

# LAB 01

## PROGRAMMING AN STM32 ARM CORETEX-M 32-BIT MICROCONTROLLER



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# PLAN A: ACCESSING THE VIRTUAL MACHINE



# VirtualBox

## Download VirtualBox

Here you will find links to VirtualBox binaries and its source code.

[About](#)

[Screenshots](#)

[Downloads](#)

[Documentation](#)

[End-user docs](#)

[Technical docs](#)

[Contribute](#)

[Community](#)

By downloading, you agree to the terms and conditions of the respective license.

If you're looking for the latest VirtualBox 6.0 packages, see [VirtualBox 6.0 builds](#). Please also use version 6.0 if you need to run VMs with software virtualization, as this has been discontinued in 6.1. Version 6.0 will remain supported until 2021.

If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2 builds](#). Please also use version 5.2 if you still need support for 32-bit hosts, as this has been discontinued in 6.0. Version 5.2 will remain supported until 2020.

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

The binaries are released under the terms of the GPL version 2 or later.

See the [changes log](#) if something has changed.

You might want to compare the checksums to verify the integrity of the files.

- [SHA256 checksums](#), [MD5 checksums](#)

**Note:** After upgrading VirtualBox it is recommended to upgrade the VM VirtualBox Extension Pack.

### VirtualBox 6.1.12 Extension VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, and the VirtualBox Personal Use and Evaluation License (PUEL). Please note that the Extension Pack is required for these features.

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

## User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it without having to install the whole thing, you also access it here:

- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

## VirtualBox older builds

LAND TO  
[WWW.VIRTUALBOX.ORG/WIKI/DOWNLOADS](http://www.virtualbox.org/wiki/Downloads)

Select your OS, download it and start the installation. Keep this webpage open.

# VirtualBox

search...  
Login Preferences

## Download VirtualBox

will find links to VirtualBox binaries and its source code.

### VirtualBox binaries

By clicking on a download link, you agree to the terms and conditions of the respective license.

For more information about Oracle VM VirtualBox, see [VirtualBox 6.0 builds](#).

For more information about Oracle VM VirtualBox, see [VirtualBox 5.2 builds](#).

### VirtualBox 6.1.12 platform packages

Windows hosts  
X hosts  
distributions  
Solaris hosts

These packages are released under the terms of the GPL version 2.

See the ChangeLog for what has changed.

If you want to compare the checksums to verify the integrity of downloaded files, see [SHA-512 checksums](#), [MD5 checksums](#).

Before upgrading VirtualBox it is recommended to upgrade the guest additions as well.

### VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

Supported platforms

USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot support. This extension pack is covered by the Oracle Personal Use and Evaluation License (PUEL). Please install the same version of the extension pack as the host system.

### VirtualBox 6.1.12 Software Developer Kit (SDK)

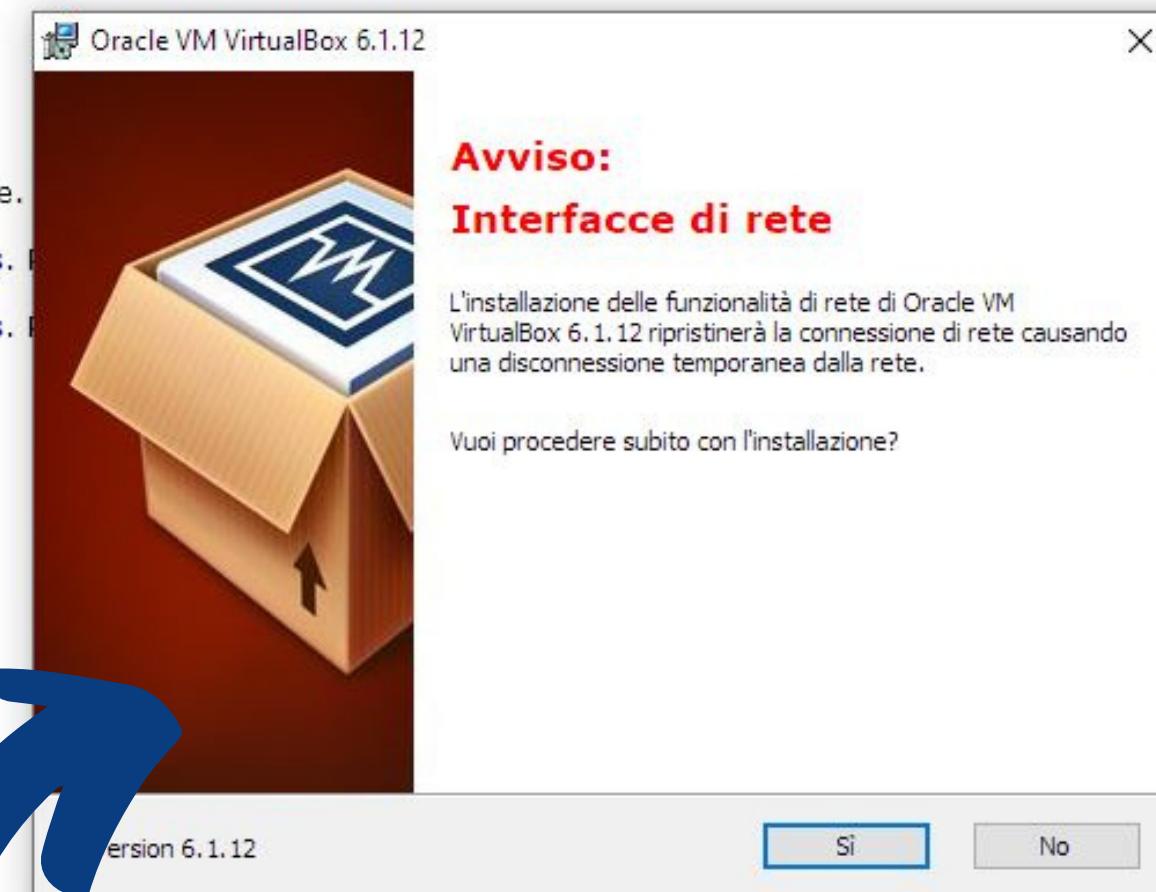
Supported platforms

### User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to read the manual online, see the [User Manual \(HTML version\)](#).

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds



**FOLLOW THE DEFAULT SETTINGS FOR THE INSTALLATION AND INSTALL THE NETWORK INTERFACE TOO**

It may interrupt your network connection for a short time, do not panic



# VirtualBox

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[About](#)

[Screenshots](#)

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### VirtualBox binaries

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If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2 builds](#). Please also use version 5.2 if you still need support for 32-bit hosts, as this has been discontinued in 6.0. Version 5.2 will remain supported until 2019.

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

The binaries are released under the terms of the GPL version 2.

See the [changelog](#) for what has changed.

You might want to compare the checksums to verify the integrity of downloaded files:

- [SHA256 checksums](#), [MD5 checksums](#)

**Note:** After upgrading VirtualBox it is recommended to upgrade the guest add-ons as well.

### VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption and more. This extension pack is covered by the [VirtualBox Personal Use and Evaluation License \(PUEL\)](#). Please install the extension pack in your host operating system.

### VirtualBox 6.1.12 Software Development Kit (SDK)

- [All platforms](#)

### User Manual

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- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds

**BACK TO THE VIRTUALBOX WEBPAGE**

[Download the Extension Pack](#)

File Home Condividi Visualizza



Questo PC > Volume (D:) > Virtual Machine

Nome	Ultima modifica	Tipo	Dimensione
Oracle_VM_VirtualBox_Extension_Pack-6.1.12.vbox-extpack	05/08/2020 14:39	VirtualBox Extensi...	10.881 KB

Access  
De  
Dc  
Dc  
Im  
Hurt  
Semir  
TL400  
Tutor  
OneDri  
Questo  
Deskt  
Docu  
Dowr  
Imma  
Music  
Ogge  
Video  
Disco  
Volun  
Unità  
Rete

PLACE IT IN A FOLDER OF YOUR CHOICE

And remember where! We are going to pick them with VirtualBox



# VirtualBox

## Download VirtualBox

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### VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective

If you're looking for the latest VirtualBox 6.0 packages, see [VirtualBox 6.0](#).

If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2](#).

### VirtualBox 6.1.12 platform packages

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- [Linux distributions](#)
- [Solaris hosts](#)

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You might want to compare the checksums to verify the integrity of dow

- [SHA256 checksums](#), [MD5 checksums](#)

**Note:** After upgrading VirtualBox it is recommended to upgrade the gues

### VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption

[VirtualBox Personal Use and Evaluation License \(PUEL\)](#). Please install the

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

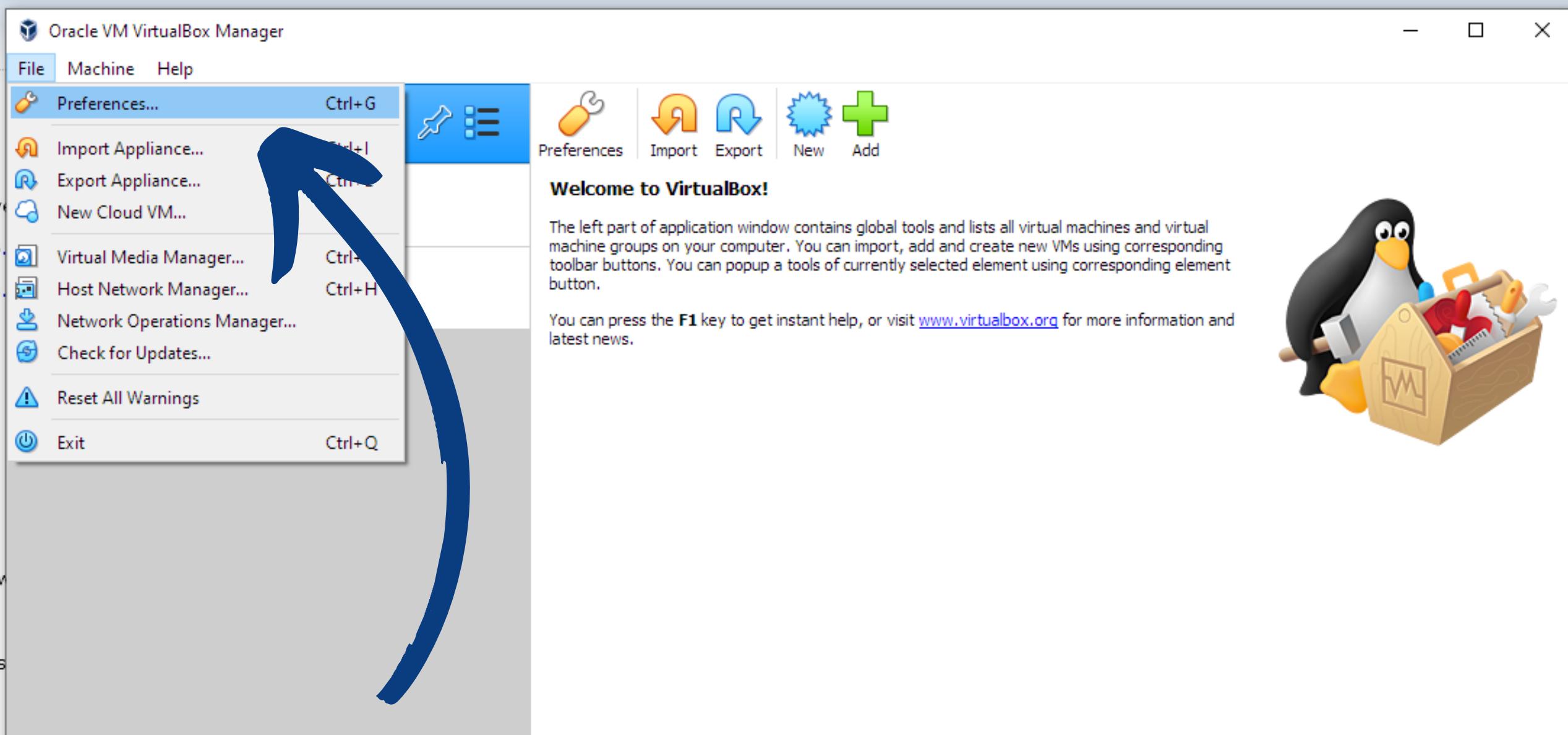
### User Manual

The VirtualBox User Manual is included in the VirtualBox packages above.

- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds



## RUN ORACLE VM VIRTUALBOX

And Select **File->Preferences**

# VirtualBox

## Download VirtualBox

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### VirtualBox binaries

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If you're looking for the latest VirtualBox 6.0 packages, see [VirtualBox 6.0 packages](#).

If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2 packages](#).

### VirtualBox 6.1.12 platform packages

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**Note:** After upgrading VirtualBox it is recommended to upgrade the guest additions as well.

### VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption and more.

VirtualBox Personal Use and Evaluation License (PUEL). Please install the Oracle VM VirtualBox Extension Pack.

