

# PMOD MacOS Installation

## INSTALLATION MANUAL Version 4.4

PMOD is a software  
FOR RESEARCH USE ONLY (RUO)  
and must not be used for diagnosis or treatment of patients.

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# 1 PMOD Installation on MacOS

## Installation Account

It is strongly recommended to install PMOD when logged into the account of the user who will later use PMOD. Note that during WIBU driver installation, administrator privileges will be required.

If multiple users need to run PMOD locally, a root installation might still be considered. In this case, the permissions of the PMOD directory and all data directories will have to be opened, and the execution permission granted for the scripts which start PMOD and its servers. Additional permission problems might occur which are sometimes tricky to solve.

## 1.1 License Types

PMOD supports two license types: On-site (previously Standalone and Network) and Remote (previously Cloud) licenses.

### Licensing, On-Site License

The PMOD On-site licensing mechanism consists of two components:

1. a **USB protection key** (WIBU-Box/RU, WIBU-SYSTEMS AG, <http://www.wibu.com>), and
2. a license file **pstarter.lcs** (in sub-directory *system/lcs* of the PMOD installation).

During PMOD startup the license information encoded in the USB key is read and compared to that in the license file. Only if the two informations match, startup proceeds. Next is a check whether the PMOD version purchased allows running the currently installed version. If all checks are successful, the PMOD ToolBox appears showing the purchased modules, and processing can start. Note that the USB protection key must remain connected to either the local machine or license server.

The PMOD on-site license may be operated as a single concurrent user local installation, or as a PMOD license server which manages a pool of purchased licenses, and an arbitrary number of PMOD clients which can check out unused licenses from the server. As soon as the PMOD program on a client is closed, the license is returned to the managed server pool. If the PMOD client crashes for some reason, the license is re-collected to the pool after about 15 minutes. On the other hand, if the license server is stopped, the clients show a warning message to the user and allow to continue work for a few minutes. Then, the clients will be stopped, unless the server has been started again.

On the license server PMOD is installed in the same way as for local operation with the USB key.

On the clients PMOD is also installed in the standard way, *except* that

- installation of the drivers for the USB protection key is not required;
- no license file is required.

Note the following:

- In Server-Client mode, the license server PMOD installation is typically intended for server purposes and not for data processing.
- The license server must be running and the USB key must be connected at all times.
- The license server and the clients must run the same PMOD version.
- It is not required that the license server and the clients have the same operating system.

### Licensing, Remote License

The PMOD Remote licensing mechanism relies on a Remote License Server operated by PMOD Technologies. During startup of a local PMOD installation, the license server is contacted over the Internet and a Client ID provided. The license server returns information about the purchased configuration. If the currently installed version matches the license, the PMOD ToolBox appears

showing the purchased modules and processing can start. Note that the Internet connection to the license server must be maintained while running PMOD.

## 1.2 Installation Overview

### Java Runtime Environment (JRE)

The entire PMOD software is programmed in Java and therefore requires an appropriate Java Runtime Environment (JRE) to be executed. During PMOD installation, an appropriately configured JRE is extracted into the java sub-directory of the PMOD installation. This dedicated JRE will then be used to run PMOD. In this controlled environment, PMOD will remain unaffected by changes due to automatic OS upgrades.

### Installation Steps

The installation of the PMOD software consists of the following steps which should be performed in the proposed sequence. They are explained in detail in the following installation sections.

1. PMOD needs Java 11 to be installed on the system. If this is not yet the case Java 11 should be downloaded (*search for "azul openjdk zulu"*). Download ARM 64-bit for M1, M2 processors, download x86 64-bit for Intel processors. Selection of the incorrect Java version will result in incorrect PMOD installation and lower performance than available for ARM processors.
2. Make sure you have access to the login information for your **Customer Account** on the PMOD website. The credentials are available in your Delivery Note.
3. Use the credentials to download the latest PMOD software package from the **Support/Download** page of the PMOD website.
4. Extraction of the PMOD program files, the JRE, and optionally example data to the *Pmod4.4* directory in a user-defined location of the file system.
5. Only for **Stand-alone Installation, License Server**: Installation of the protection USB key drivers for the WIBU-Box/RU plugged into the USB port. *Please do not connect the protection USB key before this installation has been completed.*
6. Only for **Stand-alone Installation, License Server**: Installation of the PMOD license file *pstarter.lcs*. The license file can be downloaded from the **Customer Account** area of the PMOD website.

## 1.3 PMOD Software Download

1. Download the setup zip file corresponding to the operating system of your target computer (e.g. *pmod-44-setup-macosx.zip*).
2. Unzip the archive. Don't unzip any of the files in *pmod*.
3. In case PNEURO has been licensed, download the *parcellation.zip* file into the *pmod* directory.
4. To get example data for the different tools, download the *data.zip* also into the *pmod* directory.

## 1.4 PMOD Software Extraction

We recommend leaving the installation package in your Downloads folder. **RunSetup.command** in the Setup directory should be executed from the command line in the Terminal application.

Open the application Terminal (e.g. using Spotlight). We recommend navigating to the Setup folder of the installation package. Typically this will require the command:

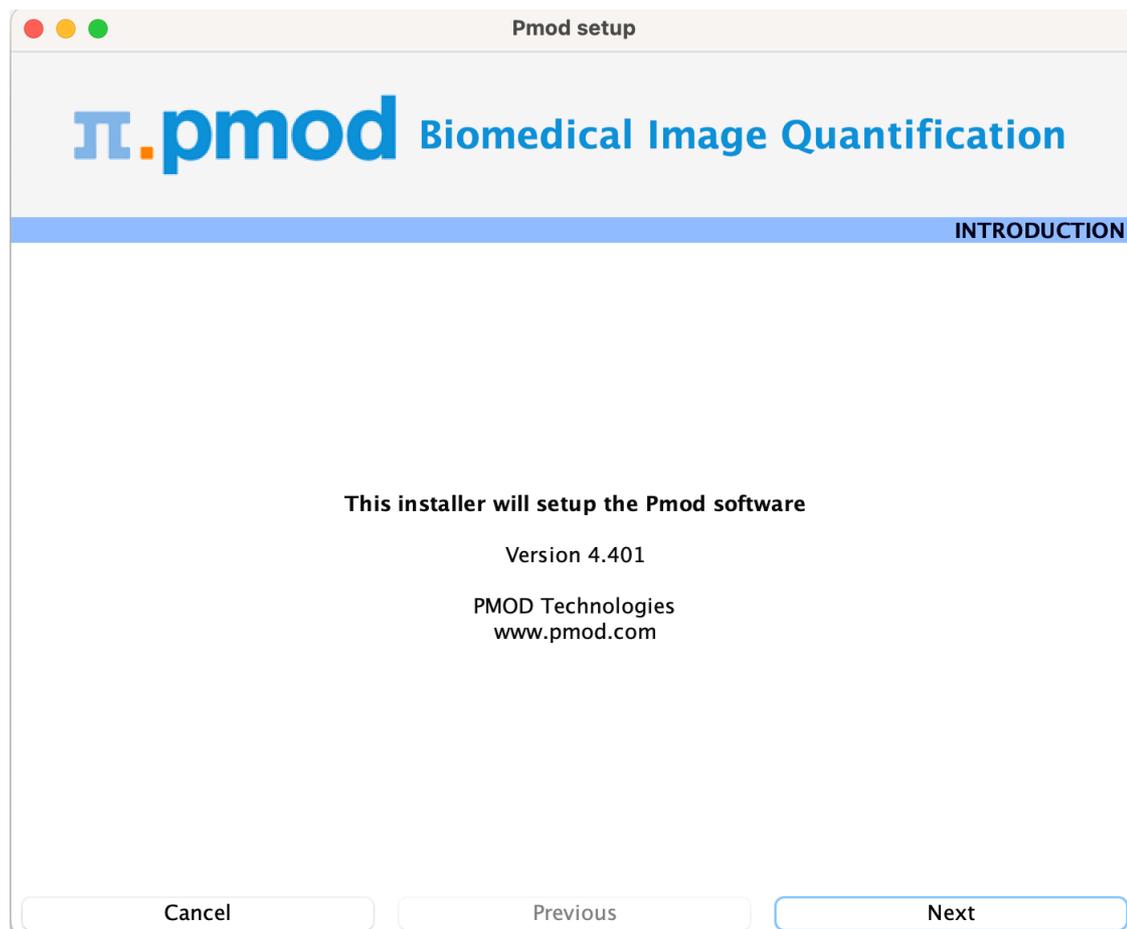
```
cd Downloads/pmod-44-setup-macosx/Setup/
```

