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School of Information Technologies

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Home Assistant OS on VirtualBox with Zigbee2MQTT: A Step-by-Step Practical Guide

Practical Guide

Tallinn 2025

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Infotehnoloogia teaduskond

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**Home Assistant OS VirtualBoxis koos
Zigbee2MQTT-ga: Samm-sammuline praktiline
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Praktiline juhend

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1 Introduction

This practical guide has been developed as a supplement to the master's thesis titled “A Practical Comparison of Wi-Fi-Based Tasmota Devices and Matter Solutions in Home Assistant.” Its main goal is to provide a step-by-step guide for installing and configuring the Home Assistant OS environment on a Windows-based system using a virtual machine, as well as integrating Zigbee-based devices using the Sonoff Zigbee 3.0 USB Dongle Plus.

In addition to supporting the core theme of the thesis, this guide is also intended for educational use. It can be used during classroom lessons and laboratory sessions, where students can gain hands-on experience with smart home technologies using Home Assistant.

The guide covers the following key stages:

- Installation of the VirtualBox virtual machine on Windows.
- Deployment of Home Assistant OS inside a Linux-based virtual machine.
- Connection and configuration of the Zigbee dongle, including driver installation and USB passthrough to the VM.
- Setup of essential Home Assistant add-ons, including Mosquitto Broker and Zigbee2MQTT.
- Adding and managing Zigbee devices through the Home Assistant interface.

The guide is written in a clear and visual format with step-by-step instructions and screenshots, making it suitable for both beginners and educators working with smart home.

2 VirtualBox

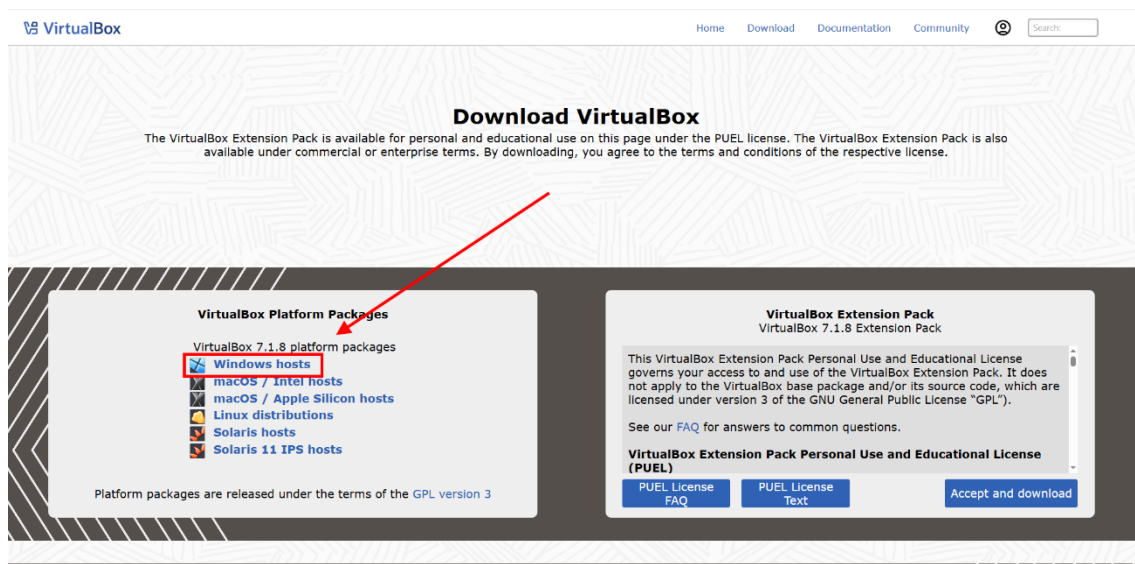
To begin setting up Home Assistant OS in a virtual environment, the first essential step is downloading VirtualBox — the software that will host your virtual machine.

2.1 Downloading VirtualBox

Start by navigating to the official VirtualBox download page for Windows: <https://www.virtualbox.org/wiki/Downloads>

Once on the page, scroll down to the “VirtualBox Platform Packages” section. Here, you’ll find several installation options depending on your operating system. Since we are working on a Windows-based setup, click on the link labelled Windows hosts to download the installer.

This package contains everything needed to install VirtualBox on a Windows machine and is required for launching the Home Assistant OS virtual machine later.



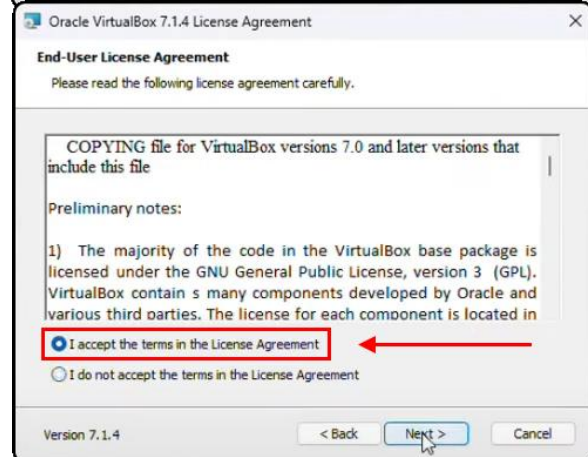
2.2 Installing VirtualBox

Once you have downloaded the VirtualBox installer from the official website, the next step is to install it properly on your Windows machine. The following steps will guide you through the installation process with explanations for each step:

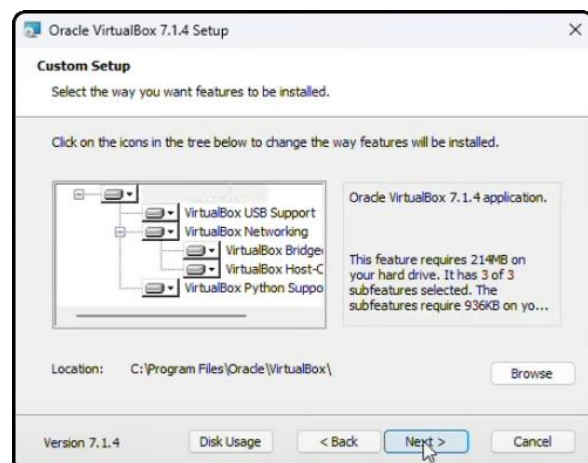
- Run the installer.
- The VirtualBox Setup Wizard welcome screen will appear.
- Click **Next** to continue.