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

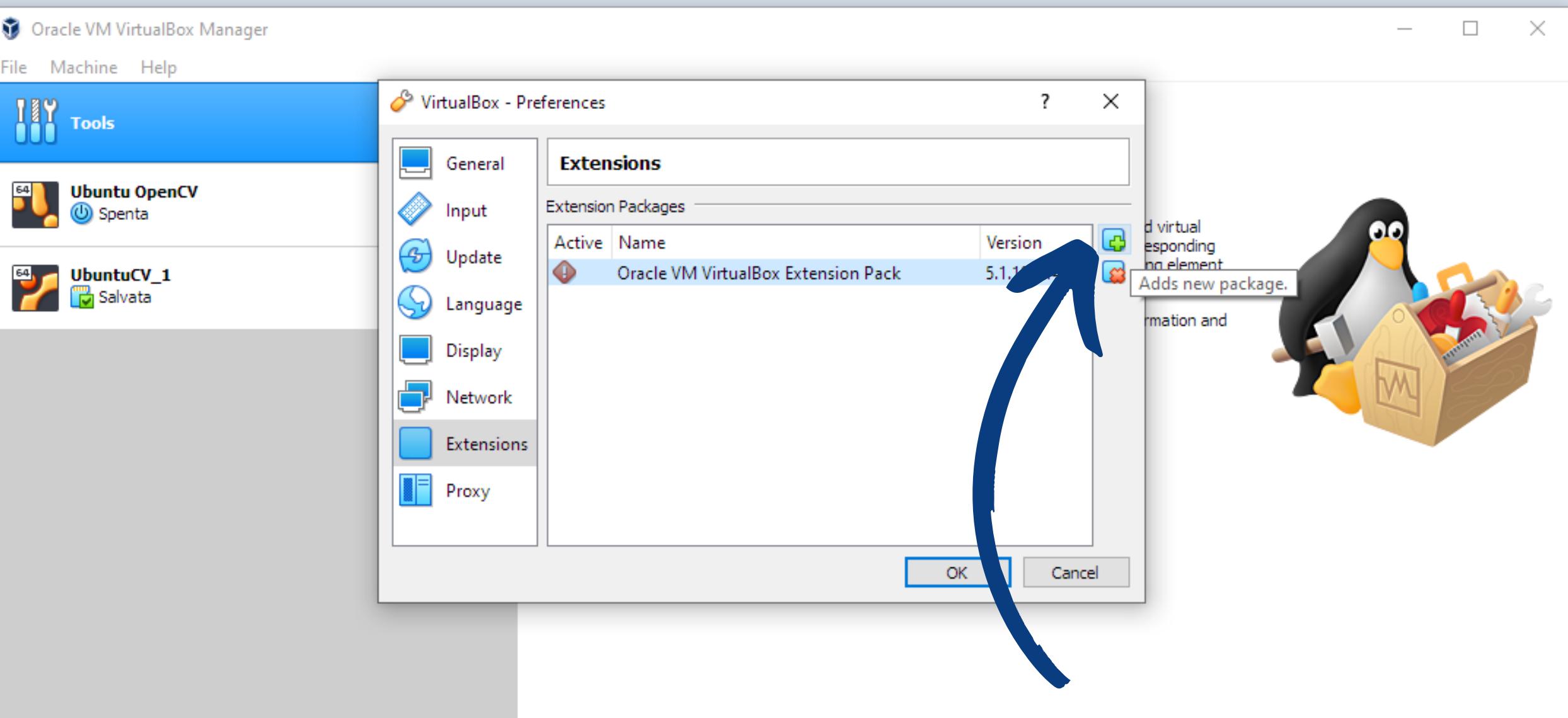
### User Manual

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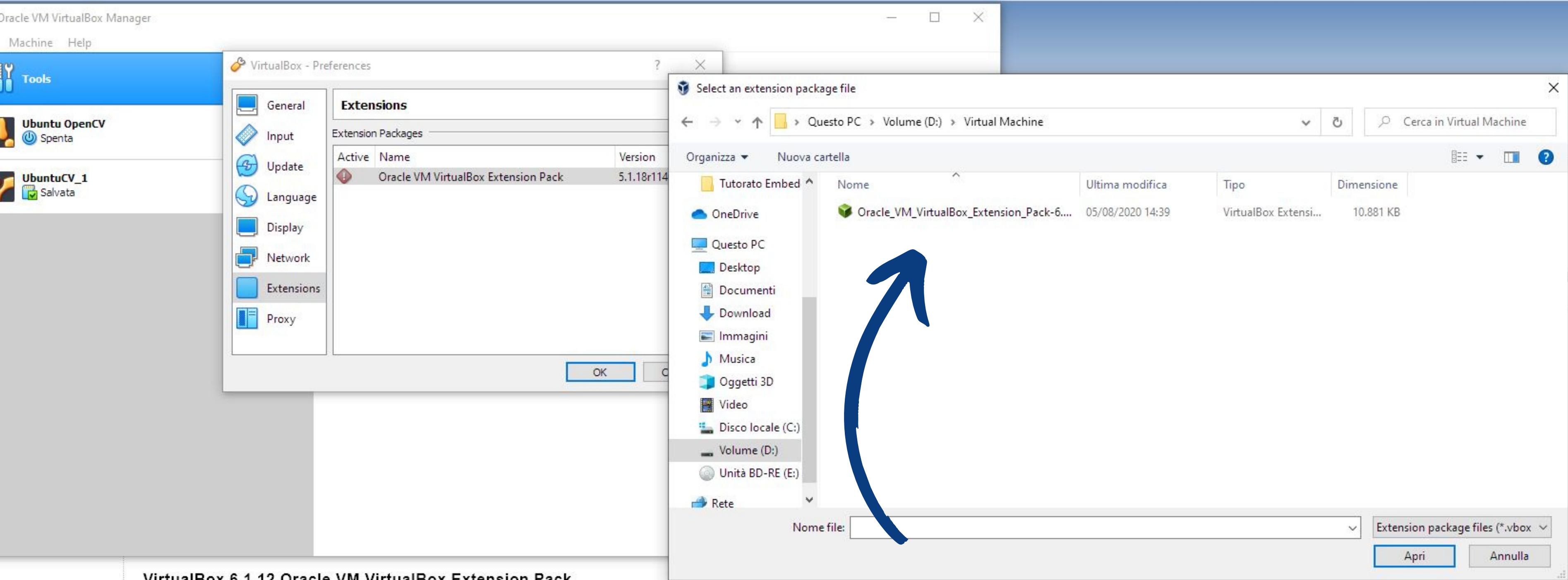
- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds



Select **Extensions** and hit the plus icon to add new packages



## VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- All supported platforms

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption and more.  
VirtualBox Personal Use and Evaluation License (PUEL). Please install it.

## VirtualBox 6.1.12 Software Developer Kit (SDK)

- All platforms

## User Manual

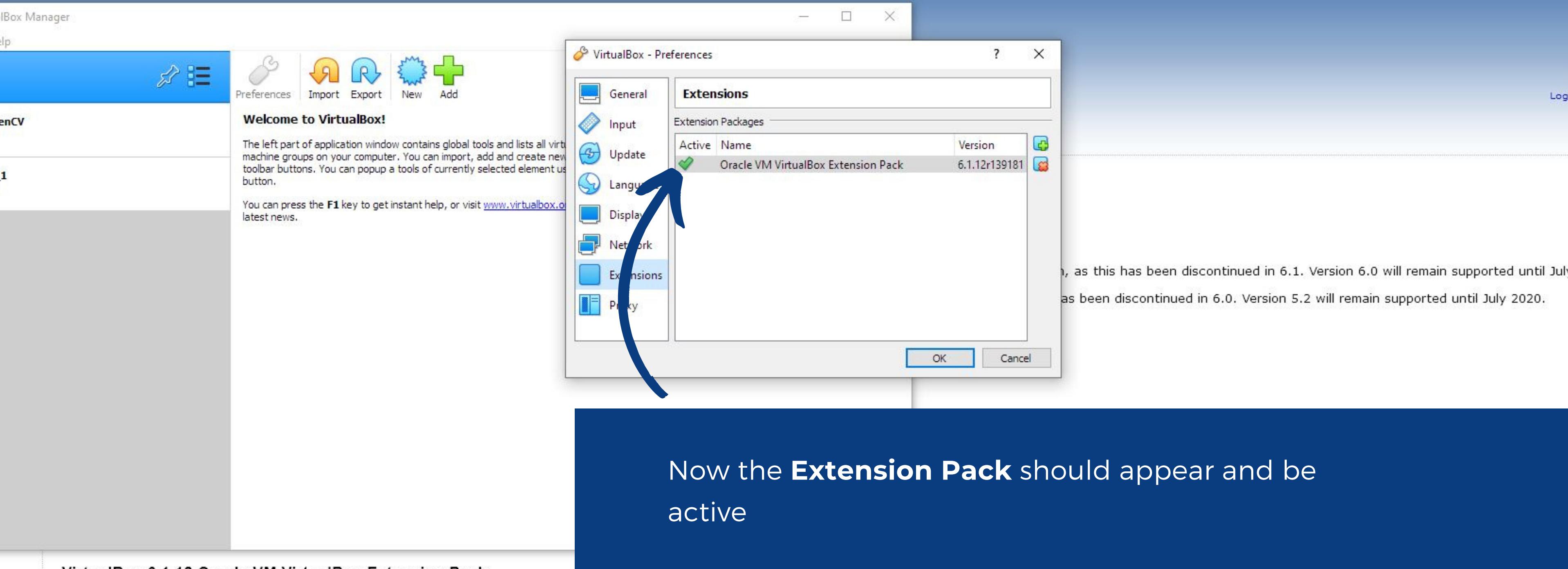
The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it without having to install the whole thing, you also access it here:

- User Manual (HTML version)

You may also like to take a look at our frequently asked questions list.

## VirtualBox older builds

Select the **Extension Pack** you have just downloaded and install it



VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- ➔ All supported platforms

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel cards. See [this chapter from the User Manual](#) for an introduction to this Extension Pack. The Extension Pack binaries are released under [VirtualBox Personal Use and Evaluation License \(PUEL\)](#). Please *install the same version extension pack as your installed version of VirtualBox*.

VirtualBox 6.1.12 Software Developer Kit (SDK)

- ↗ All platforms

User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it without having to install the whole thing, you also access it here:

- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

## **VirtualBox older builds**

# VirtualBox

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## Download VirtualBox

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### VirtualBox binaries

By downloading, you agree to the terms and conditions of the respective license.

If you're looking for the latest VirtualBox 6.0 packages, see [VirtualBox 6.0 builds](#). Please also

If you're looking for the latest VirtualBox 5.2 packages, see [VirtualBox 5.2 builds](#). Please also

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

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See the [changelog](#) for what has changed.

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- [SHA256 checksums](#), [MD5 checksums](#)

**Note:** After upgrading VirtualBox it is recommended to upgrade the guest additions as well.

### VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and  
[VirtualBox Personal Use and Evaluation License \(PUEL\)](#). Please install the same version as the host OS.