Next, use the command:

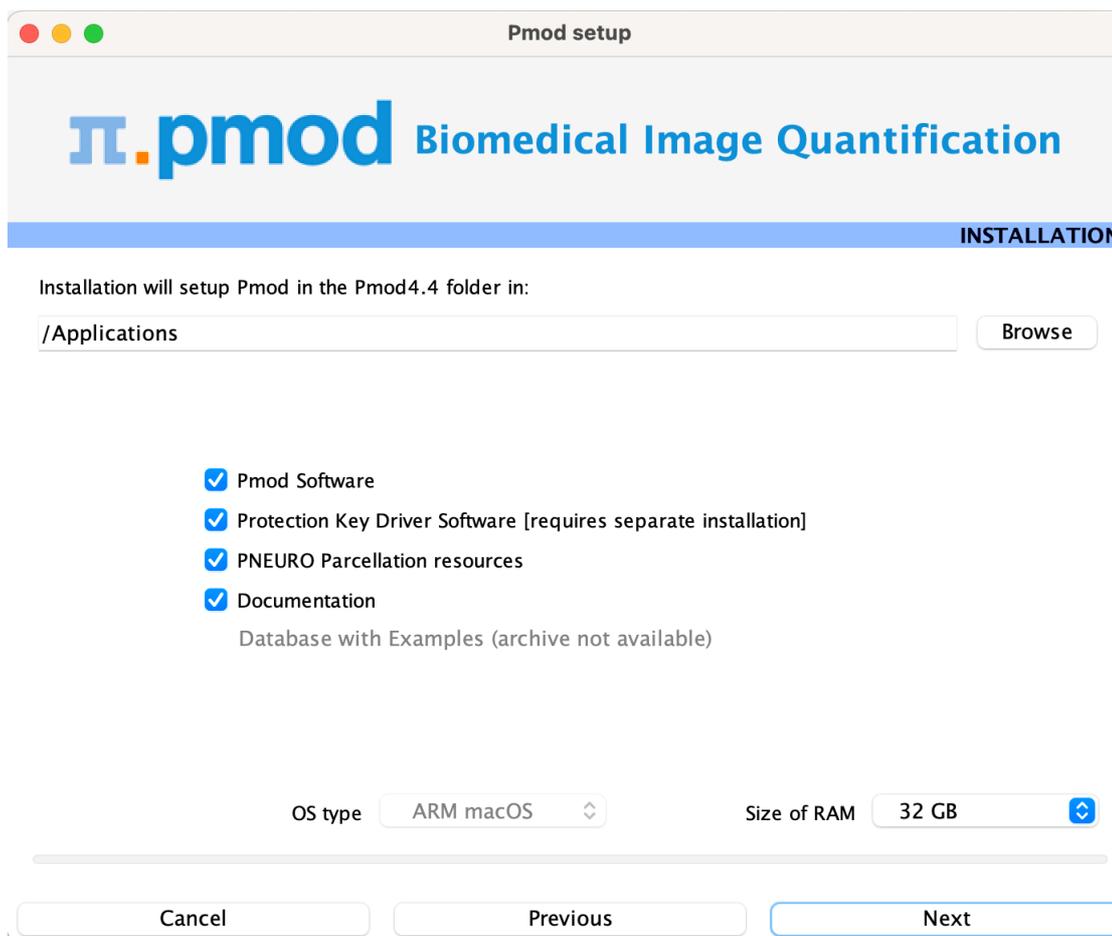
```
sh RunSetup.command
```

to launch the installer.

The following installation screen appears.



Please use **Next** to proceed and accept the license agreement in the dialog window that appears. After selecting **Next** the installation continues.



Please perform the following configurations:

### Installation Path

Use the **Browse** button to select the parent directory for the installation (*if you are not installing PMOD on your personal Mac, i.e. provided by your institution, we recommend installing PMOD in your Documents folder*). There, the installer will create a new directory **Pmod4.4** for the program files and the data. Please make sure that 5GB of free space is available for the full package.

### Packages

It is highly recommended to install the four packages **Pmod Software**, **Protection Key Driver Software**, **Documentation**, and **Database with Examples**. The **Database with Examples** requires about 3GB and will show up as database called **Demo**. This database will allow getting acquainted with the programs because it contains examples for the different types of data analysis. Note, however, that it is recommended establishing a new database externally to PMOD for productive data processing.

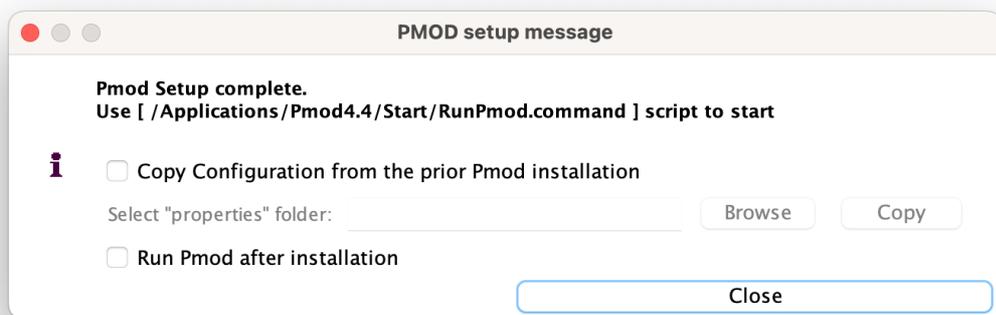
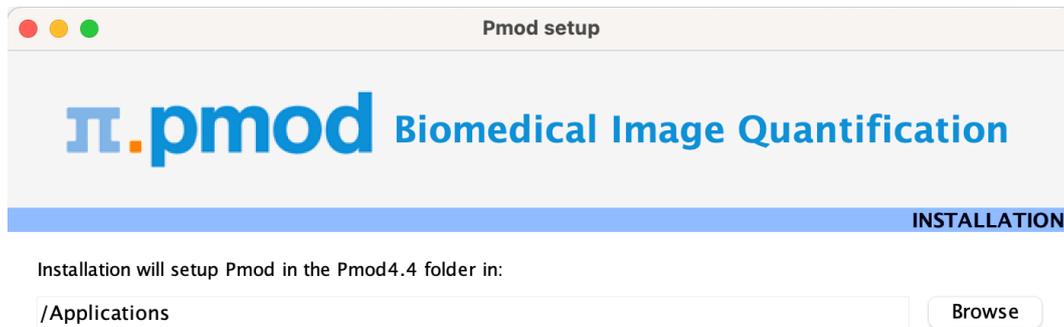
### Properties of Operating System and RAM

The operating system of your target computer needs to be 64-Bit. **Size of RAM** can be set to any size, up to 32 GB. However, if the specified size exceeds the physical RAM, the system will start swapping after RAM space is exhausted and will become very slow. Therefore we strongly recommend setting **Size of RAM** < physical RAM (e.g. 14 GB for 16 GB system). To assign more than 32 GB when it is available on your system, the start script **RunPmod.command** should be edited after installation.

### Installation of the PMOD Environment

The installation is started by the **Next** button. If the installing user has no write permission in the parent directory, a dialog window appears to report an installation problem. In this case please try the installation again using a different installation directory.