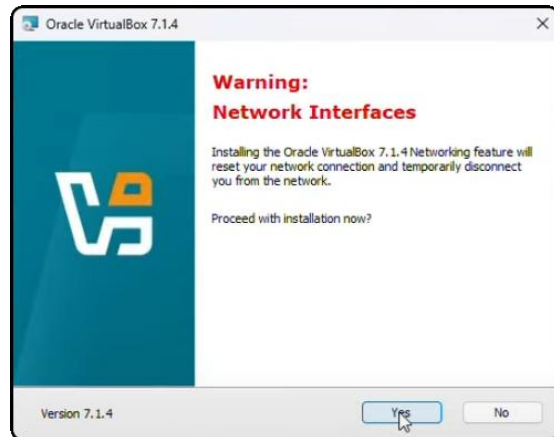
- Review the license terms.
- Check the option I accept the terms in the License Agreement.
- Click **Next**.



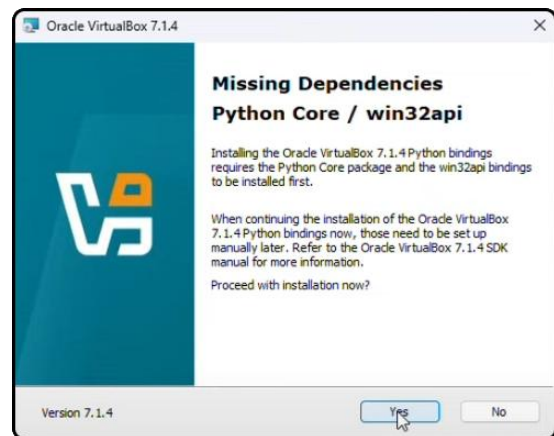
- You can leave all default options enabled (USB support, networking, Python, etc.).
- Click **Next**.



- A warning will appear that VirtualBox will temporarily disconnect network interfaces.
- Confirm by clicking **Yes**.



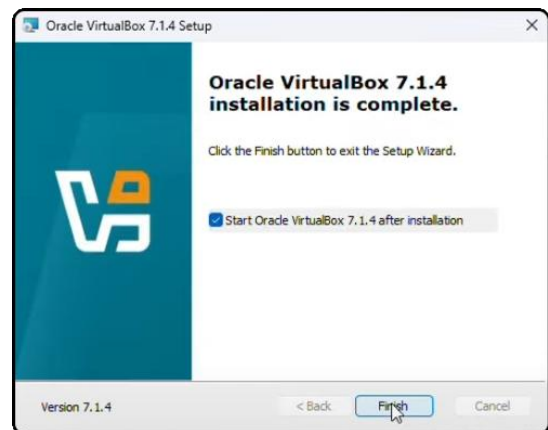
- A warning may appear about missing Python dependencies.
- Click **Yes** to continue the installation.



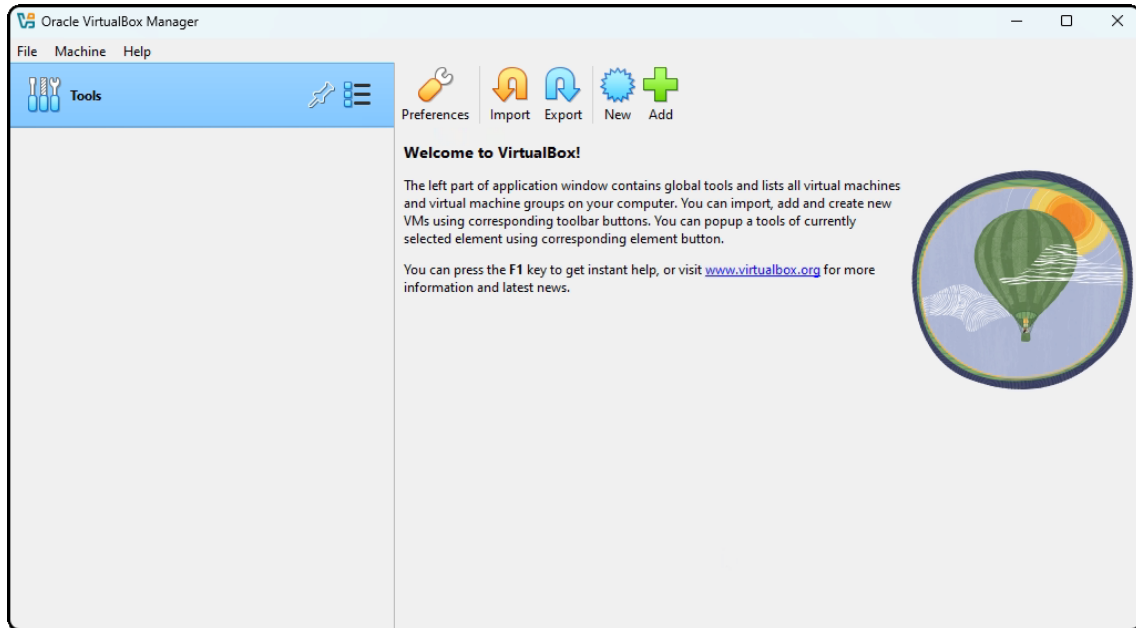
- Choose whether to create desktop/start menu shortcuts. Default options are usually fine.
- Click **Next**.



- Click **Finish** and wait for the installation process to complete.



After installation, VirtualBox will launch automatically and show the VirtualBox Manager window. This interface allows you to create and manage your virtual machines.



3 Home Assistant

Home Assistant OS is a free and open-source operating system designed specifically for running the Home Assistant home automation platform. It provides an all-in-one solution that allows users to integrate, control, and automate smart home devices locally — with full privacy and flexibility.

This section explains how to download the correct virtual disk image of Home Assistant OS that will later be used to run it inside VirtualBox on a Windows machine.

3.1 Downloading Home Assistant OS

To get started, visit the official Home Assistant OS installation page for Windows: <https://www.home-assistant.io/installation/windows>

Once on the page, scroll down to the “Download the appropriate image” section. Here, locates the option for VirtualBox (Intel chip) and click the link to download the .vdi image file. This file is a ready-to-use virtual disk containing the full Home Assistant OS environment.