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

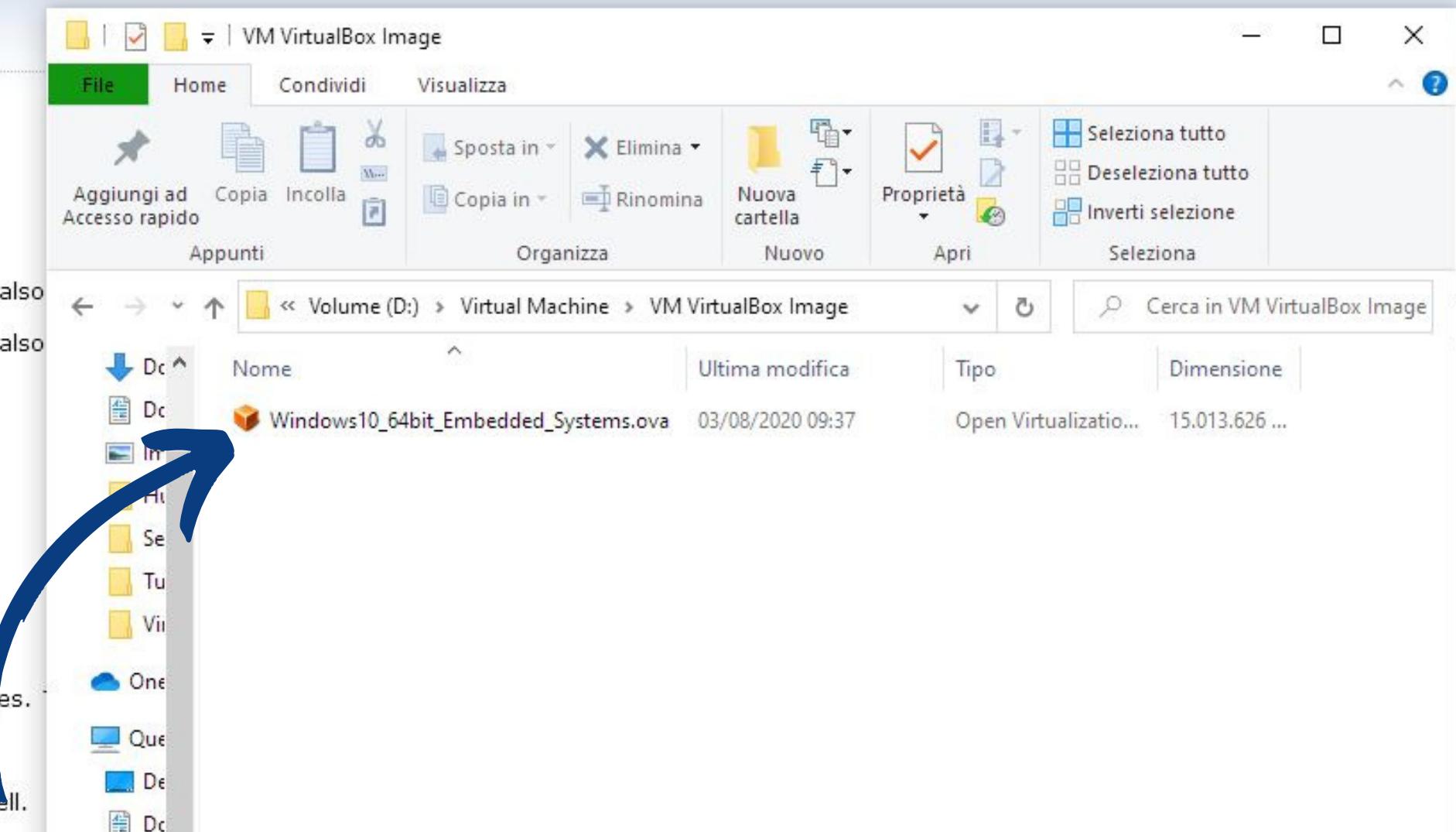
### User Manual

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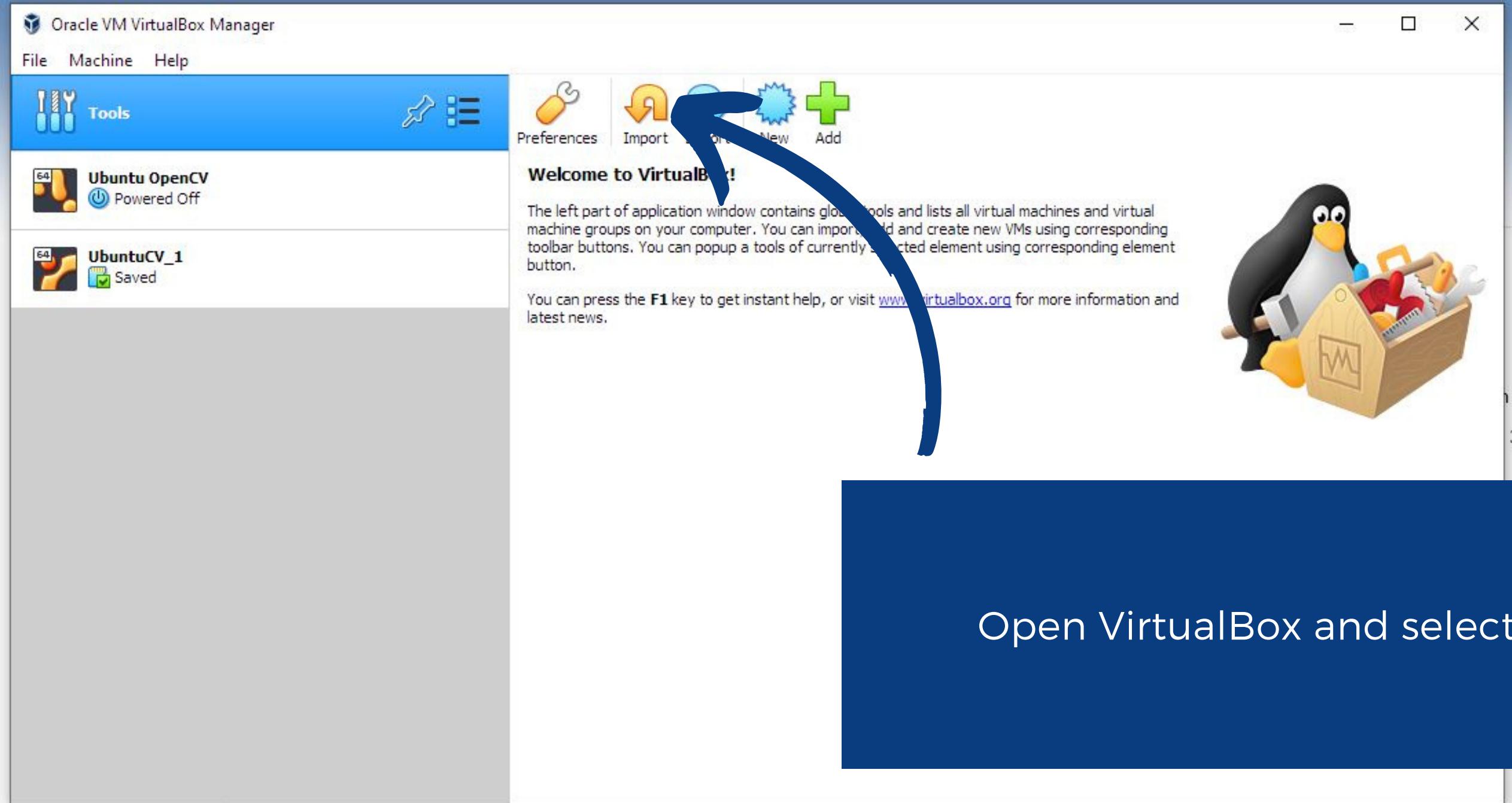
- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds



Download and save the Virtual Machine image from:  
<https://drive.google.com/drive/folders/1tHQ5O4eaGEEBfe2oR7O2wlnYTZAIRr4r?usp=sharing>  
And remember where! We are going to pick them with VirtualBox



## VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel cards. See this chapter from the User Manual for an introduction to this Extension Pack. The Extension Pack binaries are covered by the [VirtualBox Personal Use and Evaluation License \(PUEL\)](#). Please install the same version extension pack as your installed version of VirtualBox.

## VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

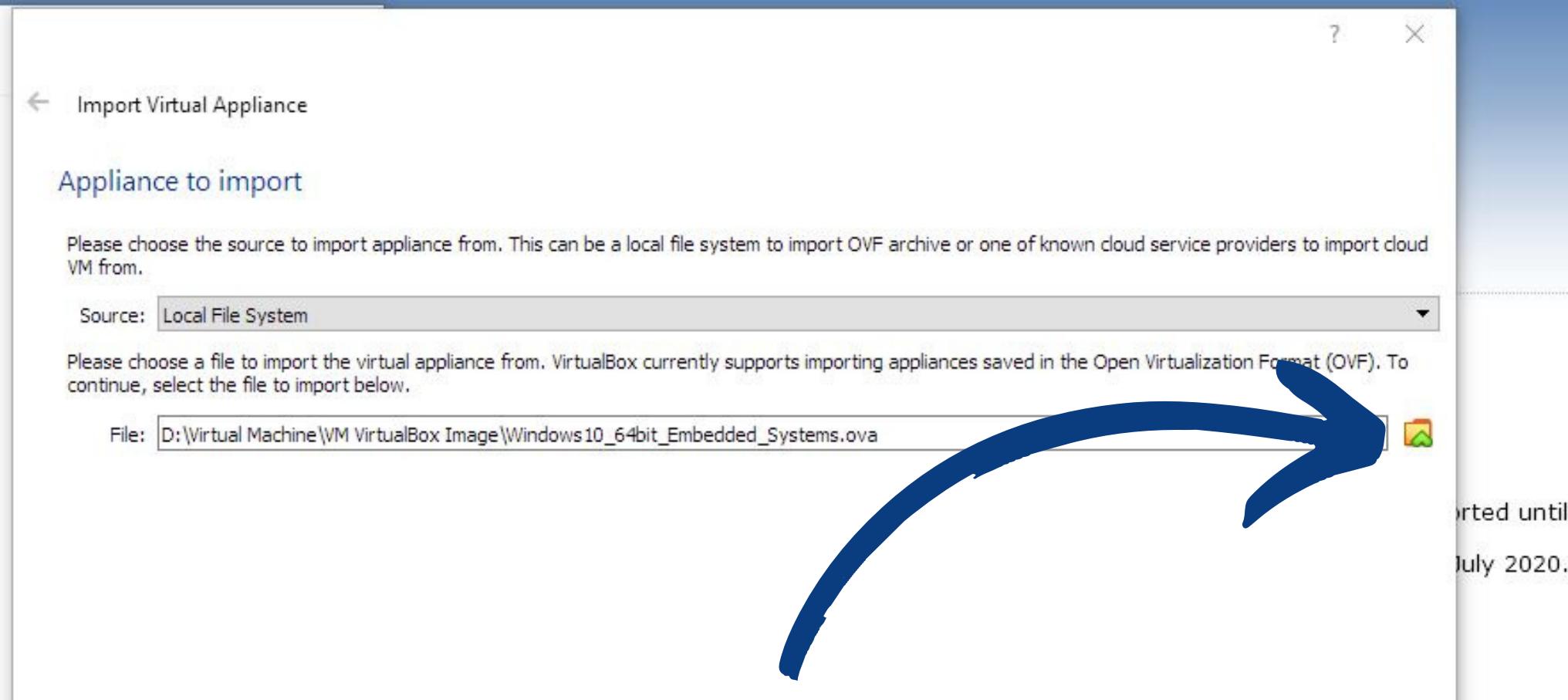
## User Manual

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- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

## VirtualBox older builds



Then click there, browse and select the Virtual Machine image you have just downloaded. Finally click **Next**

## VirtualBox 6.1.12 Oracle VM VirtualBox Extension Pack

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, VirtualBox RDP, disk encryption, NVMe and PXE boot for Intel controllers, and more. This extension pack is required for using VirtualBox on most platforms. [Learn more](#)

## VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

[Expert Mode](#) [Next](#) [Cancel](#)

## User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it without having to install the whole thing, you also access it here:

- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

## VirtualBox older builds

VirtualBox Manager

Help

OpenCV  
ed Off

V\_1

Welcome to VirtualBox!

The left part of application window contains global tools and lists all virtual machines and virtual machine groups on your computer. You can import, add and create new VMs using corresponding toolbar buttons. You can popup a tools of currently selected element using corresponding element button.

You can press the F1 key to get instant help, or visit [www.virtualbox.org](http://www.virtualbox.org) for more information and latest news.

VirtualBox

- [All s](#)

Support for  
VirtualBox Pe

VirtualBox

- [All p](#)

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The VirtualBe

- [User](#)

You may also

VirtualB

Preferences Import Export New Add

Import Virtual Appliance

Appliance settings

These are the virtual machines contained in the appliance and the suggested settings of the imported VirtualBox machines. You can change many of the properties shown by double-clicking on the items and disable others using the check boxes below.

Virtual System 1

Name	Windows10_64bit_EMBEDDED_Systems
Guest OS Type	Windows 10 (64-bit)
CPU	4
RAM	6144 MB
DVD	<input checked="" type="checkbox"/>
USB Controller	<input checked="" type="checkbox"/>
Sound Card	<input checked="" type="checkbox"/>
Network Adapter	<input checked="" type="checkbox"/> Intel PRO/1000 MT Desktop (82540EM)
Storage Controller (SATA)	AHCI

Original Value: 4

Double click on the number of **CPU** and select the number of the physical core your CPU has (e.g. for an i7 they are usually 4. If you are not sure, just insert **2**). Do the same for the amount of RAM by inserting half the amount you have (if you are not sure, just insert **3000 MB**).

# VirtualBox

## Download VirtualBox

Here you will find links to VirtualBox binaries

### VirtualBox binaries

By downloading, you agree to the terms and conditions.

If you're looking for the latest VirtualBox 6.0.0, click here.

If you're looking for the latest VirtualBox 5.2.20, click here.

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

The binaries are released under the terms of the [Apache License 2.0](#).

See the [changelog](#) for what has changed.

You might want to compare the checksums:

- [SHA256 checksums](#), [MD5 checksums](#)

**Note:** After upgrading VirtualBox it is recommended to import the VMs again.

### VirtualBox 6.1.12 Oracle VM VirtualBox

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, V

[VirtualBox Personal Use and Evaluation License](#)

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

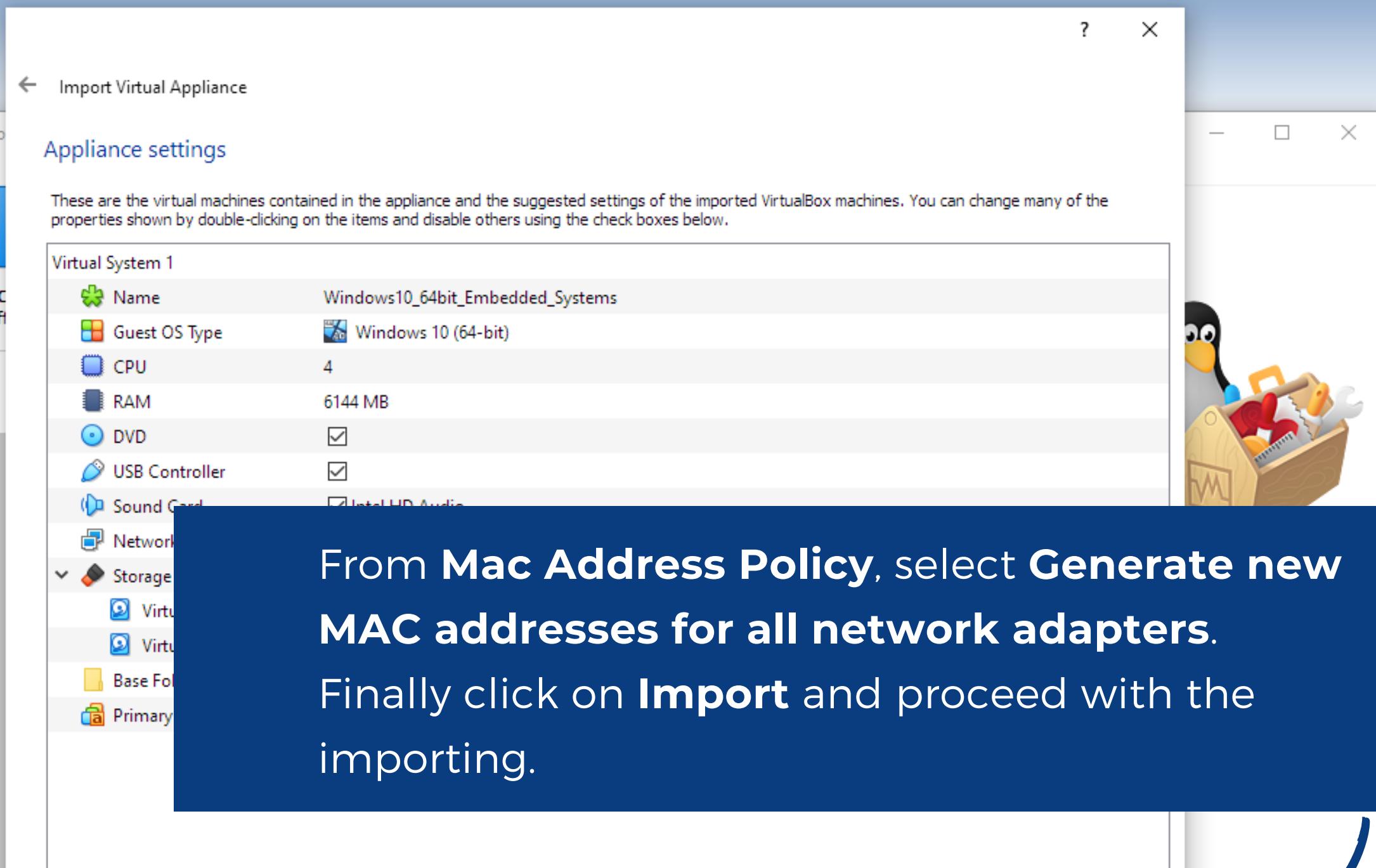
## User Manual

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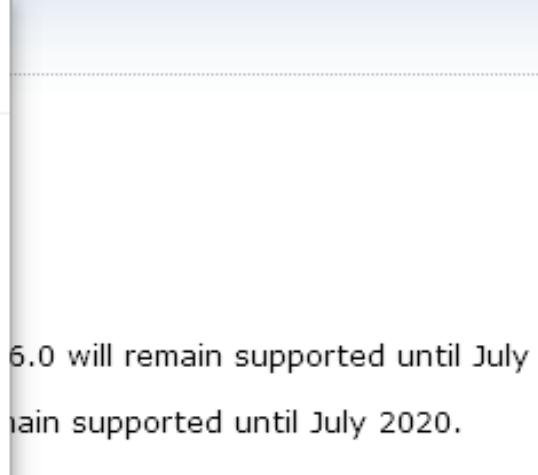
- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