If this is not your first PMOD installation we recommend importing your previous working environment. To do this, check **Copy Configuration ...** and select the **properties** folder of your old PMOD installation using the **Browse** button as illustrated below. Then click **Copy** to import the settings, after which you can **Close** the window.

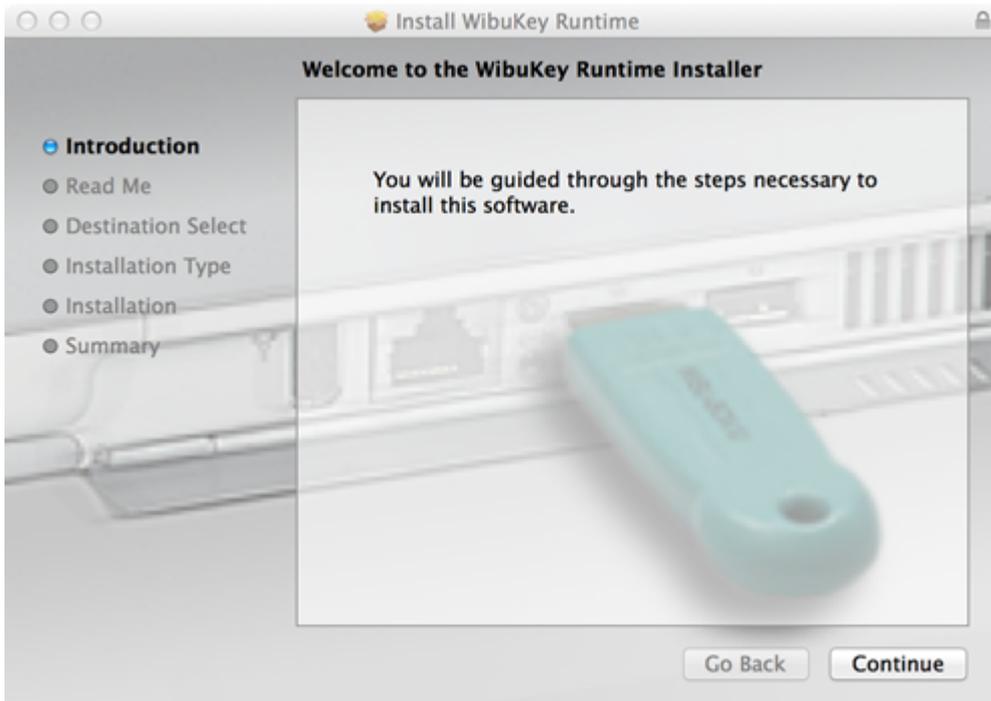


## 1.5 PMOD On-site License Installation For Standalone Operation

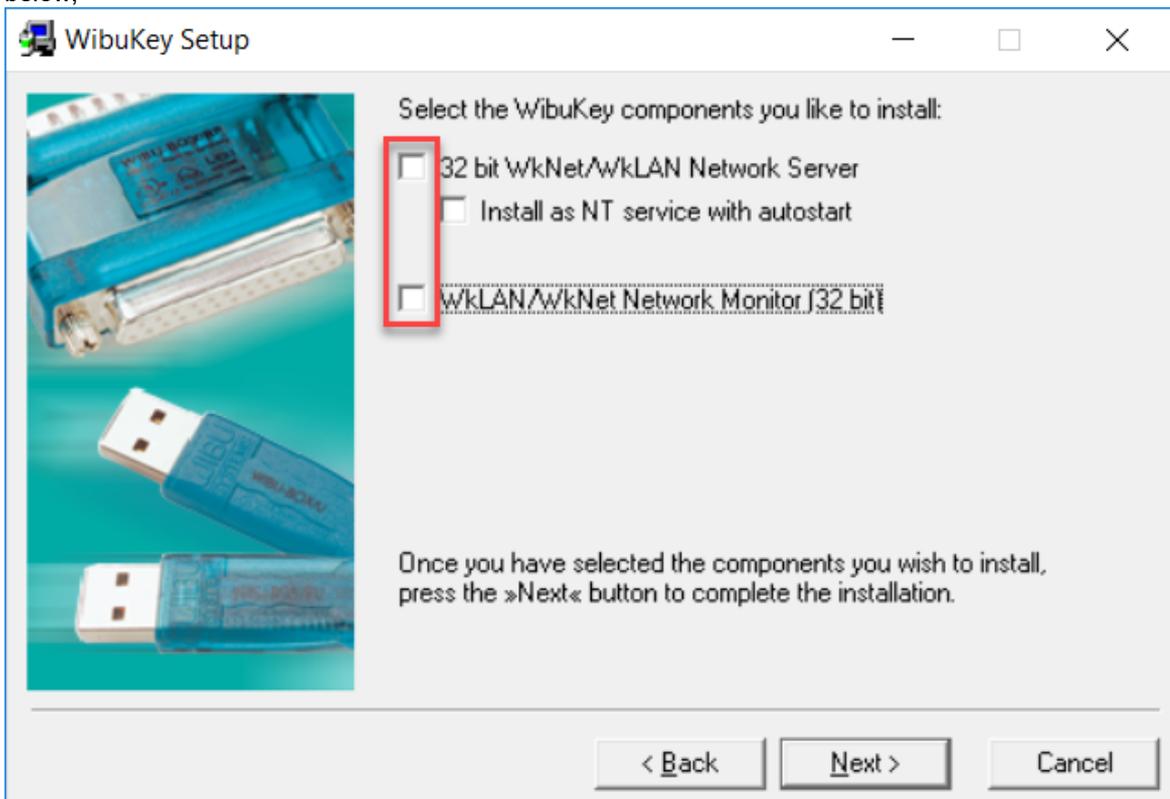
### Install USB Key Drivers

All the files required for the driver installation were extracted during the installation of the PMOD software and stored in the PMOD directory tree. Browse to the directory `/Applications/Pmod4.4/install/hk setup/MacOSX`

First double-click **WkRuntimeUser\_6.60.500.dmg**, then **WkInstall.pkg**, and perform a standard installation



Note that the network components don't need to be installed and can be unchecked as illustrated below,



**Note:** If you experience problems during driver installation, you are recommended downloading the most recent drivers for the WIBU-KEY ([WibuKey Runtime](#)) and try the installation again. Also, in some cases, a reboot may be required after driver installation.

**License File**

The delivery note you have received with the PMOD installation package contains your account information for your PMOD Customer Account at [www.pmod.com](http://www.pmod.com). There you will find a license report, and a button to download the license file for your purchased configuration. Please download `pstarter.lcs` and copy it to the directory `/Applications/Pmod4.4/system/lcs`.

**Important Note:** Please do not change `pstarter.lcs` in any way - a modified license file will not be accepted. Do not open `pstarter.lcs` in any program, do not rename it, and if you transfer it per FTP, use binary transfer.

**Start PMOD**

PMOD can now be started by double-clicking the **RunPmod.command** script in `/Applications/Pmod4.4/Start/`. Depending on the selected configuration it contains the following commands:

```
cd '/Applications/Pmod4.4'
./java/jre/bin/java -Xmx16000M -jar pmod.jar
```

Alternatively, the script can be dragged once from Finder to the MacOS taskbar to create a shortcut. From then on, PMOD can be started using this shortcut.

**Notes:**  
 The script is tailored to the installation directory. Therefore, if the PMOD installation is moved to a different location, the path needs to be adjusted.  
 The **-Xmx16000M** option specifies the maximum heap memory (16000 MB) that PMOD can allocate. To process large data sets this number should be increased.

**Change Permission Settings of Directories for writing**

If other users than the one used to install PMOD should be able to use the software from their own accounts it is necessary to open some key PMOD directories for writing.