Home Assistant 2025.3

Getting started Documentation Integrations Blog Need help?

Home • Installation •

Windows

Install Home Assistant Operating System

DOWNLOAD THE APPROPRIATE IMAGE

- [VirtualBox \(Intel chip\) \(vdi\)](#)
- [VMware Workstation \(vmdk\)](#)
- [Hyper-V \(vhdx\)](#)

After downloading, decompress the image. If the image comes in a ZIP file, for example, unzip it.

Follow this guide if you already are running a supported virtual machine hypervisor. If you are not familiar with virtual machines, install Home Assistant OS directly on a [Home Assistant Yellow](#), a [Raspberry Pi](#), or an [ODROID](#).

CREATE THE VIRTUAL MACHINE

Load the appliance image into your virtual machine hypervisor. (Note: You are free to assign as much resources as you wish to the VM, please assign enough based on your add-on needs).

Minimum recommended assignments:

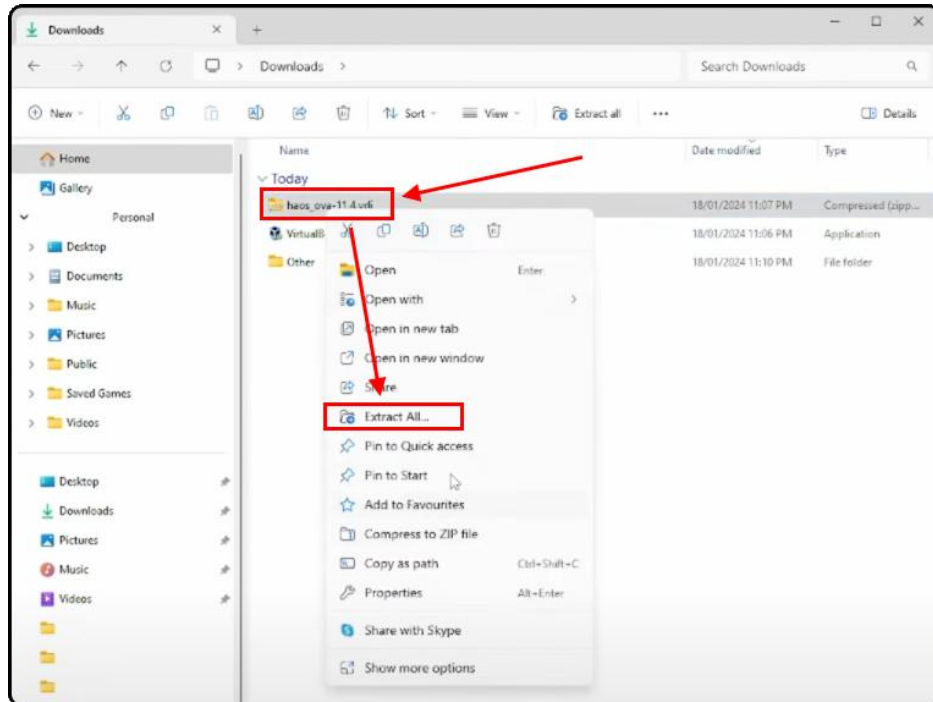
- 2 GB RAM
- 32 GB Storage

ON THIS PAGE

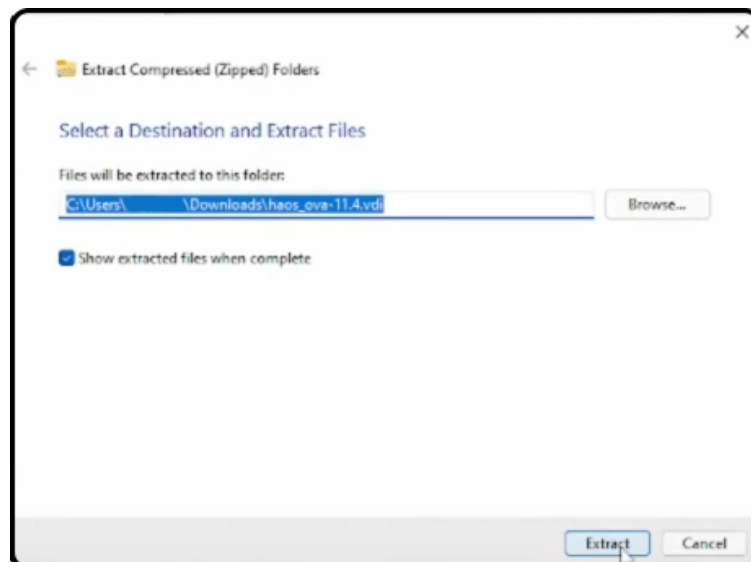
- Install Home Assistant Operating System
- Download the appropriate image
- Create the virtual machine
- Hypervisor specific configuration
- Edit the VM settings
- Start up your virtual machine

After downloading the VirtualBox (.vdi) image, it may come in a compressed ZIP archive.

- Open the folder where the file was saved (usually the Downloads folder).
- Locate the archive file, for example: haos_ova-11.4.vdi.zip.
- Right-click on the archive and select **Extract All...**



- Choose a destination folder or leave the default path, then click Extract

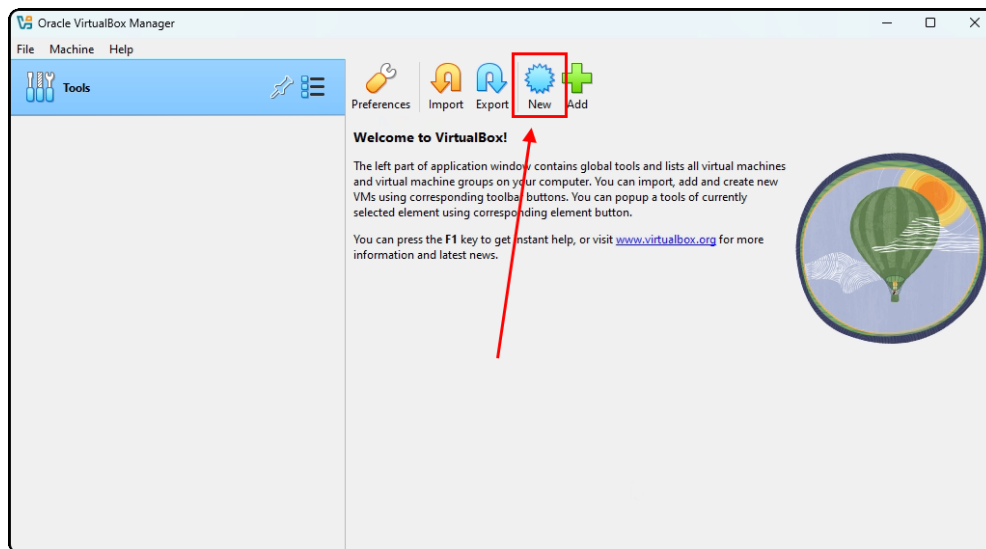


Once extraction is complete, you will get a file with the .vdi extension — this is the virtual disk for Home Assistant OS that will be used in VirtualBox.

