2000, Windows XP, or Windows Vista
- Pentium III or later
- OpenGL 1.1 from Microsoft or an accelerator that supports OpenGL 1.1, or DirectX version 8.0 or later. The graphics card should have at least 32 MB of memory.

System Requirements—64-bit Windows Version

- Windows XP Professional x64 Edition or Windows Vista
• A PC with one of these processors: AMD with AMD64 or Intel with EM64T.
• A graphics card with at least 32 MB of memory

**COMSOL Multiphysics System Requirements for Linux and Sun**

**SYSTEM REQUIREMENTS**

Standalone COMSOL Multiphysics, the COMSOL Multiphysics client, and the COMSOL Multiphysics server are available in 32- and 64-bit versions as indicated in the table:

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>OPERATING SYSTEM</th>
<th>PROCESSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-bit Linux</td>
<td>Linux 2.4.x kernel, glibc-2.2.5 or later</td>
<td>Pentium III or later</td>
</tr>
<tr>
<td>64-bit Linux</td>
<td>Linux 2.4.x kernel, glibc-2.3.2 or later</td>
<td>AMD with AMD64 or Intel with EM64T</td>
</tr>
<tr>
<td>Itanium</td>
<td>Linux 2.4.x kernel, glibc-2.3.2 or later</td>
<td>Itanium 2</td>
</tr>
<tr>
<td>Sun</td>
<td>Solaris 8, 9, 10</td>
<td>UltraSPARC II or later</td>
</tr>
</tbody>
</table>

**Note:** On the Itanium 2 only the 64-bit COMSOL Multiphysics server is available. Here you must run the COMSOL Multiphysics client on a COMSOL Multiphysics platform other than Itanium using a floating network license to access the COMSOL Multiphysics server.

The following Linux distributions are officially supported by COMSOL:

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>DISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>32-bit Linux</td>
<td>Debian 3.0, 3.1, RedHat Enterprise 4, Fedora Core 5, SUSE 10.1</td>
</tr>
<tr>
<td>64-bit Linux</td>
<td>SUSE 9.0, 9.3, and 10.1, RedHat Enterprise 4 (AMD64/Intel EM64T), Fedora Core 5</td>
</tr>
<tr>
<td>Itanium</td>
<td>Debian 3.1 (IA-64), RedHat Enterprise 4 (Itanium)</td>
</tr>
</tbody>
</table>

In addition, see the graphics requirements in the following sections.

**Linux Graphics Requirements**

You can use any of the following XFree86 and graphics-driver configurations:

- XFree86 4.1 or later with XFree86’s Mesa library and DRI (Direct Rendering Infrastructure)
• XFree86 4.1 with NVIDIA driver 1.0-2880 or later
• XFree86 4.1 with ATI Fire GL2/3/4 drivers X4.1.0-1.9.16 or later. In order to get hardware acceleration with the Fire GL2/3/4 driver, set the environment variable 
  LD_PRELOAD=/usr/lib/libGL.so before starting COMSOL (for example, 
  LD_PRELOAD=/usr/lib/libGL.so comsol). According to ATI, this step is not necessary starting with the 1.9.19 driver.
• XFree86 4.1 with an official Mesa library (not XFree86’s library). You can obtain it at http://www.mesa3d.org/. Use this configuration if you cannot or do not want to use DRI.
• XFree86 3.3.6 with Mesa 3.1 or later

**Sun Graphics Requirements**
Frame Buffer with OpenGL support (XVR-500, XVR-1000, XVR1200, XVR-4000, Expert3D, Elite3D, Creator3D, or PGX).
OpenGL 1.2.2 for Solaris or later. Depending on the type of frame buffer, a higher OpenGL version might be needed; for instance, XVR-1000 requires OpenGL 1.2.3.

**COMSOL Multiphysics System Requirements for Mac**

**SYSTEM REQUIREMENTS—INTEL PROCESSOR**
• Mac OS X 10.4.8
• Java 1.5 or later (part of the Mac OS X installation)

**SYSTEM REQUIREMENTS—POWERPC PROCESSOR**
• Mac OS X 10.3.1, 10.4
• Java 1.4 or later (part of the Mac OS X installation)
• Java 3D and Java Advanced Imaging
• BSD Subsystem (part of the Mac OS X installation)

**SYSTEM REQUIREMENTS FOR COMSOL DESKTOP—POWERPC PROCESSOR**
• Mac OS X 10.4.5
• Java 2 Standard Edition (J2SE) 5.0 Release 4.
Optional MATLAB Add-On Requirements

The following chart indicates available MATLAB interfaces in COMSOL 3.4.

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>7.0</th>
<th>7.0.1</th>
<th>7.0.4</th>
<th>7.1</th>
<th>2006A/B</th>
<th>2007A/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows, 32 bit</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Windows, 64 bit</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Linux, 32 bit</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Linux, 64 bit</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Linux, Itanium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sun, 32 bit</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sun, 64 bit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Mac, Power PC</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mac, Intel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

a. The CAD Import Module is not compatible with use of the interface to MATLAB 2007a/b on Sun.

CAD Import Modules Platform Support

Find the platform support for products in the CAD Import Module family in the following table:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>REQUIRED PRODUCTS</th>
<th>PLATFORM SUPPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD Import Module</td>
<td>COMSOL Multiphysics</td>
<td>Windows, Linux,(^a) Sun(^b)</td>
</tr>
<tr>
<td>CATIA V4 Import Module</td>
<td>CAD Import Module</td>
<td>Windows, Linux,(^a) Sun(^b)</td>
</tr>
<tr>
<td>CATIA V5 Import Module</td>
<td>CAD Import Module</td>
<td>Windows</td>
</tr>
<tr>
<td>Inventor Import Module</td>
<td>CAD Import Module</td>
<td>Windows</td>
</tr>
<tr>
<td>Pro/E Import Module</td>
<td>CAD Import Module</td>
<td>Windows, Linux,(^a) Sun(^b)</td>
</tr>
<tr>
<td>VDA-FS Import Module</td>
<td>CAD Import Module</td>
<td>Windows, Linux,(^a) Sun(^b)</td>
</tr>
</tbody>
</table>

a. Only 32-bit Linux and 64-bit Linux are supported. The Itanium platform is not supported.
b. On Sun, the CAD Import Module is not compatible with use of the interface to MATLAB 2007a/b (64 bit only).

The SolidWorks Live Connection has been tested with SolidWorks 2005 SP5.0, SolidWorks 2006 SP0 and SP5.1, SolidWorks 2007 SP0 and SP4.0, and SolidWorks 2008 SP0. It is available on Windows 2000, Windows XP, Windows XP x64, Windows Vista Business and Ultimate (32 bit only). Supported on the Windows XP x64.
platform are connections between SolidWorks 64 bit and COMSOL Multiphysics 64 bit, as well as between SolidWorks 32 bit and COMSOL Multiphysics 32 bit.

COMSOL Script System Requirements

The system requirements of COMSOL Script are similar to those for COMSOL Multiphysics except that COMSOL Script is not available on the Itanium platform.
Installing COMSOL on Windows

Before You Begin

- Check that your system meets all applicable requirements (see “COMSOL Multiphysics System Requirements for Microsoft Windows” on page 4).
- Have your passcode or license file ready. A passcode has a form similar to:

  FFFFFFF-CUSV-123456-1234567-123456789

You need a passcode or a license file to install COMSOL 3.4. 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 24 for instructions. You can install your COMSOL software products and the license manager in any order.

An installation of earlier COMSOL versions on your computer is not affected by the COMSOL 3.4 installation except that double-clicking a Model MPH-file created with an earlier version of COMSOL will open it in COMSOL 3.4. You can continue to use earlier versions or uninstall them independently of the COMSOL 3.4 installation.

Note: In this manual, the term COMSOL 3.4 refers not only to COMSOL Multiphysics 3.4 but also to any other members of the COMSOL product line including COMSOL Script, the COMSOL Reaction Engineering Lab, and all add-on modules and labs.

Installing COMSOL 3.4

1 Insert the COMSOL 3.4 DVD/CD 1 into the CD-ROM drive. The COMSOL Setup window should appear automatically; if not, run the file setup.exe on the
installation CD. Note that you might need to run setup_<language code>.exe for some languages that require special fonts.