The following commands should be executed in the Terminal:

```
chmod -R ugo+w /Applications/Pmod4.4/properties
chmod -R ugo+w /Applications/Pmod4.4/data
```

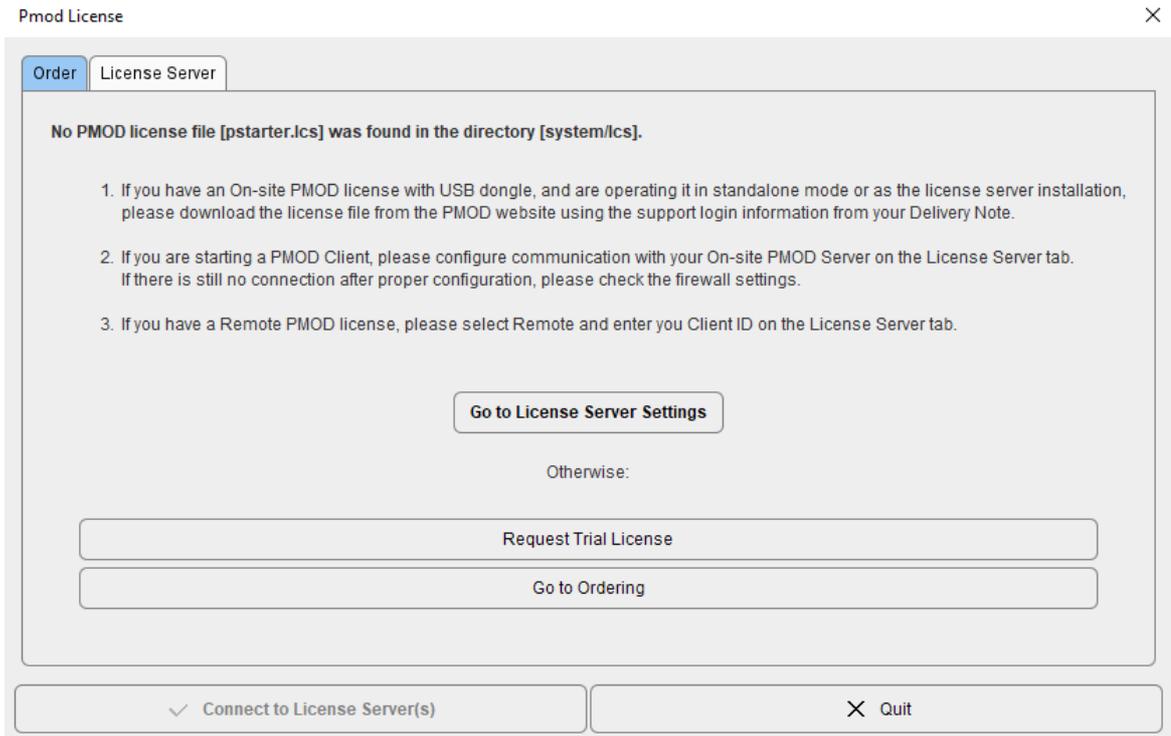
There may be other directories you have to open for writing later on, if several users are working with the same PMOD installation.

## 1.6 PMOD Remote License Activation

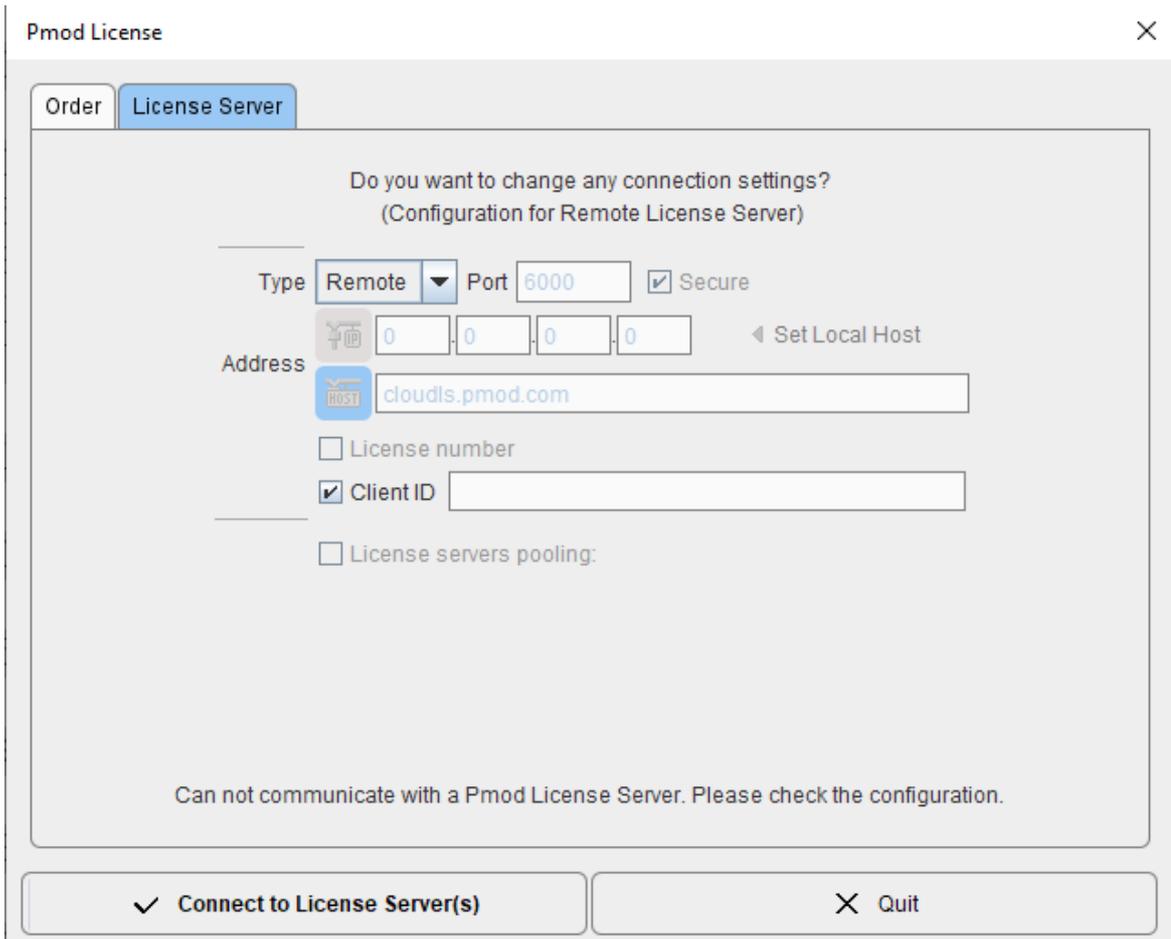
If a Remote License has been purchased, no driver installation is necessary after PMOD software extraction. Instead, registration of the **Client ID** with the PMOD Cloud License Server is required. The **Client ID** is listed in the PMOD delivery note and also when signing into the PMOD account.

**Activation of Client ID**

Please start PMOD with the command script **RunPmod.command** in `Pmod4.4/Start`. The following dialog window appears:



Activate **Go to License Server Settings**, to arrive on the **License Server** panel.