3.2 Installing Home Assistant OS

To run Home Assistant in a virtual environment, we first need to create and configure a dedicated virtual machine using VirtualBox. This machine will act as a container for the Home Assistant Operating System, using the disk image we downloaded earlier.

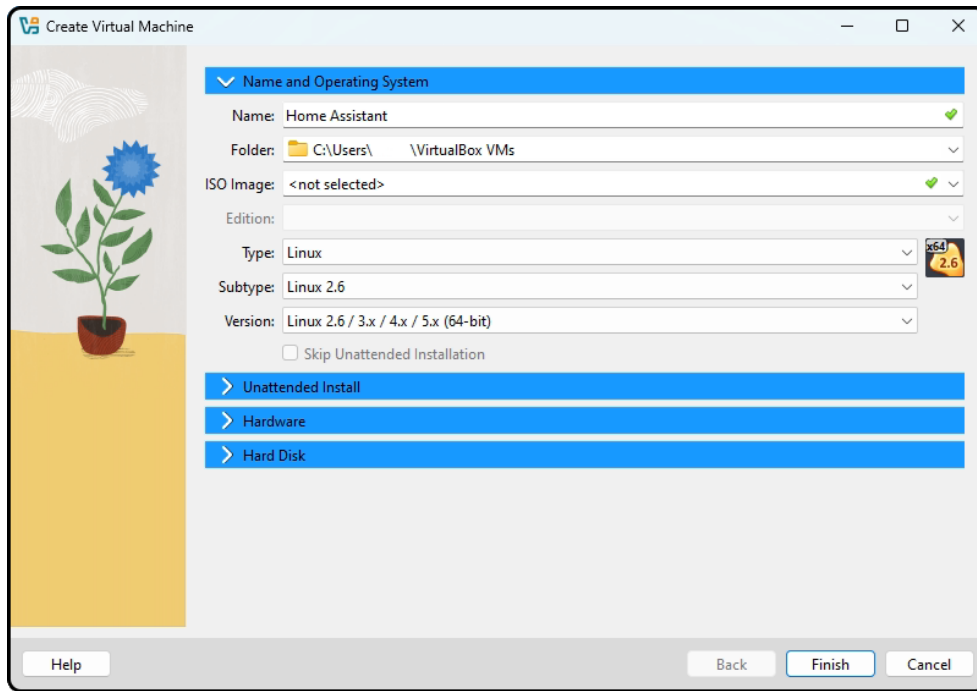
Start by opening VirtualBox. In the main window, click the New button to begin creating a new virtual machine.



In the Name and Operating System tab, configure as follows:

- **Name:** for example, Home Assistant
- **Folder:** leave it as default
- **ISO Image:** leave empty
- **Edition:** leave unchanged
- **Type:** Linux
- **Subtype:** Linux 2.6
- **Version:** Linux 2.6 / 3.x / 4.x / 5.x (64-bit)

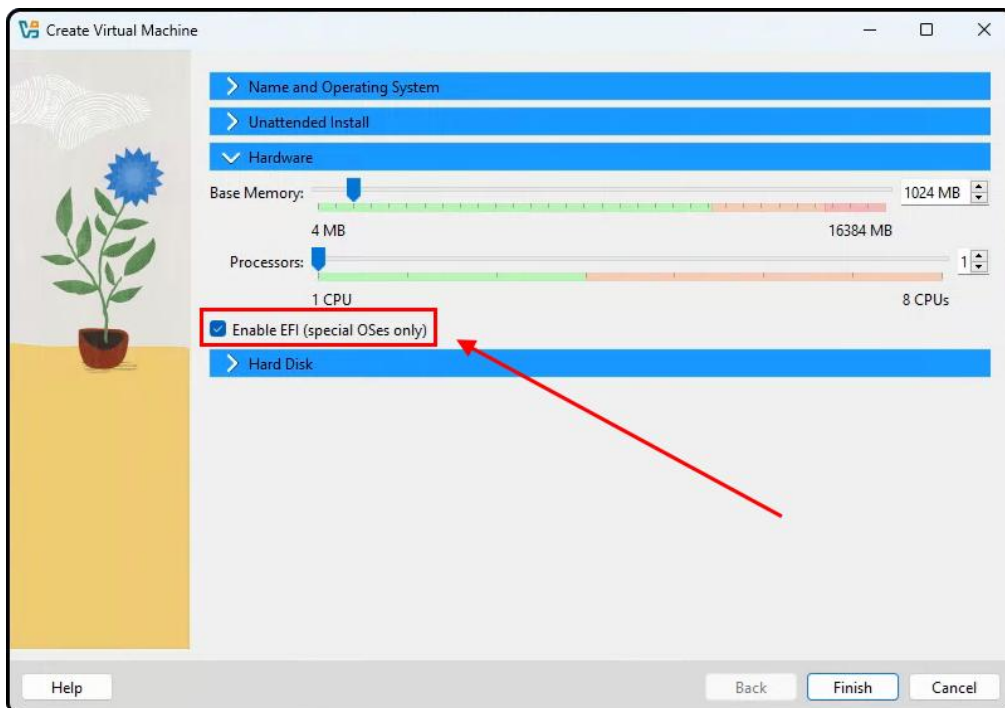
These settings ensure that the virtual environment is compatible with the Home Assistant OS.