## VirtualBox older builds



From **Mac Address Policy**, select **Generate new MAC addresses for all network adapters**.  
Finally click on **Import** and proceed with the importing.



Pack binaries are released under the terms of the [Apache License 2.0](#).

# VirtualBox

## Download VirtualBox

Here you will find links to VirtualBox binaries

### VirtualBox binaries

By downloading, you agree to the terms and conditions.

If you're looking for the latest VirtualBox 6.0

If you're looking for the latest VirtualBox 6.1.12

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)

Once you have finished, the new  
Virtual Machine will appear on the left.

- [All supported platforms](#)

Support for USB 2.0 and USB 3.0 devices, V

[VirtualBox Personal Use and Evaluation License](#)

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

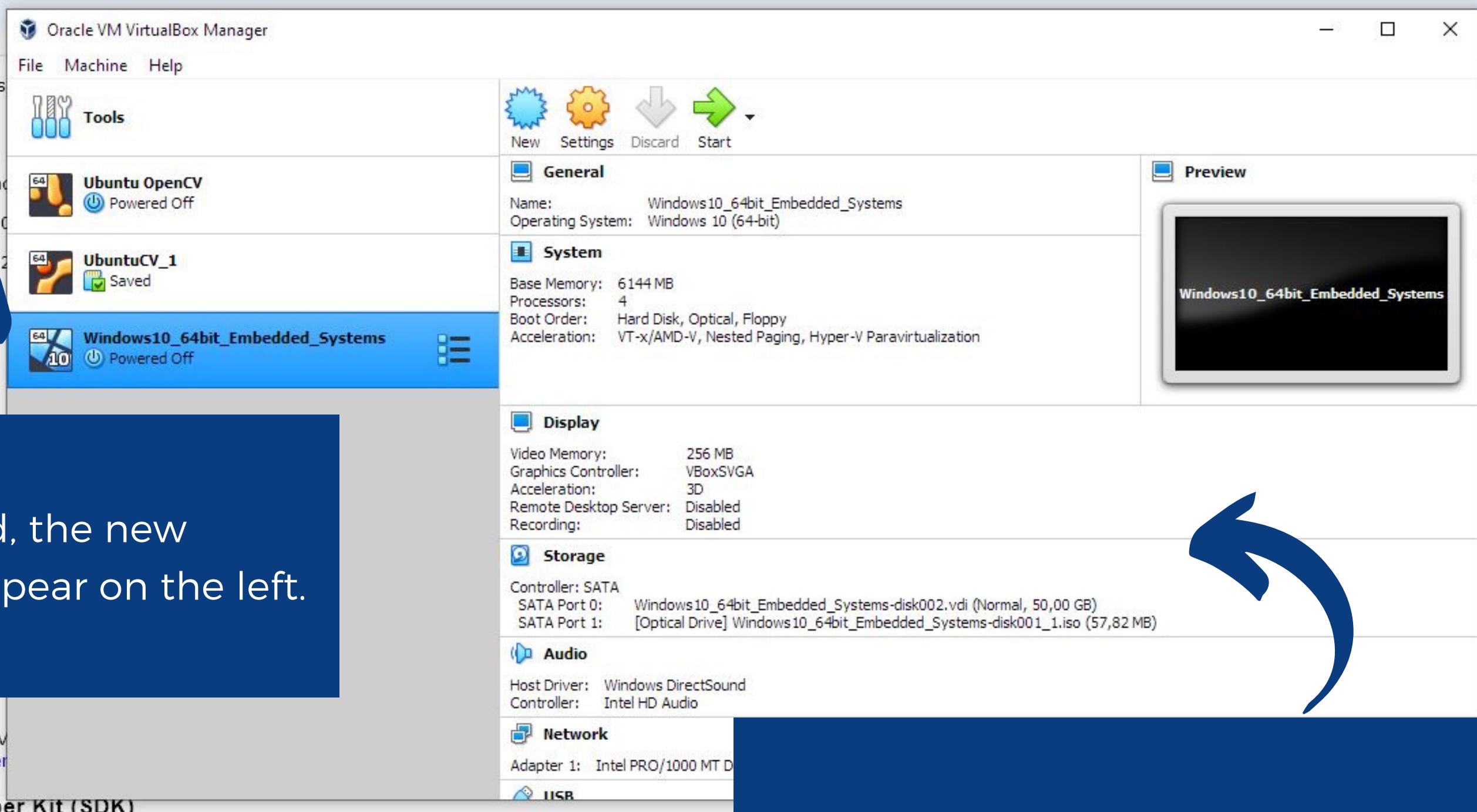
### User Manual

The VirtualBox User Manual is included in the VirtualBox packages above. If, however, you would like to take a look at it with

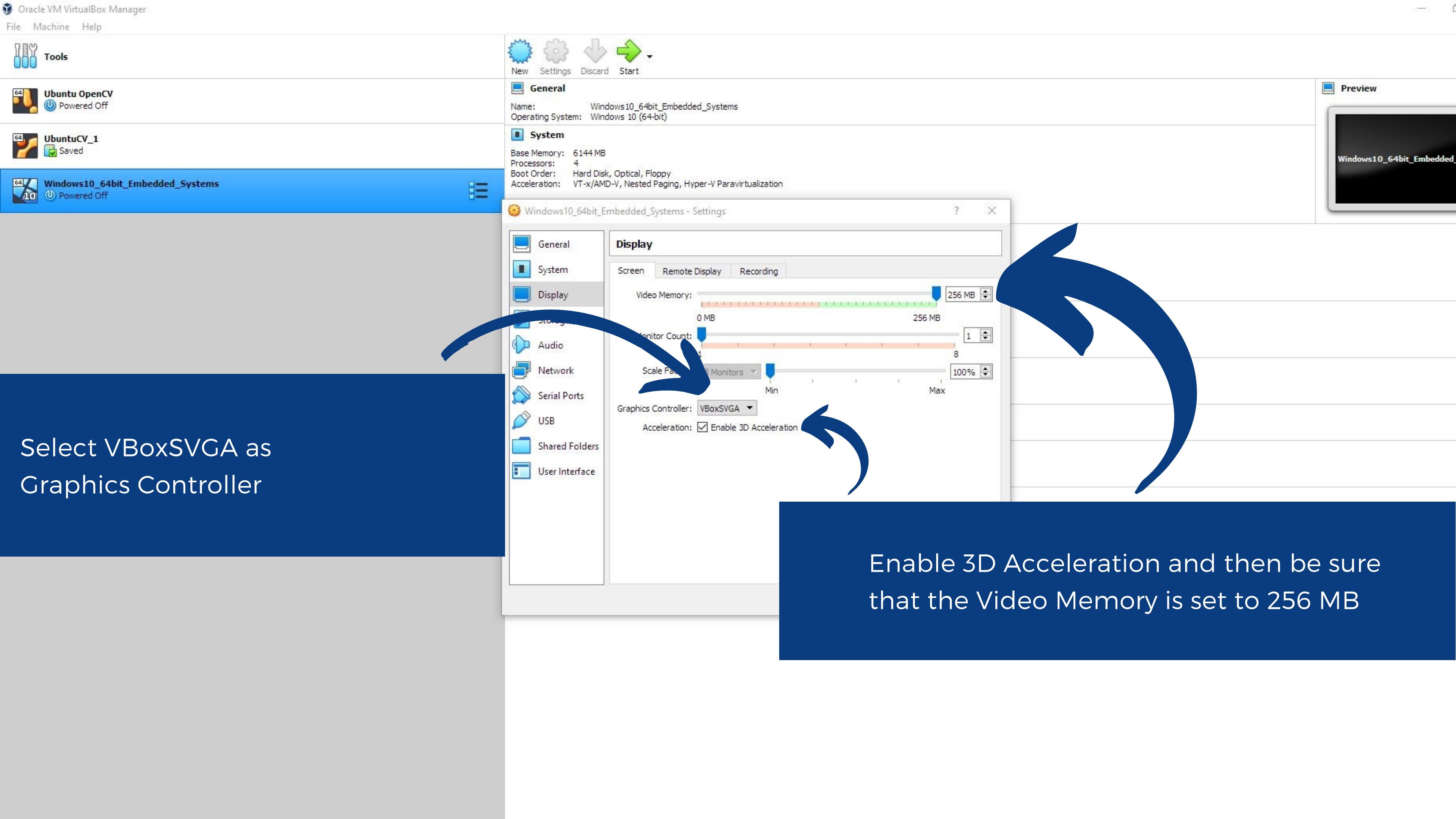
- [User Manual \(HTML version\)](#)

You may also like to take a look at our [frequently asked questions list](#).

### VirtualBox older builds



On the right you can see all of its details.



# VirtualBox

## Download VirtualBox

Here you will find links to VirtualBox binaries

### VirtualBox binaries

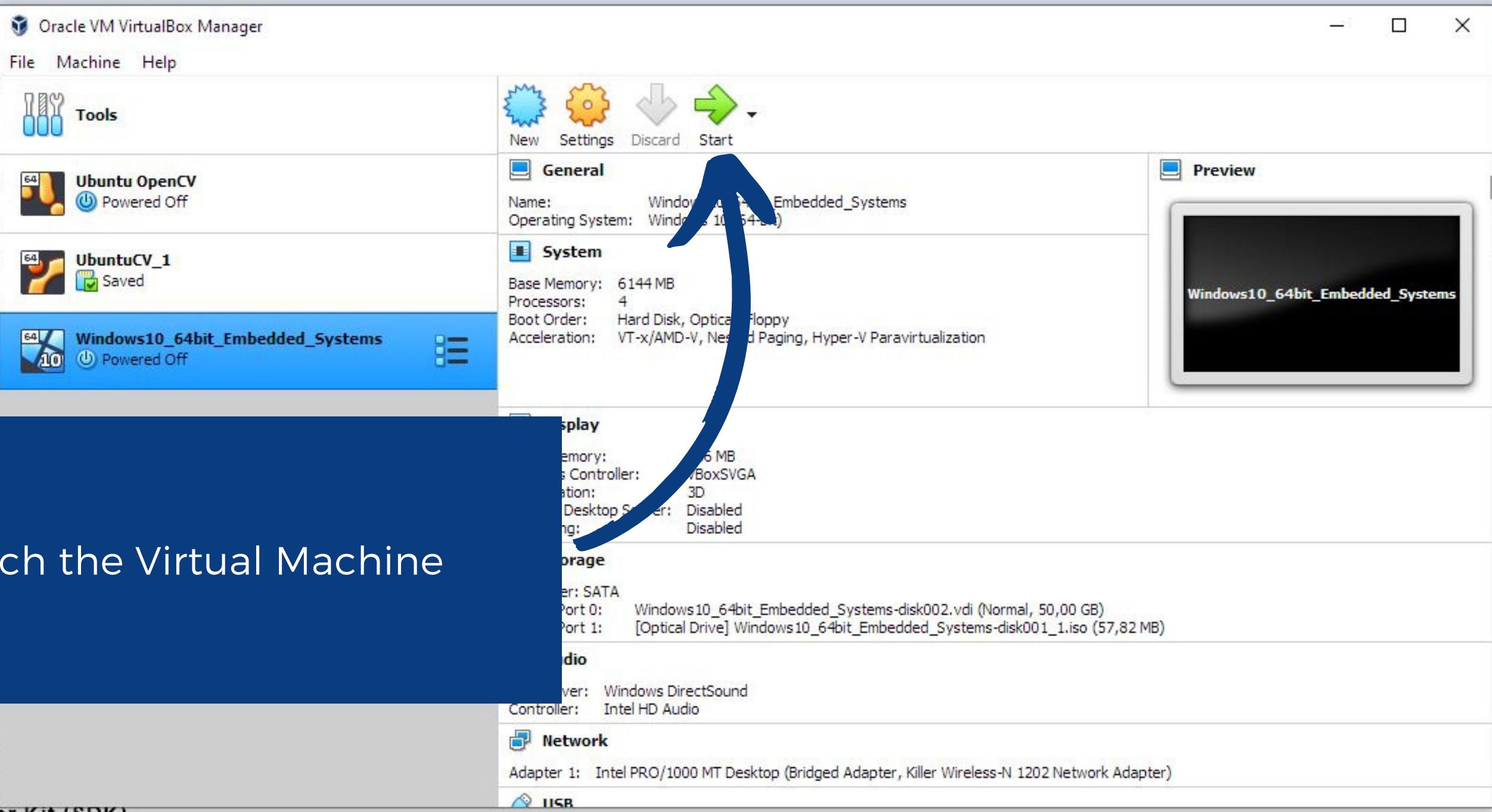
By downloading, you agree to the terms and conditions.