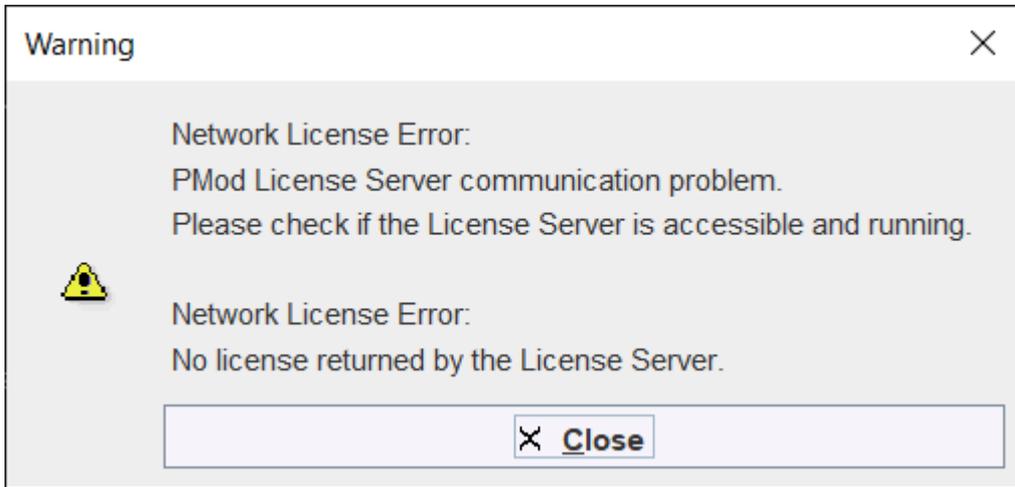


Switch **Type** to **Cloud**, and enter the **Client ID** code, which you have copied from your Delivery Note or the PMOD account. Then activate **Connect to License Server(s)**. Because the configuration is

saved in the file *lcserver.ini* in the *system/lcs* directory, the dialog window doesn't appear any more when PMOD is started.

**Troubleshooting**

If a dialog window similar to the one illustrated below appears, registration of the Client ID was not successful.



If the entered code was correct, the most likely issue is failed Internet connectivity with the Cloud License Server. Please make sure that connection to port **6000** of **cloudls.pmod.com** is allowed. If you are working behind an institution firewall, please contact your IT department and ask them to grant you this connectivity.

If there is a need to get access to the **License Server** configuration panel to enter a modified code, please remove the file *lcserver.ini* in the *system/lcs* directory.

Note that if PMOD is started more times than allowed for in the license configuration, the first instances will be forced to quit.

## 1.7 PMOD On-site License Installation For Server Operation

### 1.7.1 PMOD License Server Installation

**PMOD Software Installation**

The computer for the PMOD license server doesn't require a high performance (e.g. 2GB RAM, 20GB free space on HDD, 64-bit OS), but needs to have access to the WIBU key USB dongle and run continually. Therefore, a robust vintage machine is sufficient as a PMOD license server. Preferably, it is dedicated to serving the PMOD license, because the license server is a standard process rather than a Windows service.

When using a Virtual Machine for PMOD license serving, the USB device from the host server needs to be mapped to the selected Virtual Machine. If there are no USB ports in a host server or the mapping is not possible, a Network USB Device Server can be used. USB hubs from Digi Network, [Silex](#), and Belkin have been tested by Wibu-Systems. In such a setup, the WIBU key can be

served over the network and mapped to the Virtual Machine. The standard WIBU drivers can be installed and used at the Virtual Machine.

To install the PMOD license server first perform the steps described in the **PMOD On-site License Installation For Standalone Operation** section including copying of the license file and plugging the USB key in.

**Starting the License Server**

The PMOD license server can then be started by executing the **RunLcsSvr.command** script in */Applications/Pmod4.4/Start (or chosen installation location)* containing the following lines (64-Bit version)

```
cd '/Applications/Pmod4.4'
./java/jre/bin/java -Xmx2G -jar pmtsvr.jar 5000 -ls
```

- The meaning of the command arguments is:
- Xmx2G: Size allocated to the license server
  - 5000:IP port over which the license server communicates
  - ls: license server only, no data sharing
  - d: This option can be added for more verbose output

**Note:** The script has been tailored to the installation directory. Therefore, if the Pmod4.4 directory is moved to a different location, the path needs to be adjusted.

**Log Output**

The command window will show startup information and log the checking out/in events as illustrated below.

```
***
Started on license [897]
--> License Server started [Fri Oct 28 13:18:47 CEST 2022] : on port 5000
***
License Server [Version 4.401 24.11.2022]
(c) 1996 - 2021 by PMOD Technologies
Verbose: false, Secure: false
***
Port: 5000
Started on: NBWRS01-FVXP0F3/192.168.1.114
License Server: [ ON ] STANDALONE (Use <Ctrl+C> to stop)
License [0897], Number of Server Licenses: 10
Memory Assigned: 8 GB of 16 GB
--> Database Server started [Fri Oct 28 13:18:47 CEST 2022] on port 5000
```

Date	Command	WAN	LAN	Stamp	Max	Used	Duration[sec]			
2022.10.28	13:18:49		ADD	127.0.0.1	192.168.1.114	1666955929927	10	1	0	
2022.10.28	13:18:52		ADD	127.0.0.1	192.168.1.114	1666955932464	10	2	0	
2022.10.28	13:18:54		ADD	127.0.0.1	192.168.1.114	1666955934234	10	3	0	
2022.10.28	13:18:56		ADD	127.0.0.1	192.168.1.114	1666955936110	10	4	0	
2022.10.28	13:18:59		ADD	127.0.0.1	192.168.1.114	1666955939023	10	5	0	
2022.10.28	13:19:01		ADD	127.0.0.1	192.168.1.114	1666955941344	10	6	0	
2022.10.28	13:19:03		ADD	127.0.0.1	192.168.1.114	1666955943153	10	7	0	
2022.10.28	13:19:05		ADD	127.0.0.1	192.168.1.114	1666955945380	10	8	0	
2022.10.28	13:19:09		REMOVE	127.0.0.1	192.168.1.114	1666955929927	10	7	19	
2022.10.28	13:19:13		REMOVE	127.0.0.1	192.168.1.114	1666955932464	10	6	20	
2022.10.28	13:19:23		ADD	127.0.0.1	192.168.1.114	1666955963709	10	7	0	
2022.10.28	13:19:25		ADD	127.0.0.1	192.168.1.114	1666955965785	10	8	0	
2022.10.28	13:19:28		ADD	127.0.0.1	192.168.1.114	1666955968401	10	9	0	

Java version: OpenJDK Runtime Environment 11.0.16.1+1-LTS  
 Java type: OpenJDK 64-Bit Server VM by Azul Systems, Inc.  
 Java path: D:\Test\Pmod4.4\java\jre

```
***
Started on license [897]
--> License Server started [Fri Oct 28 13:18:47 CEST 2022] : on port
5000
***
```

```

License Server [Version 4.401 24.11.2022]
(c) 1996 - 2021 by PMOD Technologies
Verbose: false, Secure: false
***
Port: 5000
Started on: NBWRS01-FVXP0F3/192.168.1.114
License Server: [ ON ] STANDALONE (Use <Ctrl+C> to stop)
License [0897], Number of Server Licenses: 10
Memory Assigned: 8 GB of 16 GB
--> Database Server started [Fri Oct 28 13:18:47 CEST 2022] on port 5000

```

	Date	Command	WAN	LAN	Stamp	Max	Used
Duration[sec]							
	2022.10.28	13:18:49		ADD	127.0.0.1		192.168.1.114
1666955929927	10	1	0				
	2022.10.28	13:18:52		ADD	127.0.0.1		192.168.1.114
1666955932464	10	2	0				
	2022.10.28	13:18:54		ADD	127.0.0.1		192.168.1.114
1666955934234	10	3	0				
	2022.10.28	13:18:56		ADD	127.0.0.1		192.168.1.114
1666955936110	10	4	0				
	2022.10.28	13:18:59		ADD	127.0.0.1		192.168.1.114
1666955939023	10	5	0				
	2022.10.28	13:19:01		ADD	127.0.0.1		192.168.1.114
1666955941344	10	6	0				
	2022.10.28	13:19:03		ADD	127.0.0.1		192.168.1.114
1666955943153	10	7	0				
	2022.10.28	13:19:05		ADD	127.0.0.1		192.168.1.114
1666955945380	10	8	0				
	2022.10.28	13:19:09		REMOVE	127.0.0.1		192.168.1.114
1666955929927	10	7	19				
	2022.10.28	13:19:13		REMOVE	127.0.0.1		192.168.1.114
1666955932464	10	6	20				

### Multiple Licenses Management

Multiple licenses can be served by a single PMOD installation. In order to use this feature please rename the different license files (*pstarter.lcs*) by appending the license numbers in square brackets (*pstarter[1324].lcs*, *pstarter[427].lcs*, ...) and copy them into the *Pmod4.4/system/lcs* folder.