When the installation components have been loaded, the COMSOL Setup window is replaced by the COMSOL 3.4 Installer window. To continue:

- 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 3.4 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 3.4 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 `FFFFFF-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 Select the features to install and specify the path to the COMSOL installation directory. Select MATLAB Interface and specify the MATLAB root folder if you want
the ability to run COMSOL using the MATLAB interface. MATLAB versions 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, 2007a, and 2007b work with COMSOL 3.4.

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.

5 Click *Next*. 
Set the installation options. Here you can choose whether or not you want:

- COMSOL shortcuts on the Windows desktop
- COMSOL shortcuts on the Windows Start menu
- to associate the COMSOL model file type (.mph files) with the COMSOL installation. If you choose this option you can open COMSOL models by double-clicking them.
- to associate the COMSOL Reaction Engineering Lab model file type (.rxn files) with the COMSOL installation. If you choose this option you can open COMSOL Reaction Engineering Lab models by double-clicking them.

Click Next.
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.

Be prepared to eject CD 1 from the CD-ROM drive if the following dialog box appears. Follow the instructions in the dialog box, insert CD 2, CD 3, CD 4, CD 5, or CD 6, and then click **OK**.

**Note:** Whether or not you will be asked for CD 2, CD 3, CD 4, CD 5, or CD 6 depends on your license and on the features selected in Step 4.
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 of COMSOL 3.4

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

\[ \text{<path to CD 1>}	ext{\setup.exe -s <answer file path>} \]

A template answer file, **setup.ini**, with detailed usage information is available on CD 1.

Removing (Uninstalling) the COMSOL Installation

To remove a COMSOL installation from your system, use the COMSOL uninstaller.
Note: The uninstaller deletes all COMSOL 3.4 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, use either of these methods:

- On the Windows Start menu point to Programs and then to COMSOL 3.4. Click Uninstall COMSOL 3.4.
- On the Windows Start menu, point to Settings, then click Control Panel.
  Double-click Add/Remove Programs. Select COMSOL 3.4 from the list.

RUNNING THE UNINSTALLER
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 3.4

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, setup.ini, which is available on CD 1. When you have created an answer file for uninstalling, you start the uninstallation by running

```bash
<path to CD 1>\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 comsol.opts in the bin directory under the COMSOL root directory (typically C:\COMSOL34). In the file, change the line that starts with `mlroot=` to point to the root directory of your MATLAB installation.

Adding the SolidWorks Live Connection to the CAD Import Module

If you have bought the CAD Import Module, the COMSOL Installer adds an add-in to SolidWorks called the COMSOL Multiphysics Interface. This add-in should appear on the SolidWorks user interface in the Add-Ins list that appears under 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. In SolidWorks, go to the File menu and choose Open.
2. In the Files of type list select Add-Ins (*.dll).
3. Load the file flswinterface.dll from the directory lib\win32 under the COMSOL 3.4 installation directory.
Installing COMSOL on Linux and Sun

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 24 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 thus 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 and Sun does not modify any files on your system outside the COMSOL installation directory.

Installing COMSOL 3.4

1. Insert the COMSOL 3.4 CD 1 or DVD into the CD-ROM/DVD drive.
2. If the CD or DVD is not mounted automatically by your operating system, use the mount command to mount it.

Note: If you are installing from CDs, make sure not to connect to a directory on CD 1 or open files on it. If you do so while installing the software, you will be unable to unmount and eject CD 1 and continue the installation with CD 2, CD 3, CD 4, CD 5, and CD 6 (depending on the license, not all CDs might be required).

3. To start the installation, enter the command

   sh drivepath/setup

   where drivepath is the mount point of the CD-ROM/DVD drive, for example, /mnt/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. If you want the ability to run COMSOL using the MATLAB interface, select MATLAB Interface and specify the MATLAB root folder. MATLAB versions 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, 2007a, and 2007b work with COMSOL 3.4.

8 Click Next.

9 Click Install to start the installation.

The installation process might take several minutes. If you are installing from CDs, be prepared to unmount and eject CD 1 from the CD-ROM drive when the corresponding dialog box appears. Use the unmount and eject commands to unmount and eject the CD. Some Linux and Sun configurations will automatically unmount and eject the CD when you press the CD drive button. Insert CD 2, CD 3, CD 4, CD 5, or CD 6, make sure it is mounted, and click OK.

10 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 CD or DVD. Some Linux and Sun configurations will automatically unmount and eject the CD or DVD when you press the CD or 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 `comsol34/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 3.4 installation adds files only in the `comsol34` directory. To remove the COMSOL installation, simply delete the `comsol34` directory including all subdirectories.

**Using the Unattended Installer and Installing Without a Display**

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 documented in the template answer file, `setup.ini`, which is available on CD 1. When you have created an answer file, you start the uninstallation by running

```
<path to CD 1>\setup.exe -s <answer file path>
```

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

**Changing the Path to the MATLAB Installation**

Open the file `comsol` in the `bin` directory under the COMSOL installation directory. In the file, change the line that starts with `mlroot=` to point to the root directory of your MATLAB installation.
Installing COMSOL on Macintosh

Before You Begin

- Check that your system meets all applicable requirements (see “COMSOL Multiphysics System Requirements for Mac” on page 6).
- Have your passcode or license file ready. A passcode has a form similar to:
  
  FFFFFF-0USV-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 24 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 3.4 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 3.4.

Installing Java 3D and Java Advanced Imaging

COMSOL requires Java 3D and Java Advanced Imaging from Apple. It is included in Mac OS X 10.4, but for Mac OS X 10.3 it must be installed separately. You can download this software update from


To install this software after the download:

1  If the disk image was not mounted automatically following the download, mount it by double-clicking the disk image file Java3D_and_JAI.dmg.

2  Double-click the file Java3D_and_JAI.mpkg to launch the installer. Follow the instructions to install the software update.
Installing COMSOL 3.4

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 3.4 DVD/CD 1 into the CD-ROM drive. Launch the COMSOL Installer application from the Finder. The COMSOL 3.4 Installer window appears.
2. To proceed, see the instructions for Windows in the section “Installing COMSOL 3.4” on page 9. The procedure is the same for the Mac.

Removing (Uninstalling) the COMSOL Installation

The COMSOL 3.4 installation adds files only in the COMSOL34 folder. To remove the COMSOL installation, simply delete the COMSOL34 folder including all subfolders.

Changing the Path to the MATLAB Installation

Edit the file comsol in the bin directory under the COMSOL installation directory. In the file, change the line that starts with mlroot= to point to the root directory of your MATLAB installation.
License Manager Installation

The license manager supports a heterogeneous network of Windows, Linux, Sun, and Mac computers. Both the license manager and a COMSOL application can run on either Windows, Linux, Sun, 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. Then, depending on the platform, go to the following sections:

LICENSE MANAGER INSTALLATION SECTIONS

“License Manager Installation on Windows” on page 26
“License Manager Installation on Linux and Sun” on page 28
“License Manager Installation on the Mac” on page 33

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 10.8 from Macrovision Corporation 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 (see page 4). 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 3.4 permanent uncounted \ 
    VENDOR_STRING=T,7F3F3 HOSTID=DEMO SN=123456789 \ 
    SIGN=123456789ABC
INCREMENT COMSOL LMCOMSOL 3.4 permanent 10 DUP_GROUP=UH \ 
    SIGN=123456789ABC
INCREMENT COMSOLGUI LMCOMSOL 3.4 permanent 10 DUP_GROUP=UH \ 
    SIGN=123456789ABC
INCREMENT CHEM LMCOMSOL 3.4 permanent 5 DUP_GROUP=UH \ 
    SIGN=123456789ABC
INCREMENT EM LMCOMSOL 3.4 permanent 5 DUP_GROUP=UH \ 
    SIGN=123456789ABC
INCREMENT SME LMCOMSOL 3.4 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.

---

**Note:** Only the license server name and the port number should change. Do not modify anything else in the `license.dat` file or your license will not work.

---

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

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 3.4 license allowing ten concurrent users of
COMSOL Multiphysics and five concurrent users of the Chemical Engineering Module, the Electromagnetics 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 35 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 Desk.

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 Windows” on page 9 for installation instructions. When finished, skip the remainder of this section and continue with “Starting the License Manager” on page 27.

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

1. Insert the distribution disk CD 1 into the CD-ROM drive.
2. Follow the installation instructions starting on page 9 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.

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 comsol34\license\win32 directory and run lmtools.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.
5. Specify the full path to lmgrd.exe, license.dat, and the debug log file of your choice.
6 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.

7 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` directory. Now, in a command window enter