Next, open the Hardware tab. Here we allocate system resources for the virtual machine:

- Assign at least 2048 MB of memory (ideally 4096 MB for better performance)
- Assign at least 1 CPU (2 CPUs recommended for smoother operation)
- Be sure to enable the EFI option: “Enable EFI (special OSes only)”

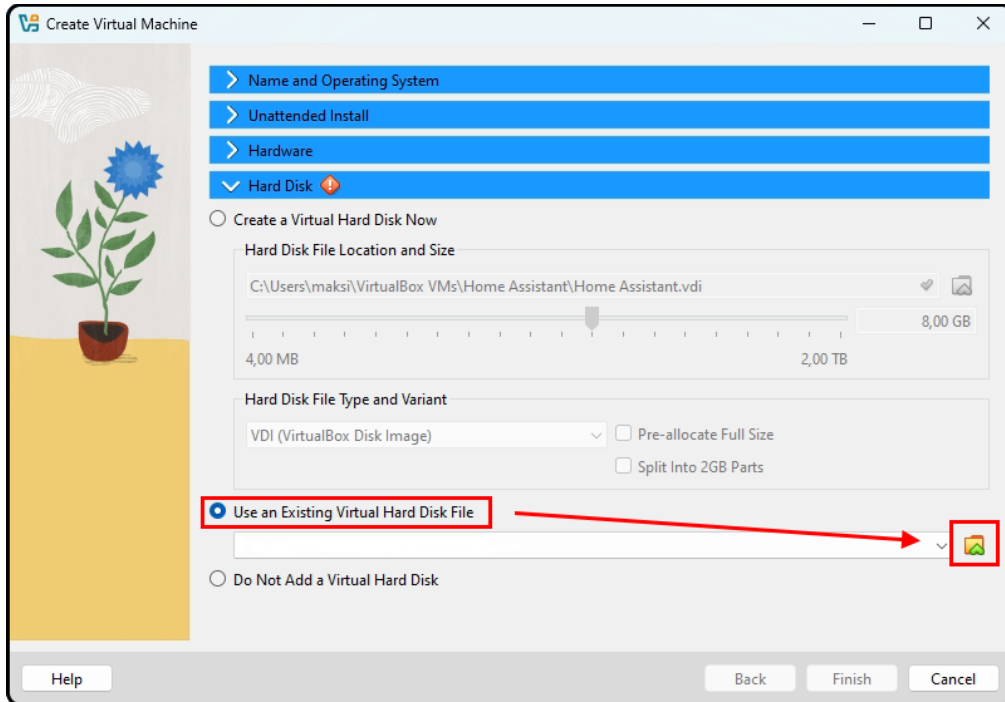
This ensures compatibility with the Home Assistant disk image.



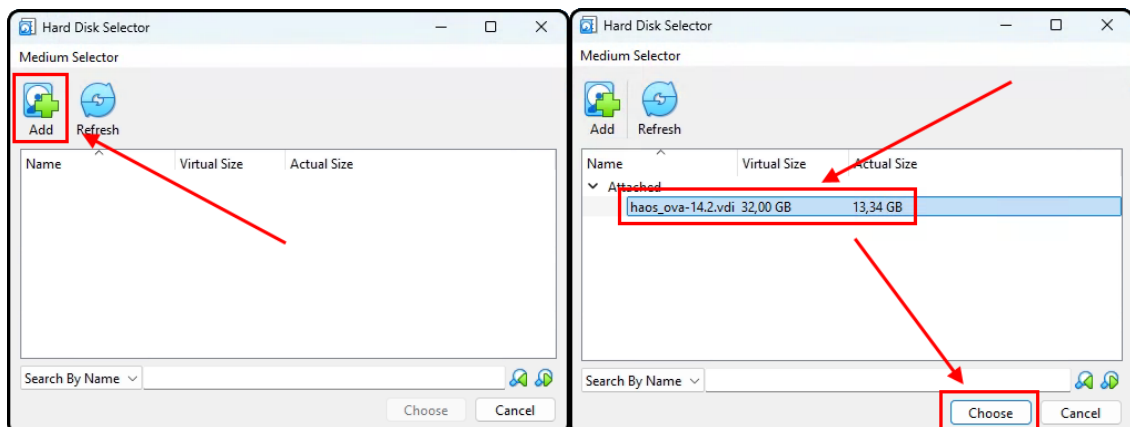
Now go to the Hard Disk section. Since we already downloaded the virtual disk file, choose:

- Use an existing virtual hard disk file

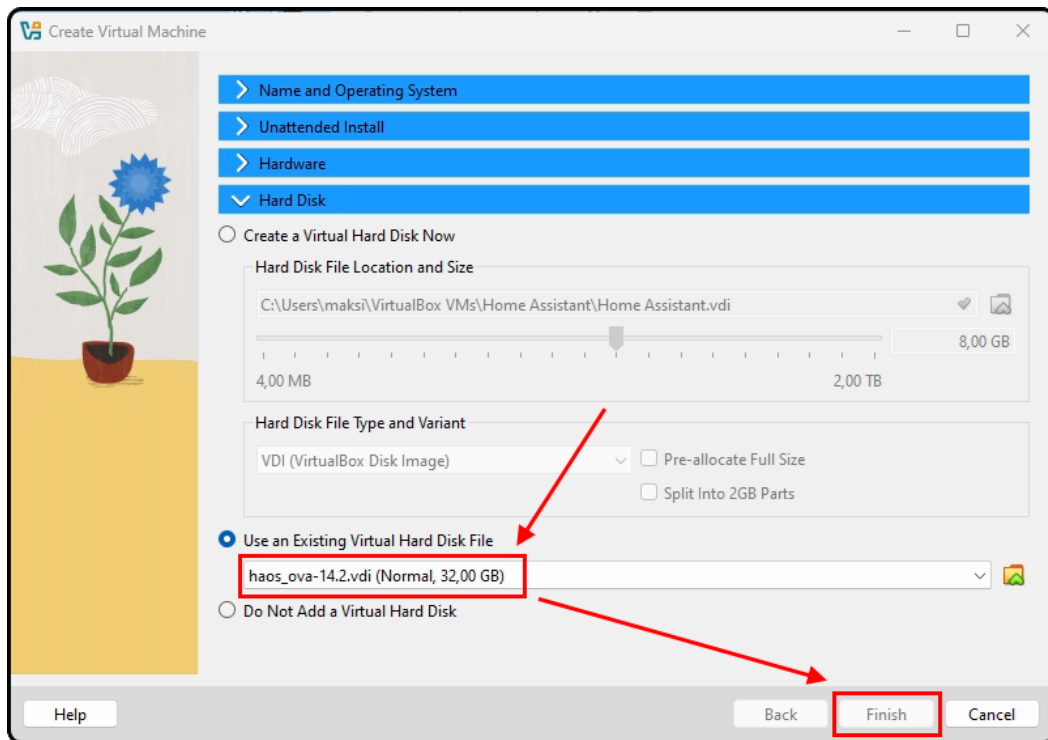
Click the folder icon on the right to open the disk file selection window.