In order to operate a dedicated server for each license please create a separate server script for each license with the "-lic[<pattern>]" option included, e.g.

```

java -Xmx2G -jar pmtsvr.jar 5000 -ls -lic[1324]
java -Xmx2G -jar pmtsvr.jar 5001 -ls -lic[427]

```

A specific license can then be defined in the *RunPmod.bat* script of the client by the command line option "-lsn[<PORT\_NO>@<IP\_ADDRESS>]" e.g.

```

.\java\jre\bin\java -Xmx16G -jar pmod.jar -lsn[5000@192.168.55.103] - to
acquire license 1324
.\java\jre\bin\java -Xmx16G -jar pmod.jar -lsn[5001@192.168.55.103] - to
acquire license 427

```

The advantage of separate servers is that the processes can be independently started, stopped and monitored.

### Emergency Restart

In the case of connection or license management problems the following procedure is recommended for restoring clean license handling:

1. Stop the license server.
2. Delete the contents of the *Pmod4.4/system/lcs/lct/* directory.
3. Start the license server again.

If this procedure is completed within 5 minutes, no shutdown of running PMOD clients is required.

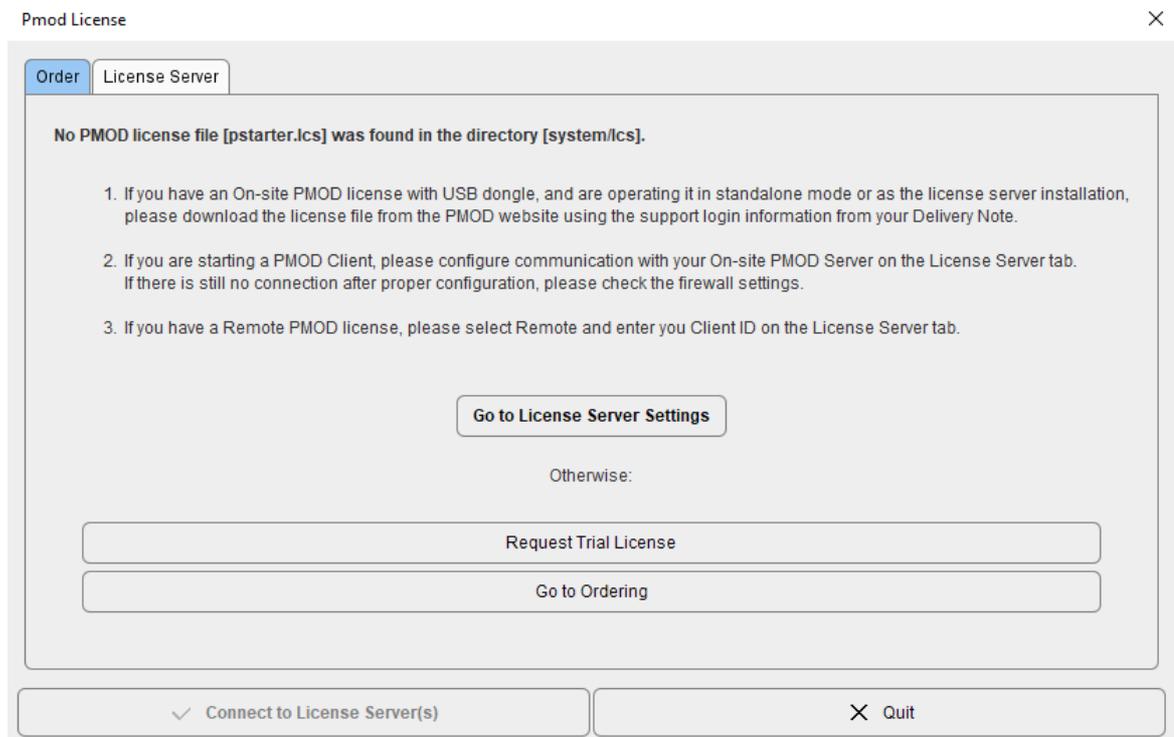
### 1.7.2 PMOD Clients Installation and Configuration

#### PMOD Software Installation

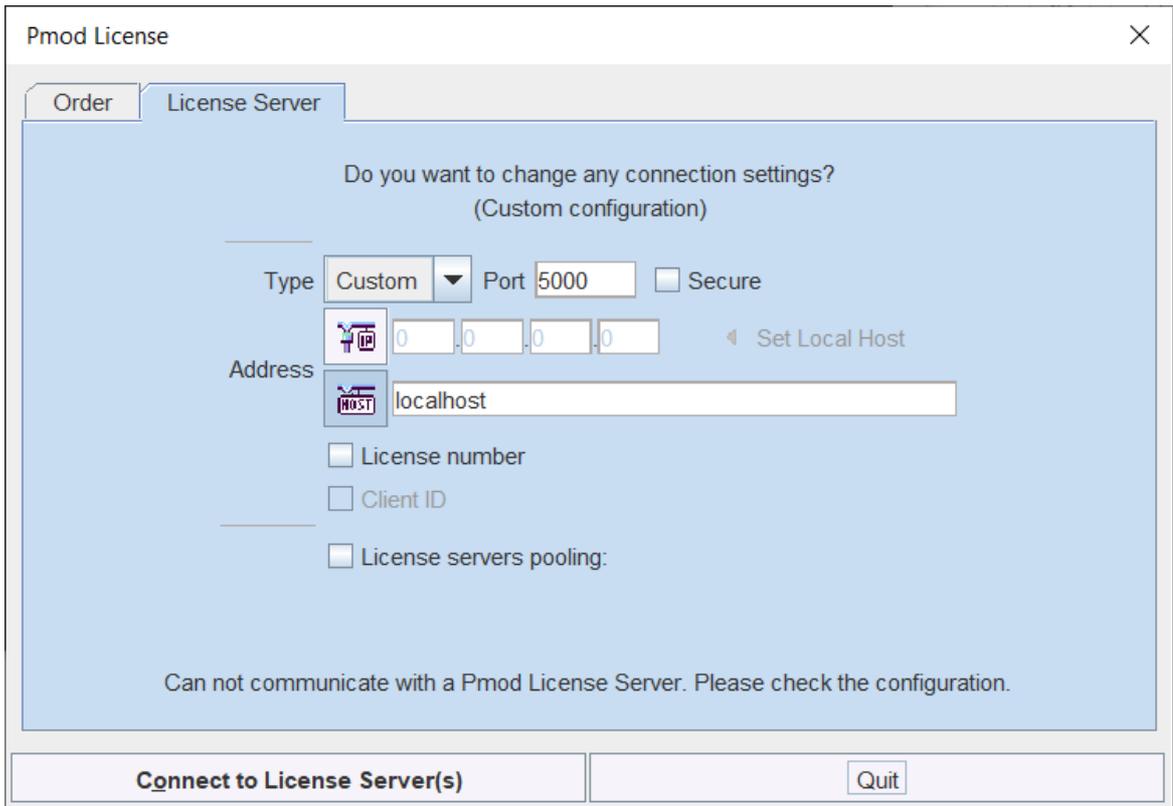
For a PMOD client only the software extraction of the **PMOD On-site License Installation For Standalone Operation** is required. *The license file should not be copied.*

#### Configuration of the License Server

The PMOD client can then be started by the command script **RunPmod.command** in the *Pmod4.4/Start* directory. As no license file is found, the following dialog window is shown.



Please select the **Go to License Server Settings** button to open the License server panel illustrated below and switch **Type** to **Custom**.