```
lgmgrd -c ..\license.dat -l ..\comsol34.log
```

The license manager is now ready to distribute licenses over the network. It writes debug information to the log file `comsol34\license\comsol34.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.

**License Manager Installation on Linux and Sun**

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 and Sun.

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 (\texttt{lmgrd})
- Vendor daemon (\texttt{LMCOMSOL})
- FLEXnet utility programs (\texttt{lmutil} and others)

The two daemons (\texttt{lmgrd} and \texttt{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 \texttt{lmgrd} daemon. The \texttt{lmgrd} daemon in turn makes a request to the vendor daemon (\texttt{LMCOMSOL}) to release a license. The vendor daemon releases licenses according to information contained in \texttt{license.dat}. The utility programs are used for license-server management. For more information on FLEXnet management, see Chapter 7 in the \textit{FLEXnet Licensing End Users Guide}, which is available on the COMSOL 3.4 Help Desk.

INSTALLING THE LICENSE MANAGER FILES

The license manager should be installed only on the host(s) listed in \texttt{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 Linux and Sun” on page 19). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 31.

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

1. Insert CD 1 into the CD-ROM drive.
2. To start the installation, enter the following command:
   \[ /mnt/cdrom/setup \]
   depending on where \texttt{/mnt/cdrom} is the mount point of the CD-ROM drive.
3. Continue according to the installation instructions on page 23 until the step where you see the \textbf{Features} screen.
4. In the list of products to install, select only the \textbf{License Manager} check box.
5. Resume the installation instructions with the \textbf{Features} screen to complete the license manager file installation.
**LICENSE FILES FOR NAMED SINGLE USER LICENSE**

If you have a *Named Single User License* the installer automatically creates a so-called *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 with COMSOL Script, 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; for COMSOL Script, the options file must include the SCRIPT and SCRIPTPROMPT features.

```
INCLUDE COMSOL USER philip
INCLUDE COMSOLGUI USER philip
INCLUDE SCRIPT USER philip
INCLUDE SCRIPTPROMPT USER philip
INCLUDE CADIMPORT 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 3.4 product family:

<table>
<thead>
<tr>
<th>PRODUCT/FEATURE</th>
<th>FEATURE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMSOL Multiphysics</td>
<td>COMSOL</td>
</tr>
<tr>
<td>COMSOL Multiphysics GUI</td>
<td>COMSOLGUI</td>
</tr>
<tr>
<td>COMSOL Multiphysics floating network license</td>
<td>CLIENTSERVER</td>
</tr>
<tr>
<td>COMSOL Script</td>
<td>SCRIPT</td>
</tr>
<tr>
<td>COMSOL Script command prompt</td>
<td>SCRIPTPROMPT</td>
</tr>
<tr>
<td>COMSOL Reaction Engineering Lab</td>
<td>REACTION</td>
</tr>
<tr>
<td>AC/DC Module</td>
<td>EM</td>
</tr>
<tr>
<td>Acoustics Module</td>
<td>ACO</td>
</tr>
<tr>
<td>CAD Import Module</td>
<td>CADIMPORT</td>
</tr>
<tr>
<td>Chemical Engineering Module</td>
<td>ChEM</td>
</tr>
<tr>
<td>Earth Science Module</td>
<td>ES</td>
</tr>
<tr>
<td>Heat Transfer Module</td>
<td>HT</td>
</tr>
</tbody>
</table>
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/comsol34/license/LMCOMSOL.opt
then the VENDOR row in license.dat should read

VENDOR LMCOMSOL options=/usr/local/comsol34/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

```bash
./lmgrd -c ../license.dat -l /var/tmp/comsol34.log
```

The server is now ready to distribute licenses over the network. It writes any debug information to the log file `/var/tmp/comsol34.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:** We do not recommend that you start the daemons as root for security reasons. Instead, use a dedicated username to start the license manager.

---

<table>
<thead>
<tr>
<th>PRODUCT/FEATURE</th>
<th>FEATURE NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEMS Module</td>
<td>MEMS</td>
</tr>
<tr>
<td>RF Module</td>
<td>RF</td>
</tr>
<tr>
<td>Structural Mechanics Module</td>
<td>SME</td>
</tr>
<tr>
<td>Signals &amp; Systems Lab</td>
<td>SIGNAL</td>
</tr>
<tr>
<td>Optimization Lab</td>
<td>OPTLAB</td>
</tr>
</tbody>
</table>

**Table 1-4: COMSOL 3.4 Products and Their Feature Names**
The procedure for editing boot scripts on each platform appears in the following table:

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>PROCEDURE</th>
</tr>
</thead>
</table>
| Sun      | Copy the file `comsol34/license/sol2/rc.lm` and paste it at the beginning of `/etc/init.d/lmgrd`. Create this file if it does not already exist.  
  Edit `/etc/init.d/lmgrd`, replacing ‘dir’ in the code fragment with the full path to the sol2 platform directory, and replace ‘username’ with an actual username.  
  If the file (link) `/etc/rc3.d/S171lmgrd` does not exist, create it with the commands  
  ```bash  
cd /etc/rc3.d  
ln -s /etc/init.d/lmgrd S171lmgrd  
``` |
| SuSE Linux | The following instructions should work for SuSE Linux distributions, where `$arch` is either `glnx86` (32-bit Linux), or `glnxa64` (64-bit Linux).  
  In the `comsol34/license/$arch` directory, type the commands  
  ```bash  
cp rc.lm /etc/init.d/comsol34lm  
chmod 755 /etc/init.d/comsol34lm  
```  
  Edit `/etc/init.d/comsol34lm`, replacing ‘dir’ with the full path to the `$arch` platform directory, and replace ‘username’ with an actual username.  
  Now create the following link  
  ```bash  
cd /etc/init.d/rc5.d  
ln -s ../comsol34lm S91comsol34lm  
``` |
| Debian/Linux | Copy the file `comsol34/license/$arch/lm_comsol` to `/etc/init.d`.  
  Edit `/etc/init.d/lm_comsol`, update the FP and MYUSER variables as indicated in the file. Use the utility `update-rc.d` to automatically update the system’s init script links:  
  ```bash  
update-rc.d lm_comsol start 99 2 3 4 5 . stop 1 0 1 6 .  
```  
  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 `man update-rc.d` for more information on init scripts. |
| Linux | The following instructions should work for most Linux distributions, where `$arch` is either `glnx86` (32-bit Linux), `glnxa64` (64-bit Linux), or `glnxi64` (Itanium).  
  Copy the file `comsol34/license/$arch/rc.lm` and paste it at the end of `/etc/rc.d/rc.local`.  
  Replace ‘dir’ in the code fragment with the full path to the `$arch` platform directory, and replace ‘username’ with an actual username. |
STARTING COMSOL

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

License Manager Installation on the Mac

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 Macintosh” on page 22). When finished, skip the remainder of this section and continue at “Starting the License Manager” on page 34.

If you want to install only the COMSOL license manager files, follow these instructions:
1 Insert the COMSOL 3.4 CD 1 into the CD-ROM drive.

2 Follow the installation instructions starting on page 23 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 9) to complete the license manager file installation.

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/macosx directory

   cd /Applications/COMSOL34/license/macosx

3 Then enter

   ./lmgrd -c ../license.dat -l /var/tmp/comsol34.log

   The server is now ready to distribute licenses over the network. It writes any debug information to the log file /var/tmp/comsol34.log.

Starting the License Manager Automatically at Startup

A folder COMSOL_Lmgr located in the folder COMSOL34/license/macosx 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/COMSOL34

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.

Obtaining a Hostid

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

    COMSOL34/license/$arch/lmhostid

where $arch is either win32 (Windows), win64 (64-bit Windows), glnx86 (32-bit
Linux), glnxa64 (64-bit Linux), glnxi64 (Itanium), sol2 (Sun), or macosx (Mac).