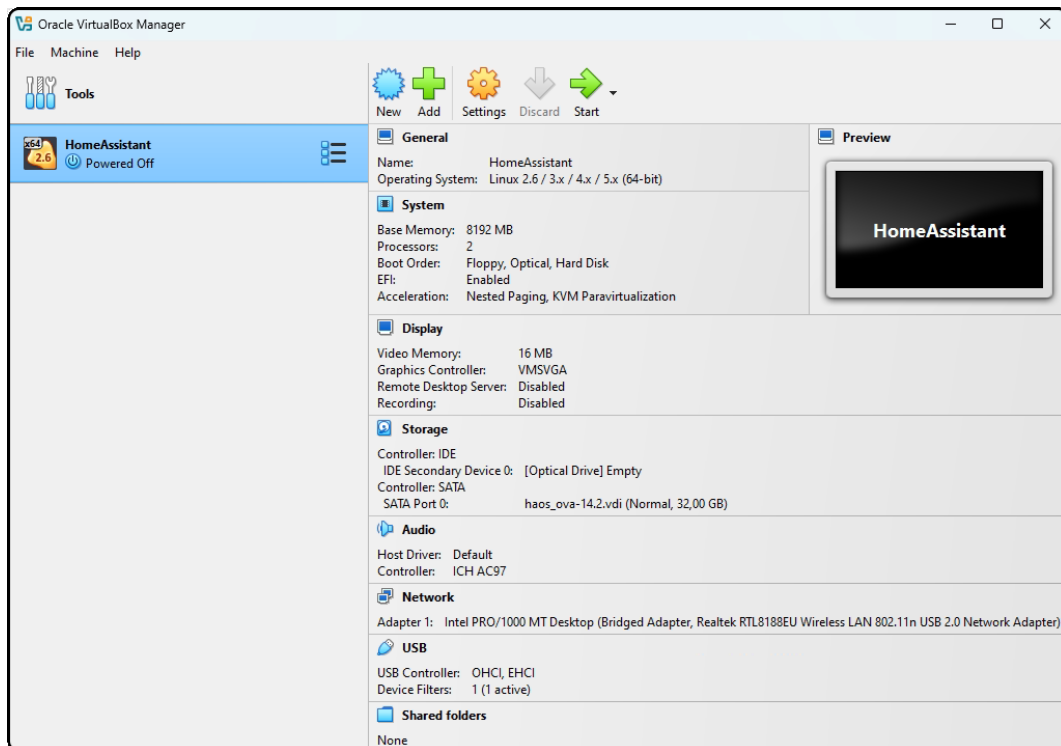
In the disk selection window, click Add, navigate to the folder where your .vdi file is located (for example: haos_ova-14.2.vdi), select it, and press **Choose**.



Make sure that the correct disk file is selected. Then click Finish to complete the creation of the virtual machine.

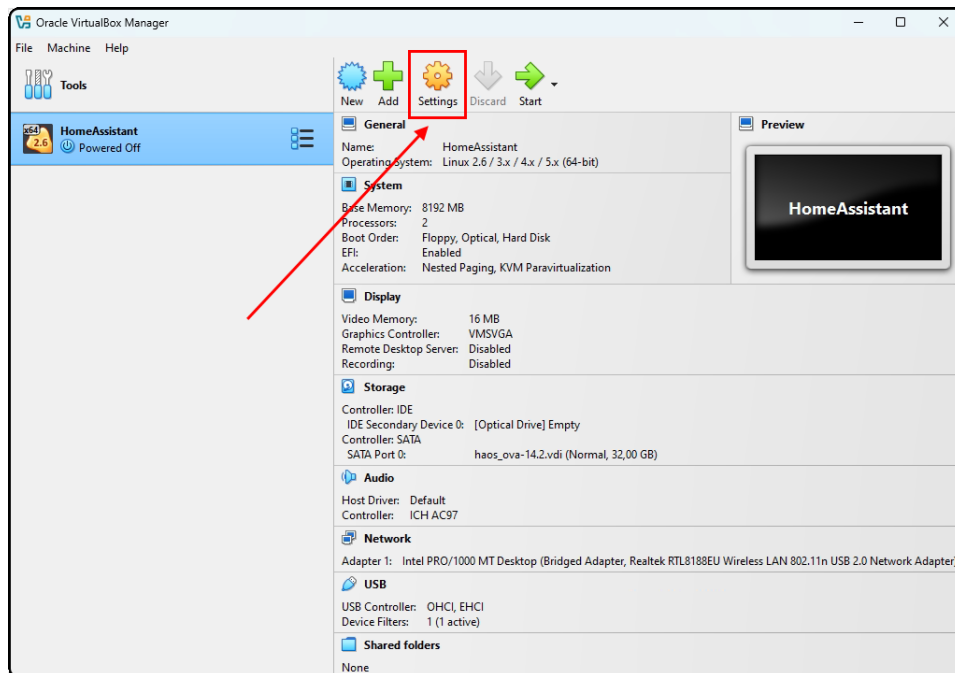


You will now see the new virtual machine listed in the VirtualBox main window.



In order for Home Assistant OS to communicate with devices on your local network — and potentially access the internet — we need to ensure that the virtual machine is properly connected to the host's network interface. The best way to do this is by using Bridged Adapter mode in VirtualBox.

To begin, click the **Settings** icon in the top toolbar to open the configuration panel.