Please configure the same **Port** that you have configured for the license server (or transaction server), and specify the server **Address** either by entering its IP address, or by entering its host name. If the process employed for license serving uses compression or encryption, please check the appropriate boxes. If the license server manages several licenses at the same time, enable the **License number** box and enter the number of the license to which you want to connect. Then activate **Yes**.

If the connection succeeds, the dialog window disappears and PMOD starts up. Otherwise the dialog

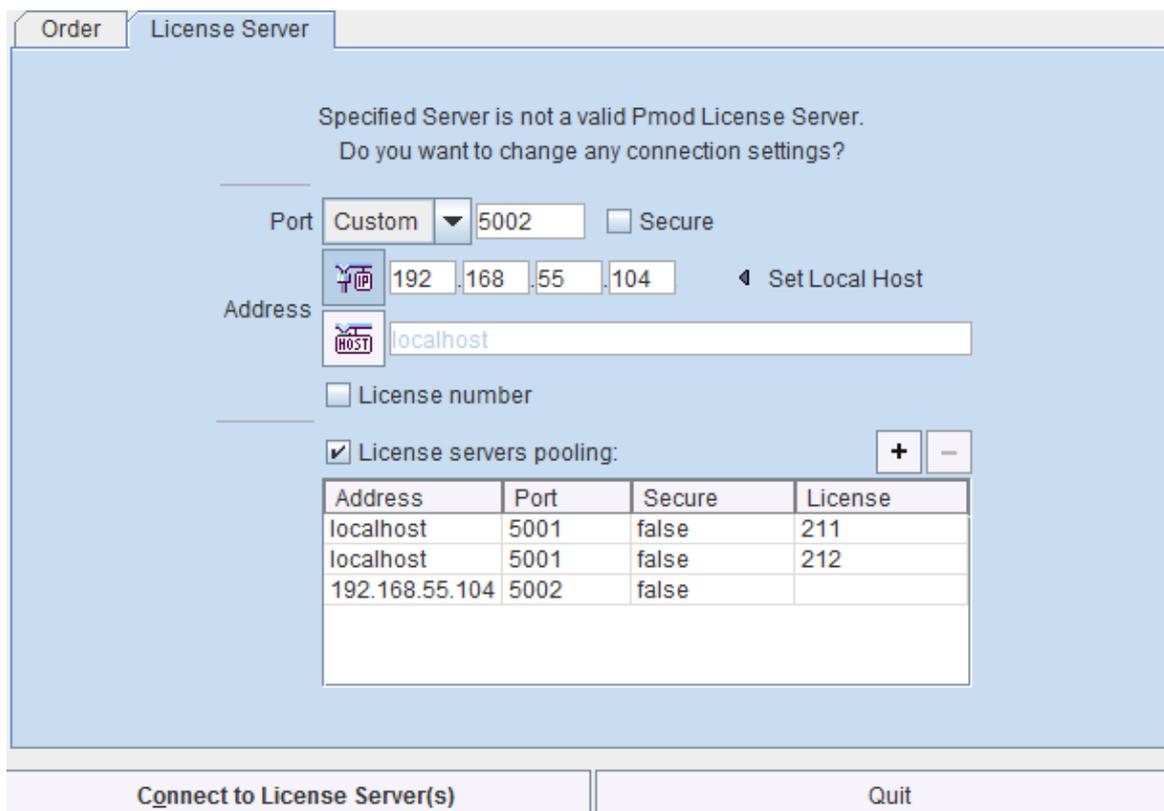


is shown. In this case, please check the configuration of the license server and try again.

If a customer has multiple license servers, the proper license server can also be specified in **RunPmod.command** as a client command line option by:

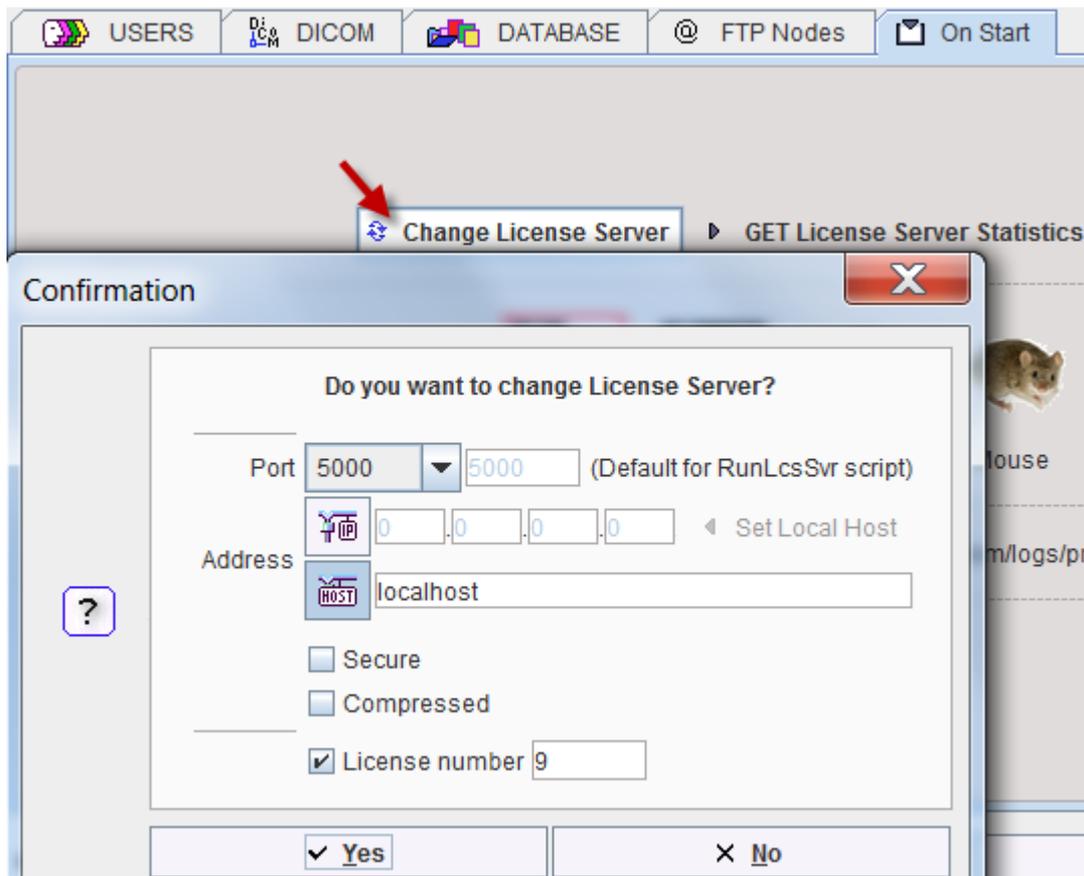
```
-l sn [<PORT_NO>.<OPTIONAL_LICENSE_NO>@<IP_ADDRESS>]
```

Alternatively multiple license servers can be added in the **License servers pooling** configuration by entering their definition in the upper area and then using the **+** button. Each time the client is started it will connect to the first license server in the list which responds.



### License Server Change and Statistics

The license server setting is available on the **On Start** panel of the **Configuration** tool. The **Change License Server** button opens a dialog window for changing the license server address. If a license server handles multiple network licenses, the **License number** field can be used to address a specific license.



The **GET License Server Statistics** button allows finding out whether there are free licenses left.

Number of free licenses: 2

LIST OF USED LICENSES:

No.	IP	Last use
1	192.168.55.104	Thu Oct 20 12:18:12 CEST 2016

### Starting and Stopping a PMOD Client

After the license server has been properly configured, PMOD can be started in exactly the same way as with local operation. However, for stopping PMOD the main **Quit** button of the ToolBox should always be used. This will initiate a proper shutdown procedure which returns the license to the license server. Otherwise, when simply killing the client, it will take about 15 minutes until the license server diagnoses loss of connection and reclaims the lost license.