If you're looking for the latest VirtualBox 6.0.0, click here.

If you're looking for the latest VirtualBox 5.2.20, click here.

### VirtualBox 6.1.12 platform packages

- [Windows hosts](#)
- [OS X hosts](#)
- [Linux distributions](#)
- [Solaris hosts](#)



Click on **Start** to launch the Virtual Machine

### All supported platforms

Support for USB 2.0 and USB 3.0 devices, V

[VirtualBox Personal Use and Evaluation License](#)

### VirtualBox 6.1.12 Software Developer Kit (SDK)

- [All platforms](#)

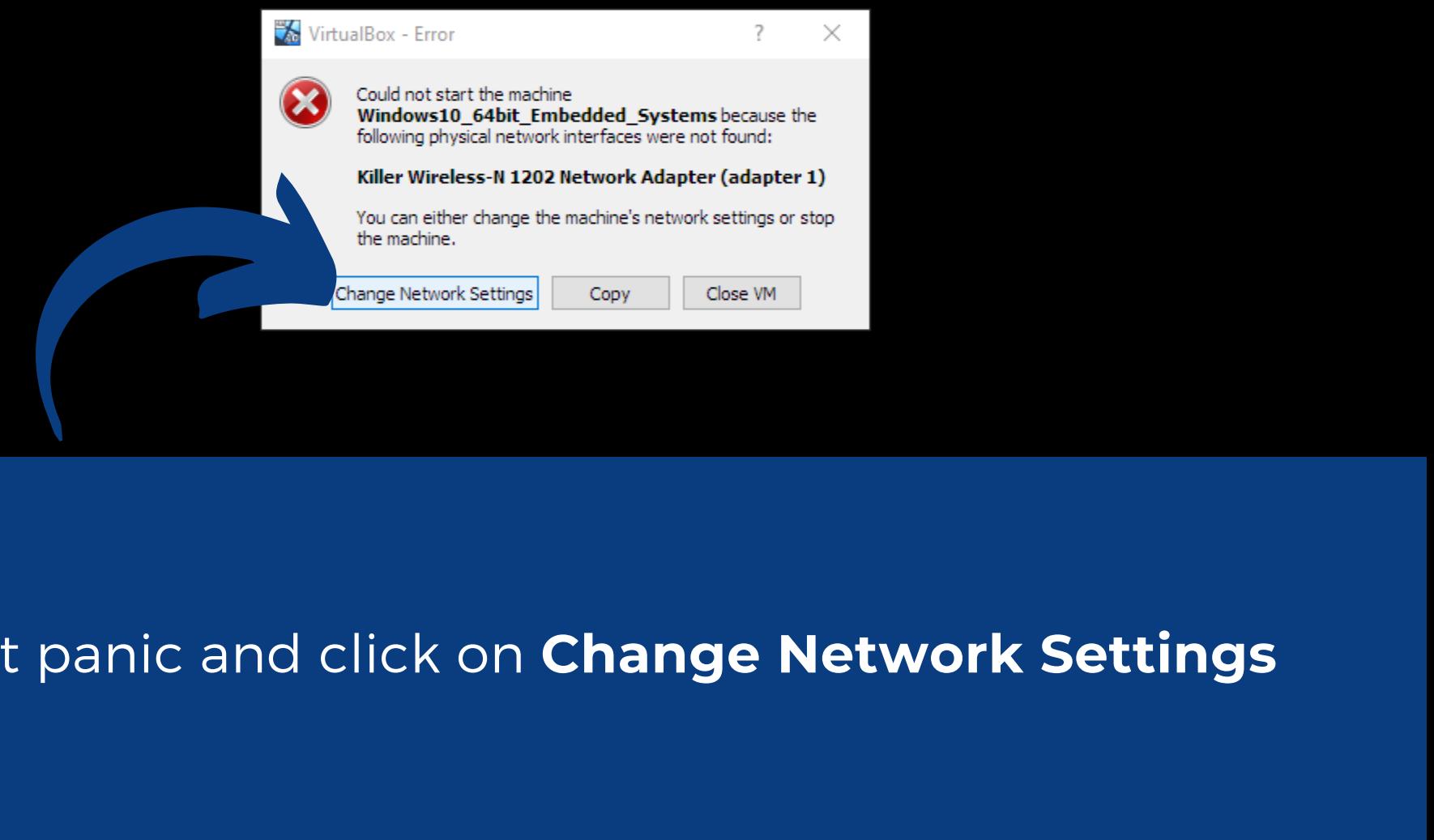
### User Manual

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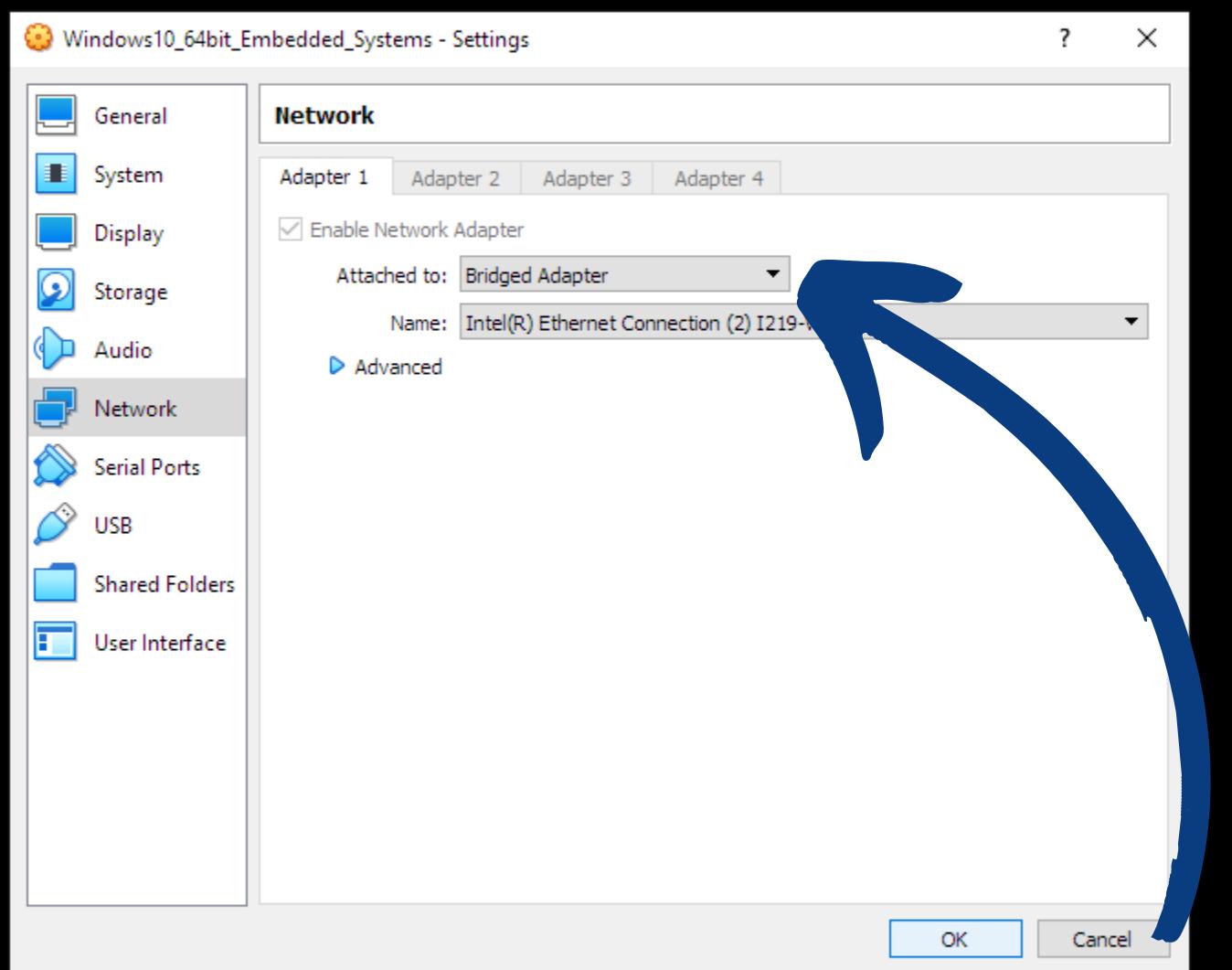
- [User Manual \(HTML version\)](#)

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### VirtualBox older builds



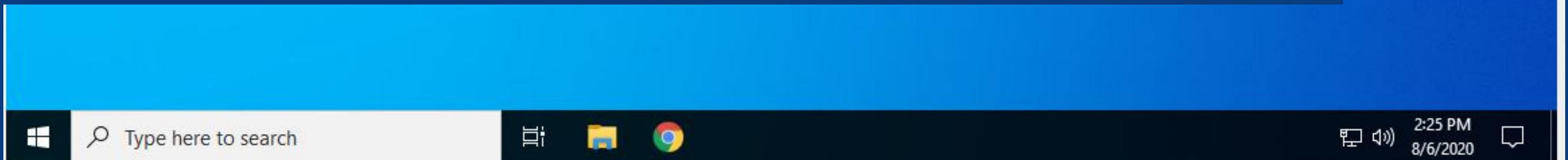
This error may appear. If so, do not panic and click on **Change Network Settings**



Be sure that **Bridge Adapter** is selected and then click **OK**



The Virtual Machine will start and after few minutes you will have your Windows 10 system set up and running.



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# PLAN B: RUNNING THE SOFTWARE NATIVELY

# STM32 DEVELOPMENT ENVIRONMENT

- Download the archive from

<https://drive.google.com/drive/u/2/folders/1tHQ5O4eaGEEBfe2oR7O2wInYTZAIRr4r>

- Unzip it

# STM32 DEVELOPMENT ENVIRONMENT

 1 - jre-8u231-windows-x64_1612862595.exe Type: Application	<b>Java Runtime Env.</b>	Date modified: 11/4/2019 3:35 PM Size: 2.21 MB
 2 - install_sw4stm32_win_64bits-v2.9.exe Type: Application	<b>System Workbench</b>	Date modified: 11/4/2019 3:42 PM Size: 454 MB
 3 - en.stm32cubemx_v5.4.0.zip	<b>STM32 Cube-MX</b>	Date modified: 11/4/2019 3:37 PM

Install the 3 software following the order

1. Java Runtime Environment
2. System Workbench
3. STM32 Cube-MX

Finally, download MobaXterm from <https://mobaxterm.mobatek.net/download.html>



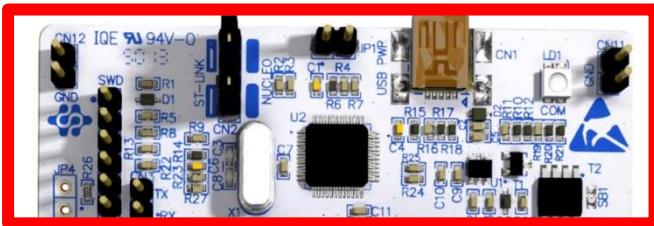
**STM32 NUCLEO L4**

# STM32 NUCLEO FAMILY



- Ideal for **quick prototyping**
- Standardized connectivity, **reusable** across all Nucleo boards
- Extends connectivity even to **Arduino** boards
- Each board contains an ST-LINK in-circuit **debugger and programmer** (usable even for external applications compatible with STM32 MCUs)