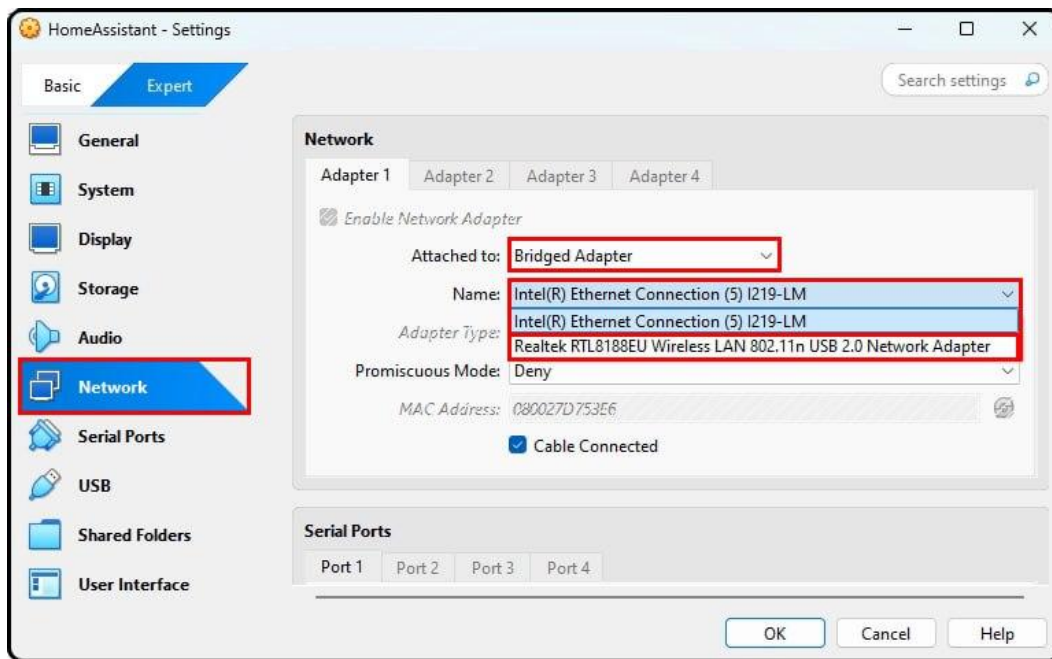


From the menu on the left, navigate to the **Network** section. Here, under the tab labeled Adapter 1, make sure the Enable Network Adapter box is checked. In the Attached to dropdown, select: Bridged Adapter

This mode allows the virtual machine to behave as if it were a separate physical device on the same local network as your host machine — making it easier to discover and control smart devices. Take your time to ensure the correct interface is selected, as this determines whether Home Assistant OS will be able to reach the network.

In the **Name** dropdown, you need to select the actual network interface your host system is using.

- If you are connected via Ethernet (cable), choose a name that includes Ethernet, LAN, or similar.
- If you are using Wi-Fi, choose an adapter name containing Wireless, Wi-Fi, or WLAN.



Once the correct network interface is selected:

- Click **OK** to save the changes.

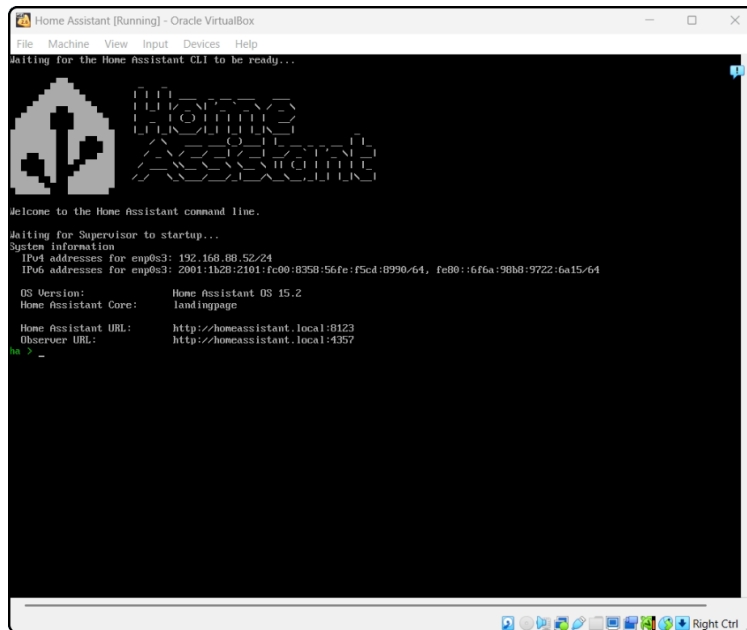
At this point, your Home Assistant OS virtual machine is fully configured network settings are in place — and is now ready for launch.

In the next section, we will power on the virtual machine and walk through the first-time setup of Home Assistant OS.

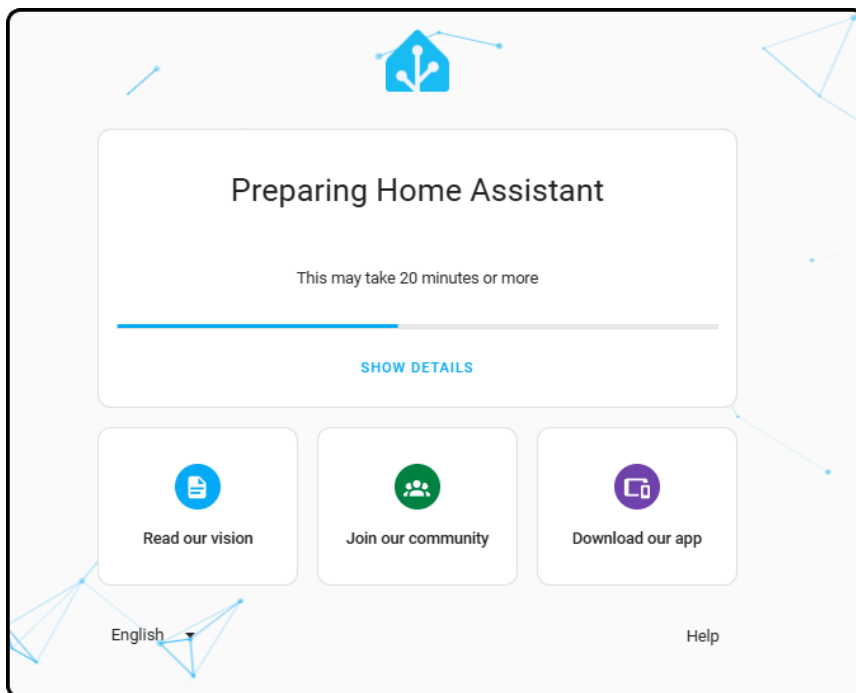
3.3 Setting up Home Assistant

Once we've created and launched the virtual machine, it's time to perform the initial configuration of Home Assistant. This phase prepares the environment and allows us to set up a new smart home instance from scratch.