### Connection Problems

If at client startup no more licenses are available from the license server because all are in use, the **License Server** connection dialog window is shown again to give the user a chance for connecting to a different license server. In case the connection is repeated with the same server following message is shown.



If a connection problem with the license server occurs while working, the **License Server** connection dialog window is shown. If it is not possible to re-establish the connection (for instance by restarting the license server) the following warning is displayed



and after five more minutes the PMOD client is finally stopped.

### 1.7.3 Combination of License and Database Server

Please note that the license server process is based on the transaction server mechanism used for publishing a database. Therefore, if the user is already running a transaction server process on the server system (RunDbSvr.command, see our documentation for PMOD Database Functionality), it is *not* necessary to start a dedicated process (RunLcsSvr.command) just for the license management. The clients can use the same port for requesting a license as for requesting data from the transaction server.

In this context the transaction server option

`-noLS`: database server only

is relevant. This option should be used when running multiple transaction servers. In this case, only one of the transaction servers should be started without `-noLS`, namely the one used for license serving.

## 1.8 Version Upgrade in a Complex PMOD Environment

Upgrading an On-site license setup for standalone operation of PMOD is straightforward. When using absolute paths for the databases the new PMOD version should be immediately functional after copying the properties folder as the last installation step.

In a more complex environment with clients and servers the following rules should be observed:

1. Absolute paths outside the PMOD installation directory should be used for the databases. If this is not the case they should be moved and the paths adjusted in the configuration.
2. The databases should be backed up before the migration.
3. Server and clients should preferably run the same PMOD version. (To some extent, newer server versions can support older client versions, but not the reverse.)
4. The PMOD version on the server should be updated first, followed by the clients.

### Server Update

Please perform the following tasks sequentially:

1. Stop all PMOD servers in the order DICOM servers (DS), transaction servers (TS), license servers (LS).
2. Install the new PMOD version and import the properties from the old installation.
3. In **Config/DATABASE** switch each database to **Use Direct Connection**, verify it with **Echo DB**, and run **Update & Optimize**. Then switch back to **Use Transaction Server** and generate new starting scripts for the transaction and license servers.
4. In **Config/DICOM/DICOM SERVER** generate new scripts for the DICOM Servers.
5. Save the configuration and exit PMOD.
6. Start the DICOM, transaction and license servers using the new scripts.
7. Start PMOD and verify with the **Configuration** utility, that the TS and DS are working properly. To this end use **Echo TS** and **C-Echo**.
8. In case of a network license: Exit PMOD and restart the license server (otherwise a license is blocked).

**Client Update**

1. Install the new PMOD version and import the properties from the old installation. For ATL installations the old properties are not required, as the configuration is centrally stored.
2. Start PMOD, provide the license server details when using a network license, and verify the connections with the transaction and DICOM servers.

## 1.9 Troubleshooting

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**Error reporting**

Internal errors typically leave messages of the form

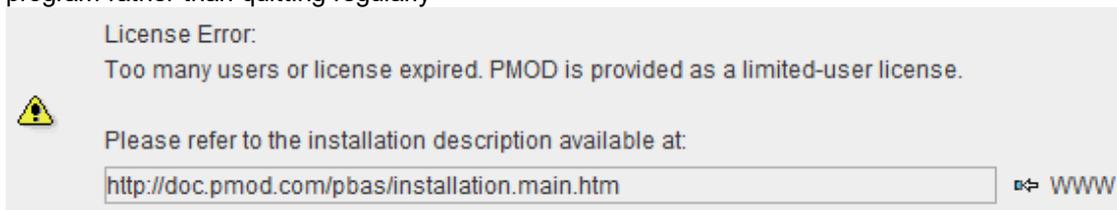
```
java.lang.NullPointerException
at
pmclass.applications.pmgateway.PMgatewayDefaults.getConversionSettings(P
MgatewayDefaults.java:143)
at
pmclass.applications.pmgateway.PMgatewayFrame.convert(PMgatewayFrame.jav
a:854)
at
pmclass.applications.pmgateway.PMgatewayFrame.run(PMgatewayFrame.java:91
1)
at java.lang.Thread.run(Thread.java:484)
in the command window or the log file.
```

To allow PMOD Technologies to track and resolve the problem please report the error using the in-built reporting mechanism as described in the problem reporting section. If this is not possible due to a firewall problem please open the [Support Request](#) section on the [www.pmod.com](http://www.pmod.com) website and fill the error message together with a description into the problem report form.

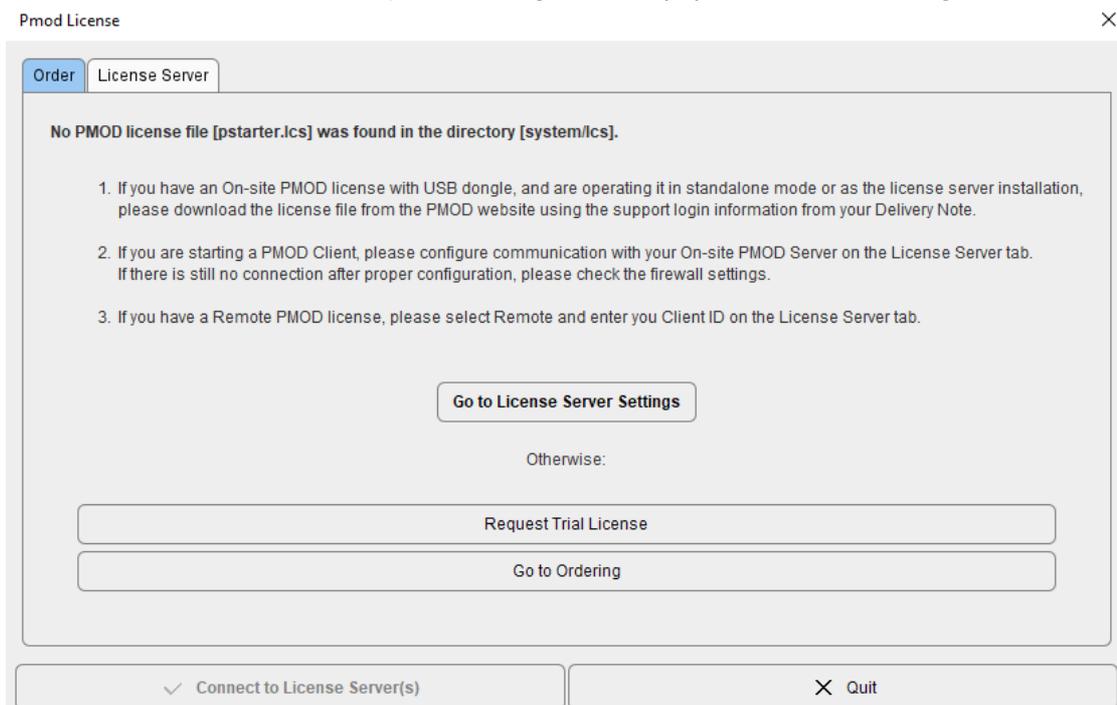
**License Errors**

Some of the most likely license errors are:

- The following error message might appear when restarting PMOD after a crash or after killing the program rather than quitting regularly



- If the license file has not been copied to the right directory, you will see a message



Please copy *pstarter.lcs* to */Applications/Pmod4.4/system/lcs*

- If the license file has been modified somehow, you will see a message *License Error. Invalid license file (2)*  
Please try to extract *pstarter.lcs* again from your e-mail without any modifications.
- If the USB key cannot be read because it is not connected or because the driver installation is not up to date, you will see an error message *Hardware license key not accessible* with additional details.  
Please make sure that the USB key is connected and the installation was done as described.  
The installation may have to be repeated after an operating system upgrade.

### R Plotting Problems

If plots are not shown or very slowly, an update of X11 is required. Please install XQuartz from <http://xquartz.macosforge.org/>.