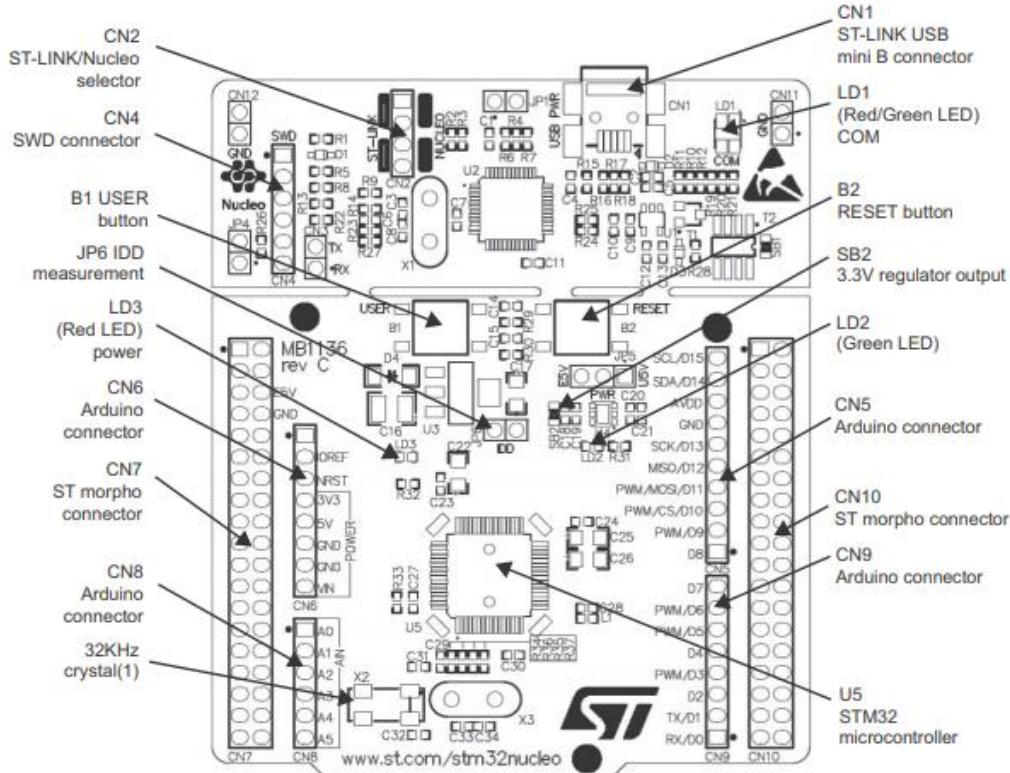
# STM32 NUCLEO F401RE



**ST-LINK  
(programmer)**

**STM32 NUCLEO  
BOARD**

# STM32 NUCLEO F401RE



# STM32 NUCLEO F401RE

## Features

- STM32 microcontroller in LQFP64 package
- SMPS: significantly reduces power consumption in Run mode, by generating Vcore logic supply from an external DC/DC converter. This function is only available on '-P' suffixed boards
- 1 user LED shared with Arduino™
- 1 user and 1 reset push-buttons
- 32.768 kHz LSE crystal oscillator
- Board expansion connectors:
  - Arduino™ Uno V3
  - ST morpho extension pin headers for full access to all STM32 I/Os
  - External SMPS experimentation dedicated connector. This function is only available on '-P' suffixed boards
- Flexible power-supply options: ST-LINK USB V<sub>BUS</sub> or external sources

- On-board ST-LINK/V2-1 debugger/programmer with USB re-enumeration capability. Three different interfaces supported on USB: mass storage, virtual COM port and debug port
- Comprehensive free software libraries and examples available with the STM32Cube MCU Package
- Support of a wide choice of Integrated Development Environments (IDEs) including IAR™, Keil®, GCC-based IDEs, Arm® Mbed™
- Arm® Mbed Enabled™ compliant (only for some Nucleo part numbers)

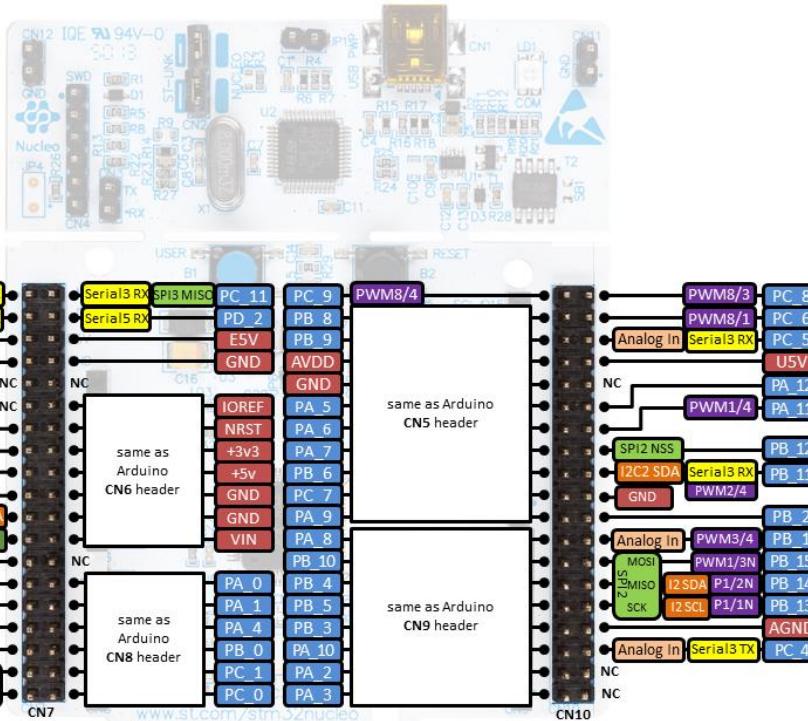
**Table 1. Device summary**

Reference	Part number
NUCLEO-XXXXRX (-P)	NUCLEO-F030R8, NUCLEO-F070RB, NUCLEO-F072RB, NUCLEO-F091RC, NUCLEO-F103RB, NUCLEO-F302R8, NUCLEO-F303RE, NUCLEO-F334R8, NUCLEO-F401RE, NUCLEO-F410RB, NUCLEO-F411RE, NUCLEO-F446RE, NUCLEO-L053R8, NUCLEO-L073RZ, NUCLEO-L152RE, NUCLEO-L452RE, NUCLEO-L476RG, NUCLEO-L452RE-P, NUCLEO-L433RC-P.

# STM32 NUCLEO F401RE



Nucleo L476RG  
Morpho Headers



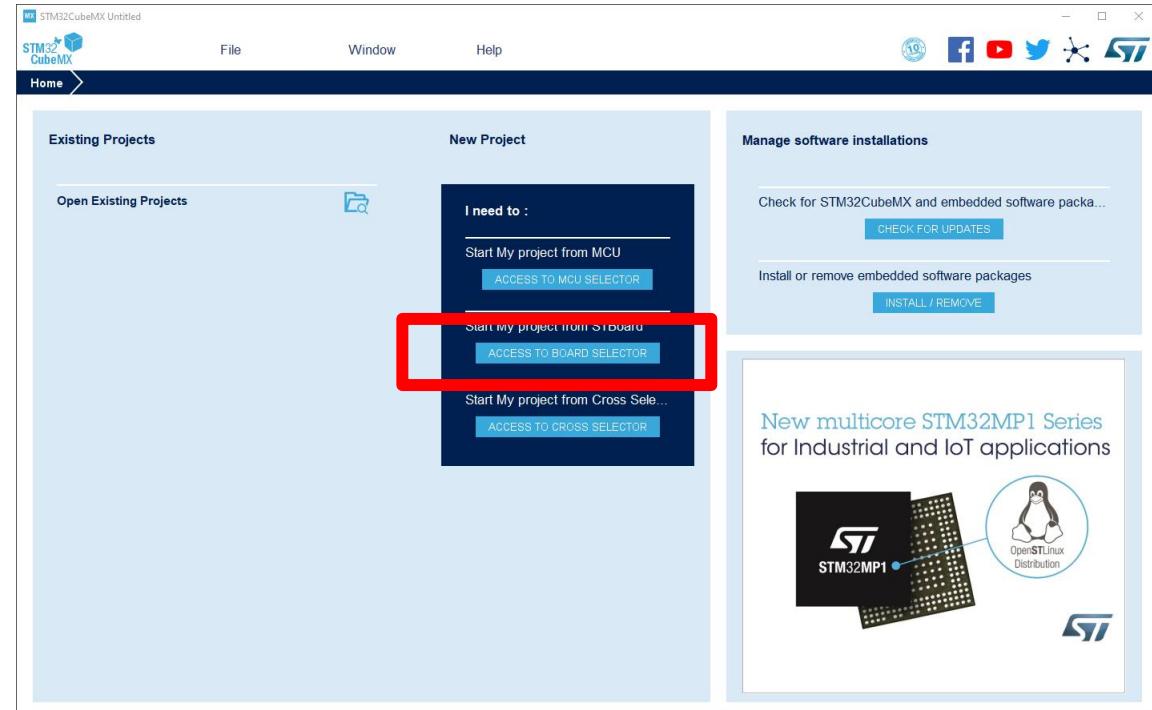


# STM32 CUBEMX

# STM32 CUBEMX – SELECTING THE BOARD

A graphical tool which enables **fast configuration** of STM32 microcontrollers and microprocessors.

Generates the corresponding **C code** for the Arm Coretex core.



# STM32 CUBEMX – SELECTING THE BOARD

New Project from a Board

MCU/MPU Selector Board Selector Example Selector Cross Selector

Board Filters:

- Commercial Part Number NUCLEO-L476RG
- NUCLEO-L476RG

Features Large Picture Docs & Resources Datasheet Buy Start Project

Datasheet document is not available

SIL Ready ASIL Ready ClassB Ready Partner Program

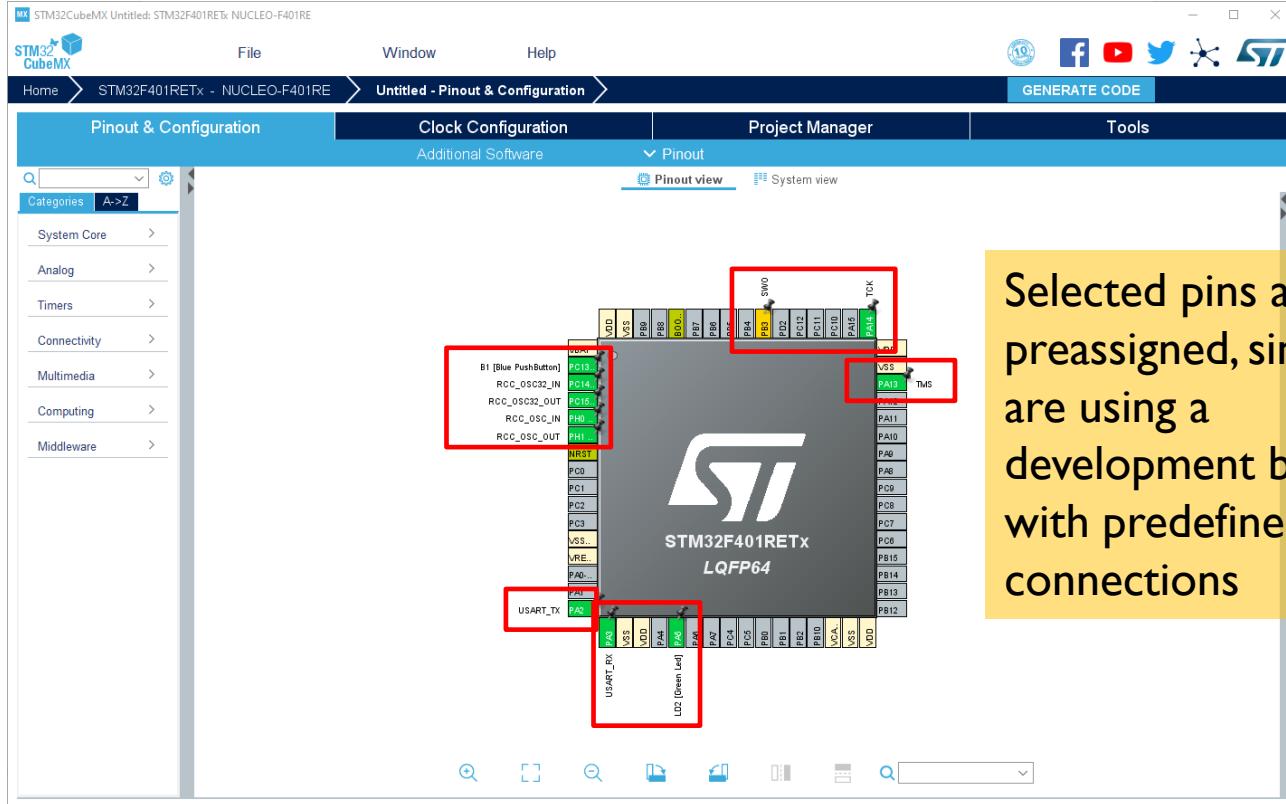
Build your certified safety system with STM32 and STM8

Boards List: 1 item

Export

	Overview	Commercial Part No	Type	Marketing Status	Unit Price (US\$)	Mounted Device
	NUCLEO-L476RG	Nucleo-64	Active	14.0	STM32L476RGTx	