If COMSOL is not installed, you must obtain a hostid using OS commands as
described in the following table:

<table>
<thead>
<tr>
<th>PLATFORM</th>
<th>HOSTID</th>
<th>TYPE THIS COMMAND ON THE LICENSE SERVER:</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux</td>
<td>Ethernet address</td>
<td>/sbin/ifconfig eth0 and remove colons from HWaddr 00:40:05:16:E5:25 (do not use the hostid command)</td>
<td>00400516E525</td>
</tr>
<tr>
<td>Sun</td>
<td>32-bit hostid</td>
<td>hostid</td>
<td>170a3472</td>
</tr>
<tr>
<td>Windows</td>
<td>Ethernet address</td>
<td>ipconfig /all (remove hyphens from the physical address 00-50-02-84-A3-28)</td>
<td>00500284A328</td>
</tr>
<tr>
<td>Mac</td>
<td>Ethernet address</td>
<td>see below</td>
<td>00039377F4AC</td>
</tr>
</tbody>
</table>

FLEXnet uses different machine identifications for different architectures. For
example, all Sun Microsystems machines have a unique hostid whereas other machines
do not. For this reason, some 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 WINDOWS
1. Open the Start menu and click Run.
2. Type cmd and click OK and the command window opens.
3. Type
dev
and press Enter.
4. The FLEXnet hostid is equal to the Physical Address, which is displayed in the next image, with the hyphens removed.

OBTAINING THE HOSTID ON A MACINTOSH
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 Macintosh 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.

<table>
<thead>
<tr>
<th>ERROR MESSAGE</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>License error</td>
<td>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 <a href="mailto:support@comsol.com">support@comsol.com</a>.</td>
</tr>
<tr>
<td>License error: -5. No such feature exists.</td>
<td>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: Windows: \COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log Please send the log file to <a href="mailto:support@comsol.com">support@comsol.com</a> 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” in the COMSOL Installation Guide for instructions how to install and start the COMSOL license manager.</td>
</tr>
<tr>
<td>License error: -12. Invalid returned data from license server system.</td>
<td>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 lmgrd daemon and the LMCOMSOL daemon. If the problems remain, send the license manager log file to <a href="mailto:support@comsol.com">support@comsol.com</a>. The log file is usually placed here: Windows: \COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log</td>
</tr>
</tbody>
</table>
License error: -15. Cannot connect to license server system.

The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this:

```
SERVER mylicserver 000123456789 1716
```
a license manager is required. Please refer to the section “License Manager Installation” in the COMSOL Installation Guide for instructions how to install and start the COMSOL license manager.

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 server.

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:

**Windows:** C:\COMSOL34\license\license.dat

**Linux/Sun:** /usr/local/comsol34/license/license.dat

**Mac:** /Applications/comsol34/license/license.dat

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:

```
SERVER mylicserver 000123456789 1716
```

If the COMSOL client computer does not recognize `mylicserver` as a proper hostname, it might helpful 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.

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:

**Windows:** C:\COMSOL34\license\comsol34.log

**Linux/Sun/Mac:** /var/tmp/comsol34.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.

---

**TABLE 1-7: GENERAL ERROR MESSAGES**

<table>
<thead>
<tr>
<th>ERROR MESSAGE</th>
<th>EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>License error: -15. Cannot connect to license server system.</td>
<td>The COMSOL license manager has not been installed or started yet. If the first line of your license.dat file looks like this: SERVER mylicserver 000123456789 1716 a license manager is required. Please refer to the section “License Manager Installation” in the COMSOL Installation Guide for instructions how to install and start the COMSOL license manager. 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 server. Check that the <code>license.dat</code> file on the COMSOL client computer points to the correct license server hostname. First, find the <code>license.dat</code> file in the COMSOL application folder: Windows: C:\COMSOL34\license\license.dat Linux/Sun: /usr/local/comsol34/license/license.dat Mac: /Applications/comsol34/license/license.dat Check that the first line has the correct license-server hostname. For example, if your license server hostname is <code>mylicserver</code>, the first row in the license.dat file should look like this: SERVER mylicserver 000123456789 1716 If the COMSOL client computer does not recognize <code>mylicserver</code> as a proper hostname, it might helpful to instead use the fully qualified domain name (<code>mylicserver.mydomain.org</code>) 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. 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: Windows: C:\COMSOL34\license\comsol34.log Linux/Sun/Mac: /var/tmp/comsol34.log NOTE: The log file is created by the license manager after it has been started. Please send the log file to <a href="mailto:support@comsol.com">support@comsol.com</a> if you want help in interpreting the information.</td>
</tr>
<tr>
<td>ERROR MESSAGE</td>
<td>EXPLANATION</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>License error: -39. User/host not on INCLUDE list for feature.</td>
<td>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.</td>
</tr>
<tr>
<td>License error: -88. System clock has been set back.</td>
<td>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.</td>
</tr>
</tbody>
</table>
| 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: Windows: C:\COMSOL34\license\license.dat  
Linux/Sun: /usr/local/comsol34/license/license.dat  
Mac: /Applications/comsol34/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:  
Windows: C:\COMSOL34\license\comsol34.log  
Linux/Sun/Mac: /var/tmp/comsol34.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

This chapter describes the various options for running the COMSOL software products on the supported platforms.
Running COMSOL on Windows

The installer adds the folder **COMSOL 3.4** 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 Script**: Starts a COMSOL Script prompt. To start the COMSOL Multiphysics GUI from within COMSOL Script, run `comsol` at the command prompt. A corresponding shortcut is added to the desktop.
- **COMSOL with MATLAB**: Starts MATLAB 7.0, 7.0.1, 7.0.4, 7.1, 2006a, 2006b, or 2007a and sets up all necessary paths, and then it opens the COMSOL Multiphysics graphical user interface. If you quit COMSOL Multiphysics you can launch it again by typing `comsol` at the MATLAB command prompt. A corresponding shortcut is added to the desktop.
- **COMSOL Multiphysics Client**: Starts a COMSOL Multiphysics client for connecting to a COMSOL Multiphysics server (see the section “Running COMSOL Multiphysics Client/Server” on page 57).
- **COMSOL Multiphysics Server**: Starts a COMSOL Multiphysics server that a COMSOL Multiphysics client can connect to (see the section “Running COMSOL Multiphysics Client/Server” on page 57).
- **Uninstall COMSOL 3.4**.
- **Documentation**: A folder that contains COMSOL documentation shortcuts.

**Running COMSOL Multiphysics**

You can run COMSOL Multiphysics by double-clicking the **COMSOL Multiphysics 3.4** icon on the desktop.

Alternatively, to activate COMSOL Multiphysics from the **Start** menu, point to **Programs**, then to **COMSOL 3.4**, and then click **COMSOL Multiphysics**.
Running COMSOL Script

You can run COMSOL Script by double-clicking the COMSOL Script 1.2 icon on the desktop.

Alternatively, to activate COMSOL Script from the Start menu, point to Programs, then to COMSOL 3.4, and then click COMSOL Script.

Use the command comsolbatch.exe in the directory bin under the COMSOL 3.4 installation directory to run COMSOL Script in batch mode. For example, use comsolbatch "inv([1 2; 3 5])" to compute the inverse of the matrix [1 2; 3 5].

Running COMSOL Multiphysics with MATLAB

To run COMSOL Multiphysics with MATLAB, double-click the COMSOL 3.4 with MATLAB icon on the desktop.

Alternatively, start COMSOL Multiphysics with MATLAB from the Start menu by pointing to Programs, then to COMSOL 3.4, and then select COMSOL with MATLAB.

The CLASSPATH file and its location

The classpath.txt file specifies which Java class path to use inside MATLAB. When starting COMSOL Multiphysics with MATLAB, COMSOL Multiphysics copies classpath.txt from the toolbox\local directory under the MATLAB installation to the directory specified as the Start in directory for the COMSOL with MATLAB shortcut. It then writes some extra lines to this file to include the Java class paths that COMSOL Multiphysics needs. Therefore you must have write access to the Start in directory when starting MATLAB using the comsol command. To change the Start in directory:

1 Right-click the COMSOL with MATLAB shortcut and choose Properties.
2 On the Shortcut page, type the path to the starting directory into the Start in edit field.
3 Click OK.
Running COMSOL on Linux/Sun

Running COMSOL Multiphysics

Run the `comsol` command. If it is not available, ask your system manager to make it available to you.

Running COMSOL Script

Run the command

    comsol script

If it is not available, ask your system manager to make it available to you.

Running COMSOL Multiphysics with MATLAB

Run the command

    comsol matlab

to launch MATLAB with paths setup to run COMSOL Multiphysics functions.

Run the command

    comsol matlab multiphysics

to launch the COMSOL Multiphysics user interface from within the MATLAB environment.