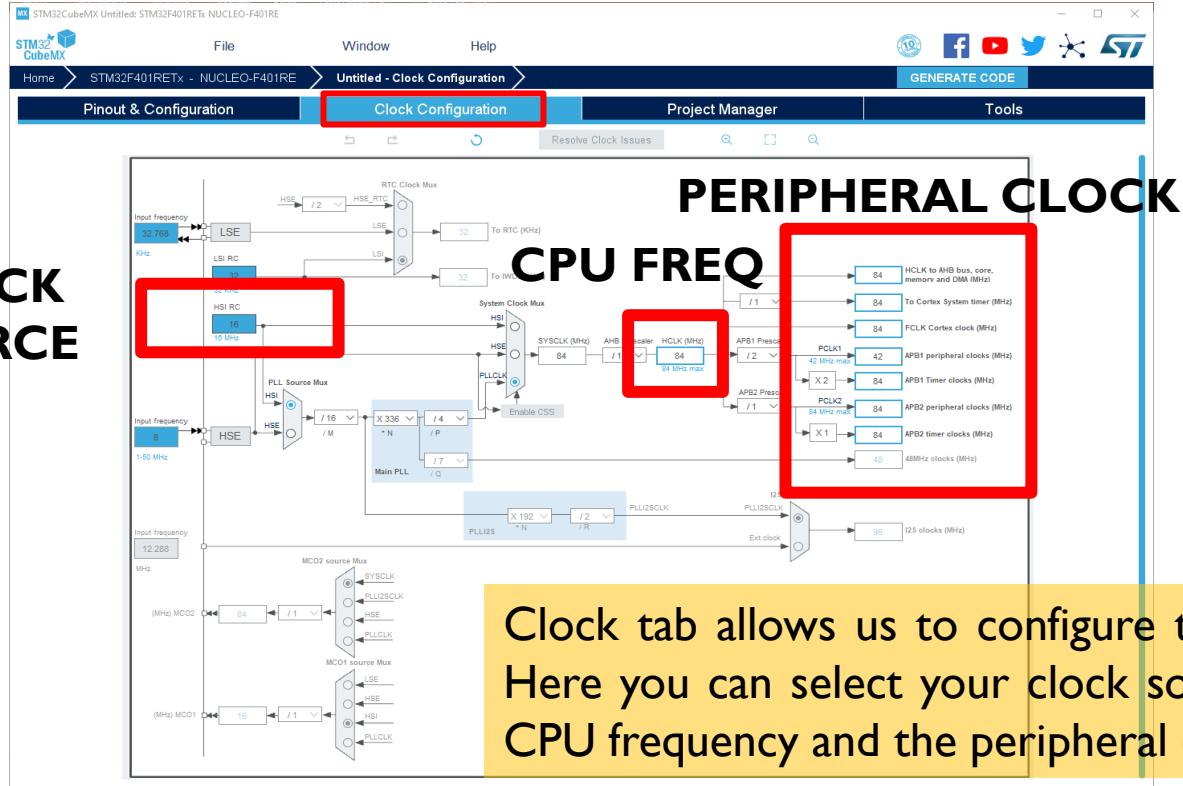
# STM32 CUBEMX – MULTIPLEXING THE PINS



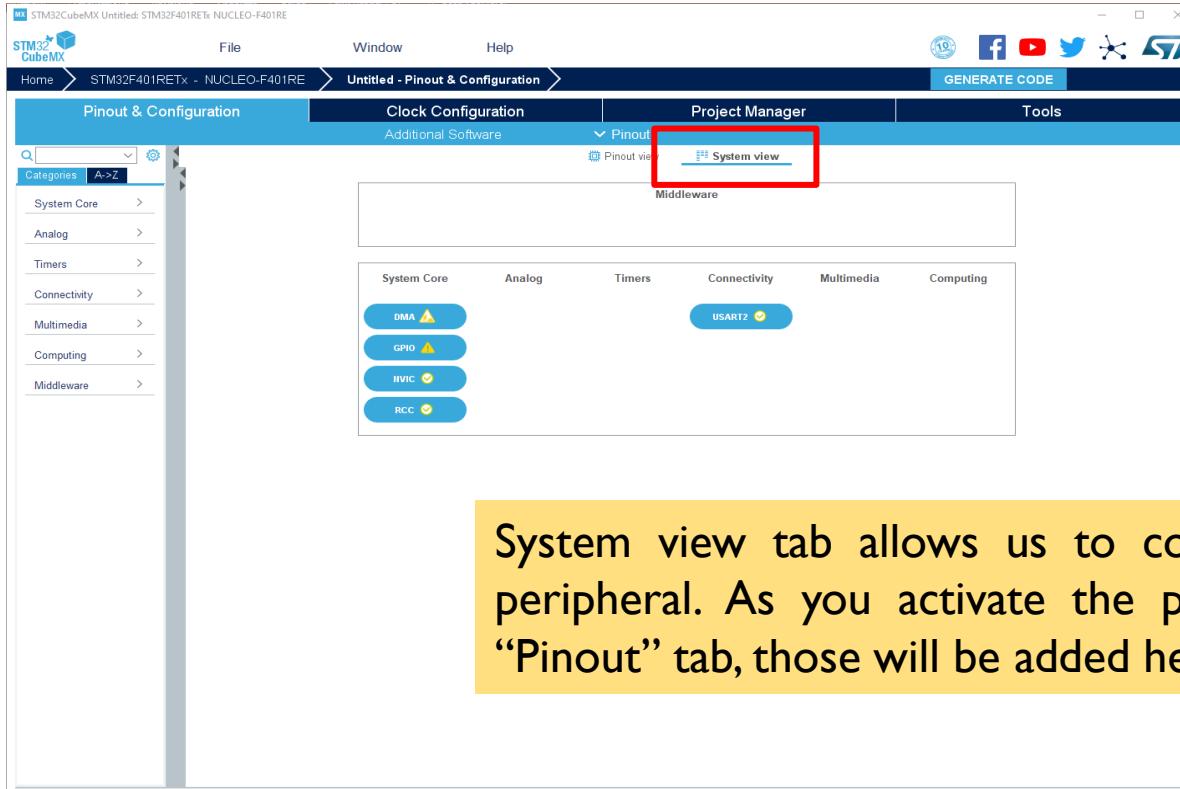
Selected pins are preassigned, since we are using a development board, with predefined connections

# STM32 CUBEMX – SETTING THE CLOCKS

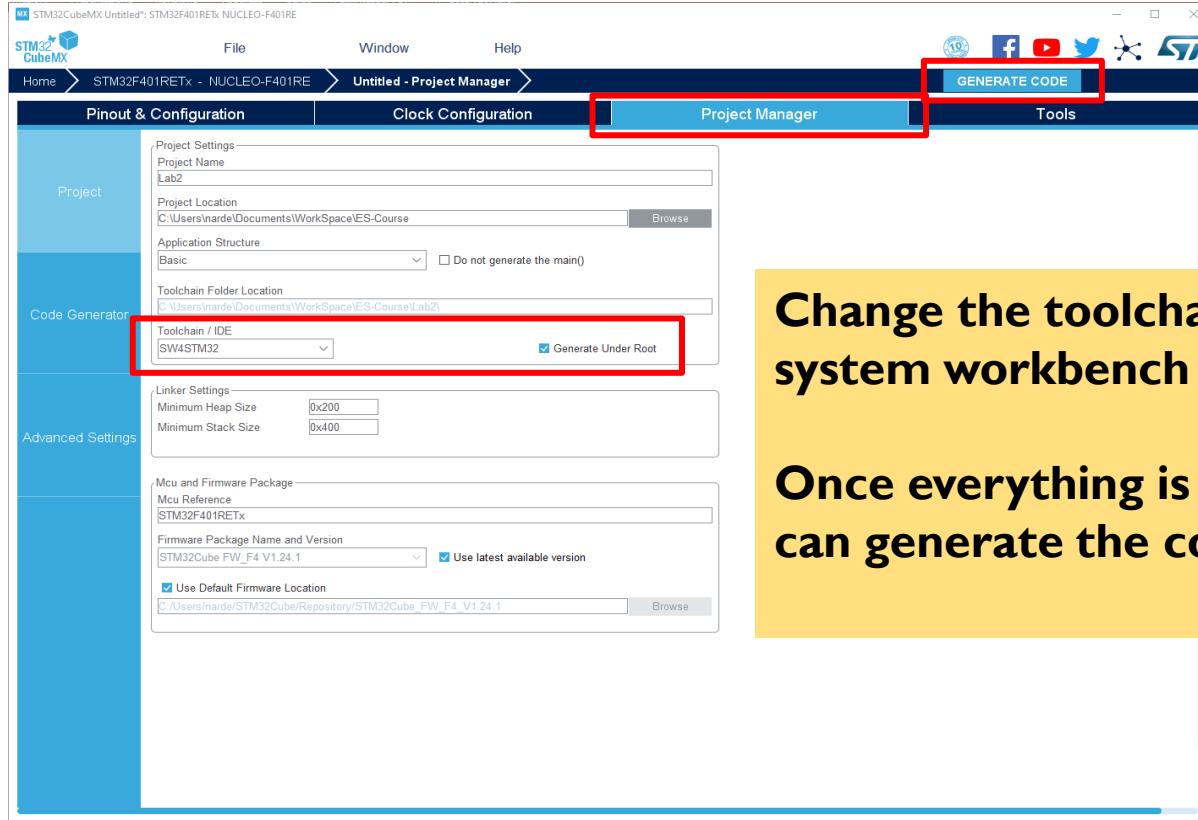
CLOCK  
SOURCE



# STM32 CUBEMX – CONFIGURING THE PERIPHERALS



# STM32 CUBEMX – SETTING THE TOOLCHAIN



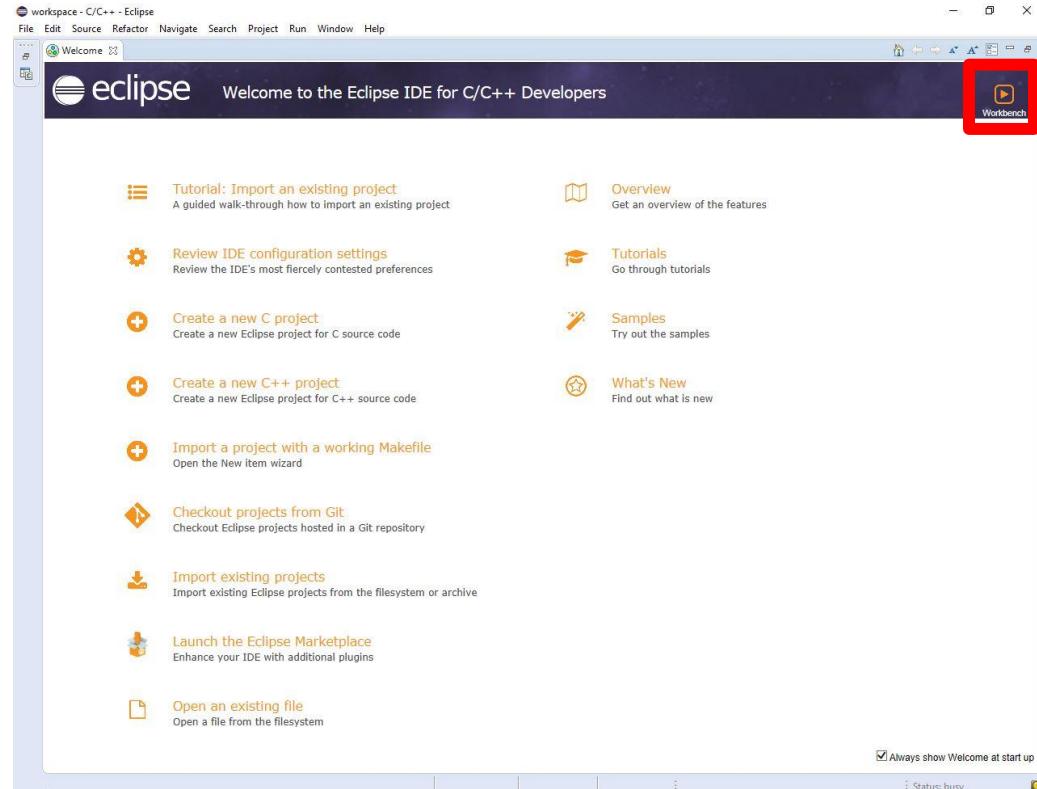
**Change the toolchain / IDE to system workbench**

**Once everything is configure, we can generate the code**



# SYSTEMWORKBENCH FOR STM32

# STM32 – SYSTEM WORKBENCH



# STM32 – SYSTEM WORKBENCH

The screenshot shows the Eclipse IDE interface with a red box highlighting the project structure on the left. The main workspace displays four files:

- main.c**: The main application file.
- stm32f4xx\_it.c**: The interrupt service routine.
- stm32f4xx\_hal\_msp.c**: HAL library initialization code.
- system\_stm32f4xx.c**: System low-level configuration code.

On the right, the Outline view lists the source files and their included headers. A yellow box highlights the following text from the **system\_stm32f4xx.c** file:

```
-> Main file  
-> Interrupt service routine  
-> HAL library initialization  
-> System low level config
```

**main.c** content (partial):

```
1 // ****  
2 // * FILE Name : main.c  
3 // * Description : Main program body  
4 // * *****  
5 // ** This notice applies to any and all portions of this file.  
6 // ** That are not between comment pairs USER CODE BEGIN and  
7 // ** USER CODE END. Other portions of this file, whether  
8 // ** generated or not, are the sole property of their respective copyright  
9 // ** owners and are controlled by their respective copyright  
10 // ** license. The use rights and restrictions contained in this  
11 // ** file are defined in the document "Software License Agreement"  
12 // ** which can be found in the root directory of this  
13 // ** distribution. By using this software you agree to the terms  
14 // ** contained in the Software License Agreement or other  
15 // ** legal agreement you entered into with its contributors.  
16 // ** Further information about our legal agreements can be  
17 // ** found at http://www.st.com/software_license_agreement_en.pdf  
18 // ****  
19 // * Expresses the intent of the copyright owner that this  
20 // * software will be made available to and freely used by others  
21 // * without restriction under the conditions specified in  
22 // * this license.  
23 // * The copyright owner makes no representations about the  
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26 // * this software, including all implied warranties of  
27 // * MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND  
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29 // * FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL  
30 // * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR  
31 // * SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER  
32 // * CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY,  
33 // * OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE  
34 // * OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.  
35 // ****  
36 // */  
37 //  
38 // * Includes .....  
39 #include "main.h"  
40 #include "stm32f4xx_hal.h"  
41  
42 // * USER CODE BEGIN Includes */  
43  
44 /* USER CODE END Includes */  
45  
46 // * Private variables .....  
47 TH_HandleTypeDef htim2;  
48
```

**stm32f4xx\_it.c** content (partial):

```
1 // ****  
2 // * FILE Name : stm32f4xx_it.c  
3 // * Description : Main program body  
4 // * *****  
5 // ** This notice applies to any and all portions of this file.  
6 // ** That are not between comment pairs USER CODE BEGIN and  
7 // ** USER CODE END. Other portions of this file, whether  
8 // ** generated or not, are the sole property of their respective copyright  
9 // ** owners and are controlled by their respective copyright  
10 // ** license. The use rights and restrictions contained in this  
11 // ** file are defined in the document "Software License Agreement"  
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13 // ** distribution. By using this software you agree to the terms  
14 // ** contained in the Software License Agreement or other  
15 // ** legal agreement you entered into with its contributors.  
16 // ** Further information about our legal agreements can be  
17 // ** found at http://www.st.com/software_license_agreement_en.pdf  
18 // ****  
19 // * Expresses the intent of the copyright owner that this  
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21 // * without restriction under the conditions specified in  
22 // * this license.  
23 // * The copyright owner makes no representations about the  
24 // * suitability of this software for any purpose. It is provided "AS IS".  
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26 // * this software, including all implied warranties of  
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29 // * FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL  
30 // * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR  
31 // * SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER  
32 // * CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY,  
33 // * OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE  
34 // * OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.  
35 // ****  
36 // */  
37 //  
38 // * Includes .....  
39 #include "main.h"  
40 #include "stm32f4xx_hal.h"  
41  
42 // * USER CODE BEGIN Includes */  
43  
44 /* USER CODE END Includes */  
45  
46 // * Private variables .....  
47 TH_HandleTypeDef htim2;
```