The script `comsol` creates a file `classpath.txt` that MATLAB requires, and it places that file in the current directory. Therefore you must have write access to this directory when starting MATLAB using the `comsol` command.

Note: To be able to run 64-bit COMSOL on Linux/Sun, make sure that you have installed the 64-bit support for your platform.
Considerations on Linux

COMSOL has been compiled to run on certain older versions of Linux. COMSOL will not automatically detect these older Linux versions so you need to tell COMSOL about this yourself. These versions do not have full parallel support.

32 BIT LINUX
To run COMSOL an a Linux version with glibc version lower than 2.3.2, you need to run COMSOL with the -gcc323 option. Type `comsol -gcc323` to start COMSOL.

64 BIT LINUX
To run COMSOL an a Linux version with glibc version lower than 2.3.4, you need to run COMSOL with the -gcc332 option. Type `comsol -gcc332` to start COMSOL.
Running COMSOL on Mac OS X

The COMSOL Applications

The following five applications allow you to run COMSOL as described in the following sections.

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.

- **COMSOL Multiphysics** application
  This is the primary application to run the software. It launches COMSOL Multiphysics as a standalone application.

- **COMSOL Script** application
  This is the primary application to run the software. It launches COMSOL Script as a standalone application.

- **COMSOL with MATLAB** application
  Use this application when you want to use the interface between COMSOL Multiphysics and MATLAB. This application first launches MATLAB and then the COMSOL Multiphysics graphical user interface. If you quit COMSOL Multiphysics you can launch it again by typing `comsol` at the MATLAB command prompt.

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 Client** application
  This application launches a COMSOL Multiphysics client that connects to a COMSOL Multiphysics server (see the section “Running COMSOL Multiphysics Client/Server” on page 57).
• **COMSOL Multiphysics Server** application
  
  This application launches the **Terminal** application and starts a COMSOL Multiphysics server in a terminal window (see “Running COMSOL Multiphysics Client/Server” on page 57).

**Running COMSOL Multiphysics from a Terminal Window**

You can also launch COMSOL Multiphysics from a terminal window using the shell script `COMSOL34/bin/comsol`. See the section “Running COMSOL on Linux/Sun” on page 44 for options available in the `comsol` command.

To run the `comsol` command more easily, include the `COMSOL34/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/COMSOL34/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 `COMSOL34/bin` folder. The COMSOL applications also use this script.
The COMSOL Command

Use the `comsol` command to start COMSOL products with detailed start-up options. This command works similarly on all platforms, but there are differences in availability and options. On non-Windows platforms, you can start all COMSOL products with the `comsol` command. On Windows there are some differences: you must use different commands to start 32- and 64-bit applications, and you need special commands to start terminal-based products (see availability in the following chart).

The general syntax of the `comsol` command is:

```
comsol [options] [product] [product arguments] [expression]
```

where `[...]` indicates something optional:

<table>
<thead>
<tr>
<th>COMSOL OPTION</th>
<th>DESCRIPTION</th>
<th>AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>-32</td>
<td>Use a 32-bit data model if available</td>
<td>In Windows, use comsol.exe</td>
</tr>
<tr>
<td>-64</td>
<td>Use a 64-bit data model if available</td>
<td>In Windows, use comsol64.exe. Not available on Mac</td>
</tr>
<tr>
<td>-blas &lt;{auto}/mkl/atlas/sunperf/path/acml&gt;</td>
<td>BLAS library to use</td>
<td>See section “COMSOL and BLAS” on page 65</td>
</tr>
<tr>
<td>-h</td>
<td>Print general help</td>
<td></td>
</tr>
<tr>
<td>-h &lt;product&gt;</td>
<td>Print product-specific help</td>
<td></td>
</tr>
<tr>
<td>-np &lt;no. of processors&gt;</td>
<td>Number of processors</td>
<td>Not available on Mac</td>
</tr>
<tr>
<td>-mpmode &lt;throughput/turnaround/owner&gt;</td>
<td>Multiprocessor mode</td>
<td>See “Optimizing Processor Usage” on page 63</td>
</tr>
<tr>
<td>-tmpdir &lt;path&gt;</td>
<td>Temporary file directory</td>
<td></td>
</tr>
<tr>
<td>-version</td>
<td>Print COMSOL version</td>
<td></td>
</tr>
<tr>
<td>-version &lt;product&gt;</td>
<td>Print product version</td>
<td></td>
</tr>
</tbody>
</table>

We support the 64-bit option on Linux, Itanium, and Sun platforms. On Windows, use the `comsol.exe` and `comsol64.exe` commands to start 32- and 64-bit products, respectively. For the `-tmpdir` option, COMSOL software uses the specified directory to store temporary files.
The available COMSOL products are:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>DESCRIPTION</th>
<th>AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>multiphysics</td>
<td>Run standalone COMSOL Multiphysics</td>
<td></td>
</tr>
<tr>
<td>server</td>
<td>Run COMSOL Multiphysics server</td>
<td>This is the only product available on the Itanium platform. In Windows use comsolserver.exe or comsolserver64.exe</td>
</tr>
<tr>
<td>client</td>
<td>Run COMSOL Multiphysics client</td>
<td></td>
</tr>
<tr>
<td>script</td>
<td>Run COMSOL Script</td>
<td>In Windows, optionally use comsolscript.exe or comsolscript64.exe</td>
</tr>
<tr>
<td>batch</td>
<td>Evaluate expression or run M-file in batch mode</td>
<td>In Windows, use comsolbatch.exe or comsolbatch64.exe</td>
</tr>
<tr>
<td>reaction</td>
<td>Run COMSOL Reaction Engineering Lab</td>
<td>In Windows, optionally use comsolreaction.exe or comsolreaction64.exe</td>
</tr>
<tr>
<td>matlab</td>
<td>Run COMSOL in MATLAB</td>
<td></td>
</tr>
<tr>
<td>ffi</td>
<td>Compile foreign function</td>
<td>In Windows, use comsolfi.exe or comsolfi64.exe</td>
</tr>
</tbody>
</table>

From within COMSOL Multiphysics, COMSOL Script, and COMSOL Reaction Engineering Lab, you can start any other product by clicking its name in the File menu. This means the products run within the same process and that they can intercommunicate. Never start products separately if you want to make them communicate later on. From within COMSOL Script and MATLAB you can start the COMSOL Multiphysics graphical user interface and the COMSOL Multiphysics server by using the M-file comsol.m. For more information about the COMSOL Multiphysics client/server architecture, see the section “Running COMSOL Multiphysics Client/Server” on page 57.
CHAPTER 2: RUNNING COMSOL

GENERAL COMSOL PRODUCT COMMAND-LINE ARGUMENTS

Example:
Start COMSOL Server and COMSOL Client, explicitly choosing a port number, enabling multiple ports, and indicating that you want to provide a new passcode to the COMSOL Server.

```
comsol server -login force -port 4711 -multi on
comsol client -port 4711
```

COMSOL SCRIPT OPTIONS

The general syntax for the command to start COMSOL Script is

```
comsol [options] script [product arguments]
```

Its detailed product arguments are:

<table>
<thead>
<tr>
<th>COMSOL SCRIPT ARGUMENTS</th>
<th>DESCRIPTION</th>
<th>AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>multiphysics</td>
<td>Run COMSOL Multiphysics within COMSOL Script</td>
<td></td>
</tr>
<tr>
<td>server</td>
<td>Run COMSOL server within COMSOL Script</td>
<td></td>
</tr>
<tr>
<td>-desktop</td>
<td>Use COMSOL desktop interface</td>
<td></td>
</tr>
<tr>
<td>-gui</td>
<td>Use graphical user interface</td>
<td>In Windows, use comsolterm.exe or comsolterm64.exe</td>
</tr>
<tr>
<td>-term</td>
<td>Use terminal interface</td>
<td></td>
</tr>
</tbody>
</table>
An example of using the `comsol script` command on Linux is

```
comsol script -desktop -ws motif <expression>
```

It starts COMSOL Script within the COMSOL desktop environment, selects the Motif window system, and evaluates the expression before starting.

**MATLAB ARGUMENTS**

The command `comsol matlab [options]` starts MATLAB with the COMSOL paths set up. Run the command `comsol matlab multiphysics` to also launch the COMSOL Multiphysics user interface.

Similarly, `comsol matlab path [options]` starts MATLAB with the COMSOL path set up.

The command `comsol matlab server [options]` starts MATLAB with the COMSOL path set up and starts a COMSOL Multiphysics server.

The command `comsol matlab reaction [options]` starts MATLAB and the COMSOL Reaction Engineering Lab graphical user interface.

The full list of options for `comsol matlab` are:

<table>
<thead>
<tr>
<th>MATLAB ARGUMENTS</th>
<th>DESCRIPTION</th>
<th>AVAILABILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>{path}</td>
<td>Set up COMSOL path within MATLAB</td>
<td></td>
</tr>
<tr>
<td>multiphysics</td>
<td>Run COMSOL Multiphysics within MATLAB</td>
<td></td>
</tr>
<tr>
<td>server</td>
<td>Run COMSOL server within MATLAB</td>
<td></td>
</tr>
<tr>
<td>reaction</td>
<td>Run COMSOL Reaction Engineering Lab within MATLAB</td>
<td></td>
</tr>
</tbody>
</table>

**Example**

```
TABLE 2-5: COMSOL MATLAB-SPECIFIC ARGUMENTS

<table>
<thead>
<tr>
<th>MATLAB ARGUMENTS</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>-ml &lt;option&gt;</td>
<td>Start MATLAB using the specified option</td>
</tr>
<tr>
<td>-mlr &lt;expression&gt;</td>
<td>Evaluate expression in MATLAB after COMSOL within MATLAB</td>
</tr>
<tr>
<td>-mlroot &lt;directory&gt;</td>
<td>Specify root directory for MATLAB installation</td>
</tr>
<tr>
<td>-D&lt;debugger&gt;</td>
<td>Run MATLAB in debugger, no COMSOL paths set</td>
</tr>
<tr>
<td>&lt;expression&gt;</td>
<td>Evaluate expression within COMSOL Script</td>
</tr>
</tbody>
</table>

Examples:
Start MATLAB without the MATLAB desktop and without the MATLAB splash screen and run mycomsolscript.
comsol matlab path -ml -nodesktop -ml -nosplash -mlr mycomsolscript

Run COMSOL Multiphysics with MATLAB using MATLAB installed in /usr/local/MyMatlab.
comsol matlab multiphysics -mlroot /usr/local/MyMatlab

PERMANENTLY CHANGING THE MATLAB OPTIONS
You can add the MATLAB startup options to the file comsol.opts (on Windows) or comsol (on the Linux, Sun, and Macintosh platforms). On the line that starts with the string mlargs=, add the MATLAB startup options that you want to use. For example, mlargs=-nodesktop -nosplash
starts COMSOL Multiphysics with MATLAB without showing the MATLAB splash screen and providing MATLAB without the desktop environment.
The COMSOL Multiphysics Client/Server Architecture

Standalone COMSOL Multiphysics

The most straightforward way of running COMSOL Multiphysics is as a standalone application. Standalone COMSOL Multiphysics 3.4 can run as a 32-bit application on Windows, Linux, Sun, and Mac.

Running COMSOL Script

COMSOL Script runs in 32-bit mode on all platforms on Windows, Linux, Sun, and Mac. In addition it can run in 64-bit mode on 64-bit Windows plus 64-bit Linux and Sun. COMSOL Script typically runs in the same process as COMSOL Multiphysics.

Running COMSOL Multiphysics with MATLAB

COMSOL Multiphysics can run together with MATLAB on the same machine using COMSOL Multiphysics' client/server architecture. The COMSOL Multiphysics server runs on the Java engine within MATLAB, while the COMSOL Multiphysics graphical user interface runs as a separate application. COMSOL Multiphysics starts
automatically in this configuration when you run COMSOL Multiphysics with MATLAB.

MATLAB can currently run in 32-bit mode on Windows, Linux, Sun, and Mac, which means that COMSOL Multiphysics with MATLAB also runs in 32-bit mode within MATLAB on those platforms. In addition, COMSOL Multiphysics with MATLAB can run in 64-bit mode on 64-bit Windows with MATLAB 2006a, 2006b, and 2007a and on 64-bit Linux with MATLAB 7.0.1, 7.0.4, 7.1, 2006a, 2006b, and 2007a and on Sun with MATLAB 2007a.

Running COMSOL Multiphysics as a Client/Server Application

The COMSOL Multiphysics client runs as a 32-bit application on all platforms for which we distribute the software: Windows, Linux, Sun, and the Mac. In addition, the COMSOL Multiphysics client can run as a 64-bit application on 64-bit Windows plus 64-bit Linux and Sun.

THE COMSOL MULTIPHYSICS SERVER

The COMSOL Multiphysics server can run as a 32-bit application on Windows, Linux, Sun, and Mac. The COMSOL server is available as a 64-bit application on 64-bit Windows, 64-bit Linux, Itanium, and Sun.
RUNNING COMSOL MULTIPHYSICS CLIENT/SERVER ON THE SAME COMPUTER

Both the COMSOL Multiphysics client and the COMSOL Multiphysics server can run on the same computer and with all available license types: named user license (NSL), CPU locked license (CPU), and floating network license (FNL).

RUNNING COMSOL MULTIPHYSICS CLIENT/SERVER ON DIFFERENT COMPUTERS

The COMSOL Multiphysics client and COMSOL Multiphysics server can also run on different computers, but this configuration requires a floating network license (FNL).

This is the only way to run the COMSOL Multiphysics server on the Itanium platform because neither the COMSOL Multiphysics client nor standalone COMSOL Multiphysics are available for this platform.

RUNNING COMSOL MULTIPHYSICS CLIENT AND COMSOL MULTIPHYSICS SERVER IN MATLAB

It is also possible to run the COMSOL Multiphysics server in MATLAB without starting the COMSOL Multiphysics graphical user interface. In this configuration you can access a COMSOL Multiphysics server running within MATLAB on a remote
computer. This configuration also requires a floating network license (FNL) for COMSOL Multiphysics.
Running COMSOL Multiphysics Client/Server

The COMSOL Multiphysics graphical user interface can run in a separate process as a client to a COMSOL Multiphysics server. The COMSOL Multiphysics client uses a TCP/IP connection to connect to the COMSOL Multiphysics server. The client and server need not run on the same platform. You must have a floating network license (FNL) to run the COMSOL Multiphysics server and the COMSOL Multiphysics client on separate computers.

You can also use the COMSOL Multiphysics client/server when running COMSOL Multiphysics with MATLAB. To do so, start a COMSOL Multiphysics client on a separate computer and connect to a COMSOL Multiphysics server started from within a MATLAB process.

Advantages of Using COMSOL Multiphysics Client/Server

The COMSOL Multiphysics client/server configuration frees your desktop computer of lengthy computations, dispatching your jobs to a dedicated computer. The computer that runs the COMSOL Multiphysics server could have more memory and a faster CPU than your desktop computer.

Note, too, that running the COMSOL Multiphysics server and the COMSOL Multiphysics client separately on the same computer increases the total memory available to solve problems. This is particularly interesting because the 32-bit limit on addressable memory can be the limiting factor for complex models. The COMSOL Multiphysics server components do not use the memory required for the graphical user interface, freeing that memory for the actual computations on the server.

Running COMSOL Multiphysics Client/Server

STARTING COMSOL MULTIPHYSICS SERVER

When you have access to the Windows desktop, start the COMSOL Multiphysics server from the Start menu. Go to Programs, select COMSOL 3.4, and then Client/Server. If starting the COMSOL Multiphysics server from a terminal window in Windows, use the command C:\COMSOL34\bin\comsolserver.exe.
On Linux and Sun, use the `comsol server` command to start a COMSOL Multiphysics server.

On the Mac, use the **COMSOL Multiphysics Server** application, or if you are logging on to the Mac from another computer, use the `comsol server` command in the terminal window.

**STARTING A COMSOL MULTIPHYSICS CLIENT**

To start a COMSOL Multiphysics client under Windows, use the **Start** menu. Go to **Programs**, select **COMSOL 3.4**, and then **Client/Server**. To start a client on Linux and Sun use the `comsol client` command. On Mac OS X use the **COMSOL Multiphysics Client** application.

**ACCESSING THE COMSOL MULTIPHYSICS SERVER COMPUTER**

To access the COMSOL Multiphysics server computer under Linux, Sun, or Mac OS X, simply log in on the server computer by using `ssh`, `rlogin`, or `telnet`, then enter the `comsol server` command. When running the COMSOL Multiphysics server within MATLAB on Linux and Sun, you need access to the X-Windows display pointed to by the DISPLAY variable. On Mac OS X, you need access to the Mac desktop, that is, you must be logged on from the Mac OS X computer console in order to run the COMSOL Multiphysics server within MATLAB.

On Windows 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 NetMeeting or Remote Desktop (Windows XP). Start the COMSOL Multiphysics server from the **Start** menu. If several people want to access a single Windows computer to run the COMSOL Multiphysics 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 Multiphysics server.