**stm32f4xx\_hal\_msp.c** content (partial):

```
1 // ****  
2 // * FILE Name : stm32f4xx_hal_msp.c  
3 // * Description : HAL library initialization  
4 // * *****  
5 // ** This notice applies to any and all portions of this file.  
6 // ** That are not between comment pairs USER CODE BEGIN and  
7 // ** USER CODE END. Other portions of this file, whether  
8 // ** generated or not, are the sole property of their respective copyright  
9 // ** owners and are controlled by their respective copyright  
10 // ** license. The use rights and restrictions contained in this  
11 // ** file are defined in the document "Software License Agreement"  
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15 // ** legal agreement you entered into with its contributors.  
16 // ** Further information about our legal agreements can be  
17 // ** found at http://www.st.com/software_license_agreement_en.pdf  
18 // ****  
19 // * Expresses the intent of the copyright owner that this  
20 // * software will be made available to and freely used by others  
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23 // * The copyright owner makes no representations about the  
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29 // * FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL  
30 // * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR  
31 // * SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER  
32 // * CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY,  
33 // * OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE  
34 // * OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.  
35 // ****  
36 // */  
37 //  
38 // * Includes .....  
39 #include "main.h"  
40 #include "stm32f4xx_hal.h"  
41  
42 // * USER CODE BEGIN Includes */  
43  
44 /* USER CODE END Includes */  
45  
46 // * Private variables .....  
47 TH_HandleTypeDef htim2;
```

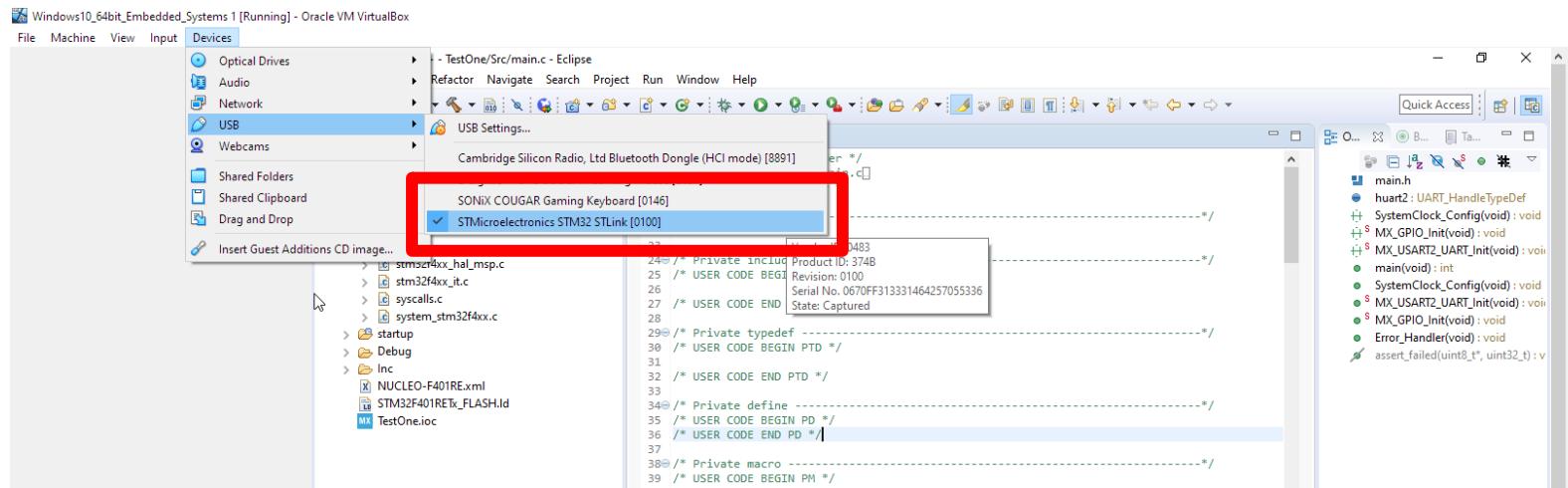
**system\_stm32f4xx.c** content (partial):

```
1 // ****  
2 // * FILE Name : system_stm32f4xx.c  
3 // * Description : System low level configuration  
4 // * *****  
5 // ** This notice applies to any and all portions of this file.  
6 // ** That are not between comment pairs USER CODE BEGIN and  
7 // ** USER CODE END. Other portions of this file, whether  
8 // ** generated or not, are the sole property of their respective copyright  
9 // ** owners and are controlled by their respective copyright  
10 // ** license. The use rights and restrictions contained in this  
11 // ** file are defined in the document "Software License Agreement"  
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15 // ** legal agreement you entered into with its contributors.  
16 // ** Further information about our legal agreements can be  
17 // ** found at http://www.st.com/software_license_agreement_en.pdf  
18 // ****  
19 // * Expresses the intent of the copyright owner that this  
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22 // * this license.  
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30 // * DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR  
31 // * SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER  
32 // * CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY,  
33 // * OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE  
34 // * OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.  
35 // ****  
36 // */  
37 //  
38 // * Includes .....  
39 #include "main.h"  
40 #include "stm32f4xx_hal.h"  
41  
42 // * USER CODE BEGIN Includes */  
43  
44 /* USER CODE END Includes */  
45  
46 // * Private variables .....  
47 TH_HandleTypeDef htim2;
```

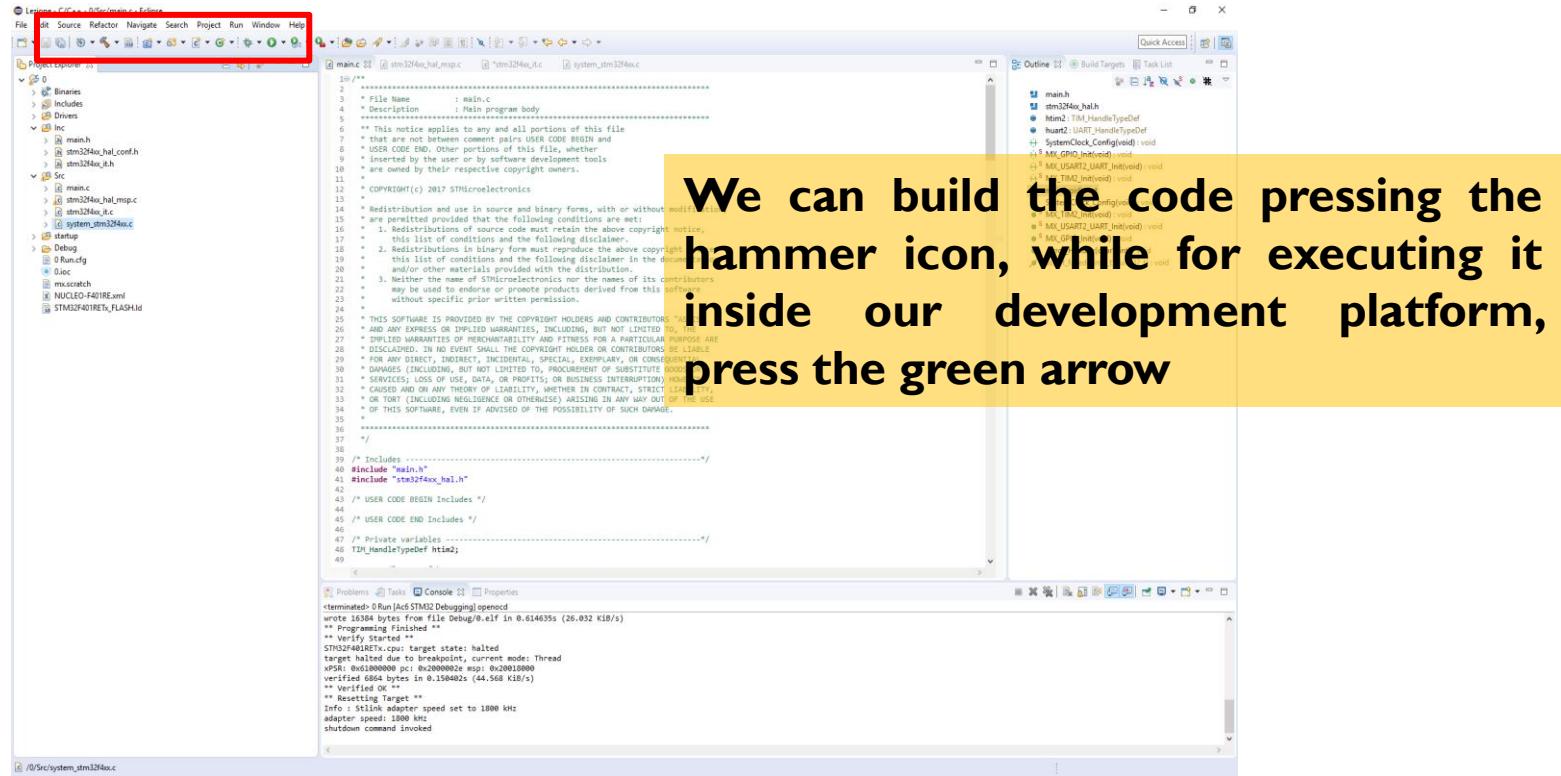
Bottom status bar: /O/Src/system\_stm32f4xx.c

# STM32 – SYSTEM WORKBENCH

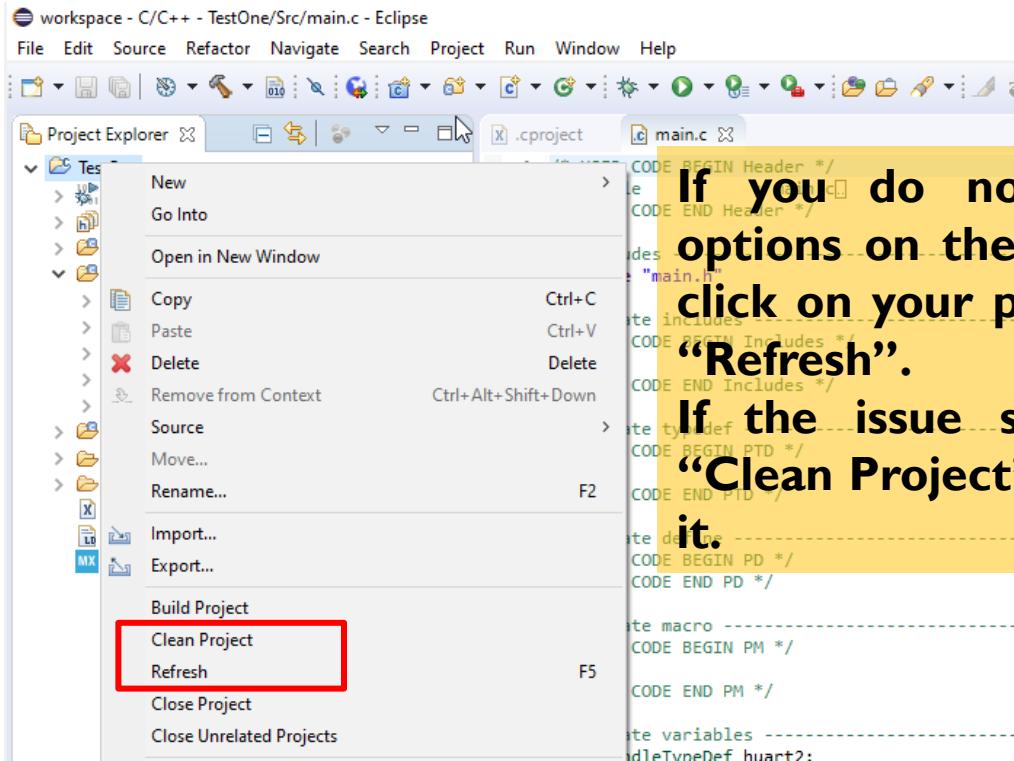
If you are using a virtual machine, before building and compiling, be sure to have enabled the STM board as a USB Device



# STM32 – SYSTEM WORKBENCH



# STM32 – SYSTEM WORKBENCH



If you do not have any available options on the “Run as” menu, right click on your project folder and try a “Refresh”.

If the issue still appears, try with “Clean Project”, rebuild it and refresh it.

## ADDITIONAL MATERIAL

- **MCU Datasheet**

<http://www.st.com/content/ccc/resource/technical/document/datasheet/30/91/86/2d/db/94/4a/d6/DM00102166.pdf/files/DM00102166.pdf/jcr:content/translations/en.DM00102166.pdf>

- **STM32 Nucleo-64 User manual**

[http://www.st.com/content/ccc/resource/technical/document/user\\_manual/98/2e/fa/4b/e0/82/43/b7/DM00105823.pdf/files/DM00105823.pdf/jcr:content/translations/en.DM00105823.pdf](http://www.st.com/content/ccc/resource/technical/document/user_manual/98/2e/fa/4b/e0/82/43/b7/DM00105823.pdf/files/DM00105823.pdf/jcr:content/translations/en.DM00105823.pdf)