**Initializing the COMSOL Multiphysics Server**

The first time you start a COMSOL Multiphysics server on a computer, a dialog box asks for a user name and password. A terminal window without access to a display does not allow you to open this dialog box, so you cannot use a terminal window when initially logging on to the server computer. The easiest method is to sit down at the computer and log in on it the first time you start the COMSOL Multiphysics server. Enter a user name and password, and then select the **Remember password** check box.
You can now connect through a terminal window the next time you want to run the COMSOL Multiphysics server.

PORT NUMBER
The COMSOL Multiphysics server requires that each user log in and start the COMSOL Multiphysics server manually. The COMSOL Multiphysics server prints a port number in the terminal window. In the COMSOL Multiphysics client, go to the Model Navigator, click the Settings tab, and provide the computer name and a port number. If you have identical home directories on the server and client and you start the COMSOL Multiphysics client after the COMSOL Multiphysics server has been started, the COMSOL Multiphysics client can obtain the computer name and port number from the .comsol directory in your home directory. If the COMSOL Multiphysics client has not determined the computer name and port number, you must enter them manually.

SAVING AND LOADING MODELS ON THE SERVER
For large models run on the 64-bit COMSOL Multiphysics server, memory available on the client might not be sufficient to save the model. Therefore we have implemented the ability to load and save a model directly on the computer where the COMSOL Multiphysics server is running. Please note that the file systems accessible on the COMSOL Multiphysics server might be different than the ones where your COMSOL Multiphysics client is running. These options are available when you are running COMSOL Multiphysics client/server on different computers by going to the File menu and choosing Open and Save As.

RUNNING THE COMSOL MULTIPHYSICS SERVER WITHIN MATLAB REMOTELY
On Windows and the Macintosh you must have access to a display to run MATLAB. Thus to run the COMSOL Multiphysics server within MATLAB on a remote Windows or Macintosh computer, you must sit down at the computer and log in, or you need a remote login tool with display capabilities such as NetMeeting or Remote Desktop.

On Linux and Sun you can start MATLAB remotely as long as you have access to a display pointed to by the DISPLAY variable. Start the COMSOL Multiphysics server within MATLAB by typing comsol server. You must start MATLAB in Windows by using COMSOL with MATLAB on the Start menu, on a Mac by running the COMSOL with MATLAB application, or on Linux and Sun platforms by typing the command comsol matlab.
Connecting Standalone COMSOL Multiphysics to a Server

It is not necessary to set up a client-server connection from the start when you run COMSOL Multiphysics. You can connect COMSOL Multiphysics running in standalone mode to a COMSOL Multiphysics server or to MATLAB at any time. To do this use the Client/Server/MATLAB menu in the File menu.

When a standalone version of COMSOL Multiphysics is connected to a server, data the solvers need is transferred to the server, and the previously standalone COMSOL Multiphysics becomes a COMSOL Multiphysics client.

CONNECTING TO MATLAB
To connect to MATLAB, use the menu item Connect to MATLAB. This launches MATLAB and starts a server in MATLAB. Then the standalone COMSOL Multiphysics is connected to this server.

The Connect to MATLAB menu item always launches a new MATLAB session. To connect to an already running session of MATLAB, first go to MATLAB and issue the command comsol server. This starts a COMSOL Multiphysics server in MATLAB. Then use the Connect to Server menu item to connect to this server.

CONNECTING TO A SERVER
To connect to a COMSOL Multiphysics server, use the menu item Connect to Server. This opens a dialog box where you can enter the server and login information.

The user name and password are the ones you used when starting the server, and the port number is printed by the server when it is started.

DISCONNECTING FROM A SERVER
You can close the connection to the server or MATLAB using the menu item Disconnect from Server/MATLAB. Doing so transfers all data from the server to the client and makes it a standalone version of COMSOL Multiphysics.

Keep in mind that if you close the connection from a server running on another computer and the client computer has less memory, there might not be enough...
memory on the client computer for all data. This can in particular happen if you have a large model open at the time you close the connection. The solution data resides on the server. This data is transferred to the client, and there must be enough memory on the client computer to complete this transfer.
CHAPTER 2: RUNNING COMSOL

Login Information and Security

Login Information

When you start a COMSOL Multiphysics server for the first time, the *Set Login Information* window appears. 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 subdirectory `.comsol/ver34/login` in your home directory. On Mac OS X this login information is located in *Library/Preferences/COMSOL/ver34/login* 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/ver34/login` 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. By default, only a single COMSOL Multiphysics client can connect to a server. If you disconnect from the server, you must once again run the `comsol server` command to make further connections. 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.
Running COMSOL in Parallel

The parallel sections of COMSOL are based on the parallel shared memory model. Most multiple-processor machines and dual-core/multicore machines support the shared memory model; however, it is not supported by clusters. The solvers, assembly, and meshing in COMSOL Multiphysics and the linear algebra functions in COMSOL Script benefit from parallelism.

# Parallel COMSOL

## Number of Processors That COMSOL Uses

On Linux and Sun, the COMSOL software runs on one processor by default. On Windows, COMSOL uses the environment variable `NUMBER_OF_PROCESSORS`. If you have a parallel machine that COMSOL supports, you can override the default with the switch `-np <number of processors>`.

**Note:** You can set the environment variable `COMSOL_NUM_THREADS` instead. It is overridden by the switch `-np`.

**Note:** On processors with hyperthreading, `NUMBER_OF_PROCESSORS` is set to the number of hyperthreads. On computers with hyperthreading processors, you provide the actual number of processors with one of the techniques above.

**Note:** MATLAB 2007a supports multiple processors. The support is activated in the `General` settings under `File>Preferences`. The settings override the processor settings in COMSOL.

## Optimizing Processor Usage

Depending on how loaded your machine is, you can control how COMSOL uses the available processors. Apart from the default mode there are three modes of operation
that you control with the switch `-mpmode <multiprocessor mode>`. The `throughput mode` (`-mpmode throughput`) is expected to give the best performance when several different processes are running actively at the same time as COMSOL. The `turnaround mode` (`-mpmode turnaround`) and `owner mode` (`-mpmode owner`) typically provide the best performance when no other processes than COMSOL are active. The owner mode provides the highest performance in most cases, but the only way to find out is to experiment with the different modes.

**Note:** You can set the environment variable `COMSOL_MP_MODE` instead. It is overridden by the switch `-mpmode`.

### Benefits of Running COMSOL in Parallel

A significant part of the parallel speedup in computations comes from functions of the type BLAS (basic linear algebra subprogram; see the next section). If you want to run the software in parallel, it is important that the BLAS library you use supports parallelism. The MKL and Sun performance libraries run in parallel.

**Note:** These libraries run in parallel but they might not be the best choice for your processor type.

The direct solvers UMFPACK and TAUCS both benefit from BLAS. On Linux and Windows, you can also use the parallel sparse direct linear solver PARDISO, which is parallel independently of which BLAS library you use. All iterative solvers and smoothers except Incomplete U are parallelized. Some smoothers have blocked versions. The blocked versions are usually more parallel than the nonblocked versions. The matrix assembly stage also runs in parallel. Usually the speedup depends on the problem size; problems using a lot of memory usually have better speedup.

All dense linear algebra operations in COMSOL Script benefit from BLAS. In addition, many sparse linear algebra operations in COMSOL Script run in parallel independently of BLAS.

The free mesher in 3D runs in parallel over the faces and subdomains of the geometry object being meshed. For this reason, the speedup when running on several processors depends strongly on the domain partitioning of the corresponding geometry. Meshing a geometry with only one subdomain, such as an imported CAD part, gives almost no
speedup at all. On the other hand, meshing a geometry with several subdomains, such as an imported CAD assembly with many parts, can give significant speedup, especially if the number of elements in the mesh is large.

Running in parallel usually requires extra memory. If you run out of memory, try to set the -np switch to a lower number. The speedup depends on the processor load. For instance, if your system has \( m \) processors and \( n \) of them are used by other active programs, do not set the -np switch to a number that is greater than \( m - n \). The reason is that the programs compete for the same resources, which slows all of them considerably.

**COMSOL and BLAS**

BLAS is a set of functions for basic linear algebra operations. Vendors often supply BLAS libraries optimized for their hardware. A large portion of the computational engine in COMSOL relies on BLAS. Included with COMSOL are the BLAS libraries MKL (Math Kernel Library) optimized for Intel processors and ATLAS (Automatically Tuned Linear Algebra Software). On Mac OS X, COMSOL relies on vecLib, which is installed on the system. AMD also supplies a BLAS library called ACML (AMD Core Math Library), which you can download from http://developer.amd.com/acml.jsp. Sun provides the Sun Performance Library with Sun Studio. Use the Sun Studio 11 version on 64-bit Solaris and the Sun Studio 8 version on 32-bit Solaris. On Linux, Windows, and Sun, you can also supply your own BLAS library optimized for your hardware. By default COMSOL automatically tries to detect an appropriate BLAS library. The defaults in COMSOL are:

- MKL on Intel processors (Linux and Windows).
- ATLAS on AMD processors (Linux and Windows except Windows 64-bit where MKL is used). If ACML is installed and appropriately set up COMSOL uses it instead.
- ATLAS on Sun.
- vecLib on Mac OS X.

You can override the default with the switch -blas. Valid options to the -blas switch are:

- **auto**—same as not using the switch (Linux, Windows, Sun)
- **mkl**—selects the MKL library (Linux, Windows)
- **atlas**—selects the ATLAS library (Linux, Windows, Sun)
• **acml**—selects the ACML library (Linux, Windows)
• **sunperf**—selects the Sun Performance Library (Sun)
• **path**—tries to load the library specified by the environment variable
  `COMSOL_BLAS_PATH`. The library must support the standard FORTRAN BLAS
  interface (Linux, Windows, Sun)

If the library you want to use is unavailable or incorrectly installed, COMSOL switches
back to the default library.

---

**Note:** Instead of starting COMSOL with the `-blas` switch, you can set the
environment variable `COMSOL_BLAS_LIBRARY`. The switch `-blas` overrides the
default.

---

**USING A DIFFERENT BLAS LIBRARY THAN THE DEFAULT**

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
`COMSOL34/lib/ARCH` where `ARCH` is the architecture (`glnx86`, `glnxa64`, `glnxi64`,
`win32`, `win64`, `sol64`, or `sol164`) or somewhere in the standard search path.

---

**Note:** You must also provide the path to any sublibraries needed by the library.
ACML requires `libg2c.so` on Linux, for instance.

---

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` on Linux and Sun
(`LD_LIBRARY_PATH_64` on 64-bit Sun), or the environment variable `PATH` on
Windows.

If you use the Sun Performance Library on Sun, that vendor recommends you change
the default stack size to 4 MB for 32-bit Solaris and 8 MB for 64-bit Solaris. COMSOL
assumes that Sun Performance Library is installed in `/opt/SUNWspro/`. Otherwise you
must provide the search path.
INDEX

A  ACML 65
   add feature 10
   ATLAS 65
   automated installation 16
   automated uninstallation 18

B  batch
   COMSOL Script 43, 49
   BLAS libraries 65
   for parallel speedup 64
   boot script 32
   Bourne shell commands 31
   browser
       Linux and Sun file 20

C  CAD Import Module, platform support
   for 7
   change license 10
   classpath file
       on Linux and Sun 44
       on Windows 43
   client 24
   client/server
       running COMSOL Multiphysics as 57
       running COMSOL Multiphysics with
           MATLAB as 57
       security issues with 62
   COMSOL
       documentation 2
       installing on Linux and Sun 19
       installing on Macintosh 22
       installing on Windows 9
       online help 2
       running on Linux and Sun 44
       running on Macintosh 46
       running on Windows 42
       technical support 2
   uninstalling on Linux and Sun 21
   uninstalling on Macintosh 23
   uninstalling on Windows 16
   comsol command 44
   COMSOL Multiphysics
       running with MATLAB as client/server
           57
       Start menu items 63
   COMSOL Multiphysics server
       accessing 58
       initializing 58
       running within MATLAB remotely 59
   COMSOL Script
       batch 43, 49
       system requirements 8
   comsol.opts
       setting MATLAB startup options 52
       specifying the MATLAB path 18, 21, 23
   comsolbatch.exe 43
   connecting standalone COMSOL Multi-
      physics 60
   connecting to server 60

D  daemon
       license manager 26, 29, 33
       starting 31
       vendor 26, 29, 33
       disconnecting from server 60
       documentation 2

E  Ethernet address 35

F  FLEXlm 24
   FLEXnet 24
   control panel 26
   license server 26, 29, 33
   Licensing End Users Guide 26, 29, 33
   management 26, 29, 33
utility program 26, 29, 33
floating network license 24
floating network license support
heterogeneous network 4

G
graphics requirements, Linux 5

H
hostid 35
in license file 25
Linux 35
Macintosh 35
of license server 26
Windows 35
hyperthreading 63

I
initializing a COMSOL Multiphysics server 58
installation
floating network license 24
Linux and Sun license server 28
Macintosh license manager 33
on Linux 19
on Macintosh 22
on Sun 19
on Windows 9
Windows license server 26
Intel processor, for Macs 6

L
license errors, troubleshooting 38
license file 19, 25
license manager
FLEXnet 24
installing files 26
starting 27, 31, 34
license manager daemon 26, 29, 33
license manager files 26
license manager installation
Linux and Sun 28
Macintosh 33
Windows 26
license server
definition of 24
license server files 26, 29, 33
license.dat 25
Linux
graphics requirements 5
hostid 35
installing COMSOL on 19
running COMSOL on 44
system requirements 5
lmgrd 29, 33
lmgrd.exe 26
lmhostid 35
lmutil 29, 33
lmutil.exe 26
loading on server 59
log file 28, 31, 34
login information 62

M
Mac OS X 6
machine identification 35
Macintosh
hostid 35
installing COMSOL on 22
license manager installation 33
running COMSOL on 46
system requirements 6
Macs with Intel processor 6
MATLAB
changing path to 18, 21, 23
connecting to 60
disconnecting from 60
requirements 7
running COMSOL Multiphysics on
Linux and Sun with 44
running COMSOL Multiphysics on
Macintosh with 46
running COMSOL Multiphysics on
Windows with 43
setting startup options for 52
Mesa library 6
meshing, running in parallel 64
Microsoft Windows
hostid 35
installing COMSOL on 9
running COMSOL on 42
system requirements 4
Windows 2000 4
Windows Vista 4
Windows XP 4
MKL (Math Kernel Library) 65
N
named single user license 20, 30
O
obtaining a license file 25
online help 2
OpenGL 4, 6
optimizing processor usage 63
options file 30
owner mode, for multiprocessor usage 64
P
parallel, running COMSOL in 63
PARDISO 64
passcode
format of 9, 22
Pentium III 4
port number 25
for COMSOL Multiphysics server 59
PowerPC processor, for Macs 6
processor usage, optimizing 63
processors
number of that COMSOL uses 63
Pentium III 4
UltraSPARC 5
R
remove feature 10
root 31
S
saving on server 59
security issues
in client/server mode 62
server
connecting to 60
disconnecting from 60
saving models on 59
shared memory model 63
Solaris 5
SolidWorks Live Connection 7, 18
Start menu, COMSOL Multiphysics folder 63
Sun
installing COMSOL on 19
running COMSOL on 44
system requirements 5
Sun Performance Library 65
system recommendations 4
system requirements
for running COMSOL Script 8
general 4
Linux and Sun 5
Macintosh 6
Windows 4
T
TCP/IP 4
technical support 2
throughput mode, for multiprocessor usage 64
turnaround mode, for multiprocessor usage 64
typographical conventions 2
U
UltraSPARC 5
unattended installation 16
unattended uninstallation 18
uninstalling COMSOL
on Linux and Sun 21
on Macintosh 23
on Windows 16
utility program 26, 29, 33
V
vecLib 65
vendor daemon 26, 29, 33

**W** web browsers, for Linux and Sun 20
  Windows Vista 4
  Windows XP Professional x64 Edition 4
  Windows. See Microsoft Windows