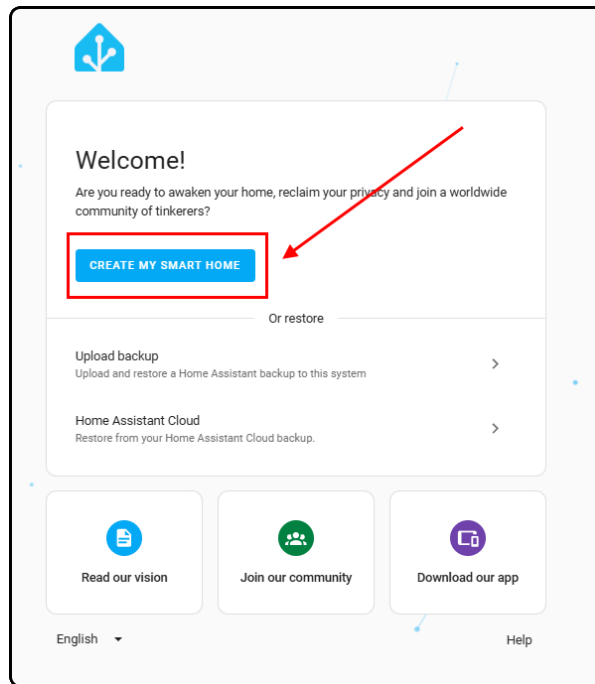
After you launch the virtual machine in VirtualBox, a terminal-style console window will appear. You'll see the Home Assistant logo displayed along with some startup messages. Wait for the system to finish booting — this can take a few moments. When it's ready, the console will show an IP address and a local URL you can use to access the Home Assistant interface, such as: `http://homeassistant.local:8123`



Next, open your browser and go to the URL provided: <http://homeassistant.local:8123>. You'll see a loading screen that says "Preparing Home Assistant". This means the system is finalizing its background setup. Depending on your machine, this may take 5-20 minutes.



Once the preparation is complete, you'll be presented with the welcome screen. To begin with a fresh installation, click on **Create My Smart Home**. Alternatively, if you already have a backup of a previous setup, you can restore it from [here](#).

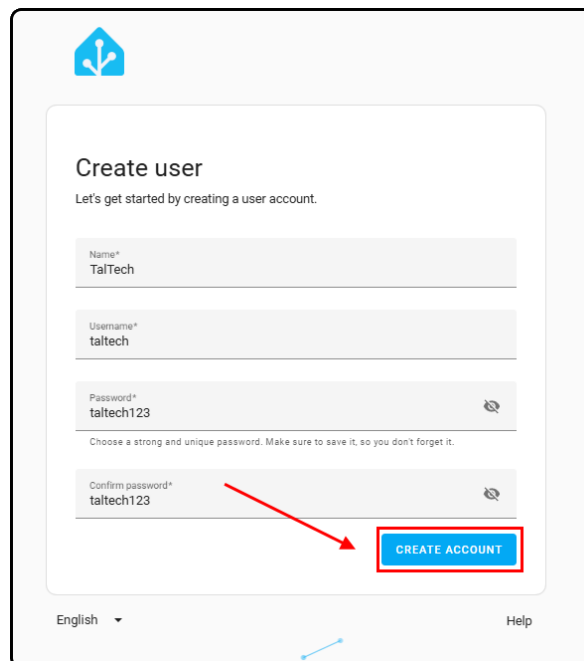


In the next step, you'll need to create your administrator account — this account gives you full control over your Home Assistant system.

Enter the following details:

- Name: e.g. TalTech
- Username: taltech
- Password: taltech123

Then click **Create Account**.

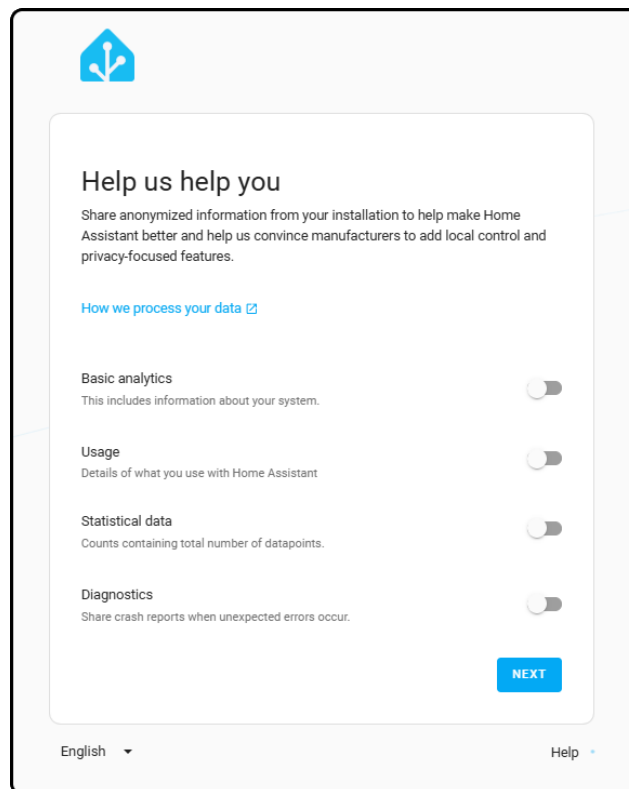


You'll now see the "Help us help you" screen. Here, Home Assistant asks whether you'd like to share anonymous statistics to help improve the project.

You can review and enable/disable the following options:

- Basic analytics – info about your system
- Usage – details of how you use Home Assistant
- Statistical data – count of devices, sensors, etc.
- Diagnostics – automatic error/crash reports

You may leave all options disabled or enable the ones you're comfortable with. Click **Next** to proceed.

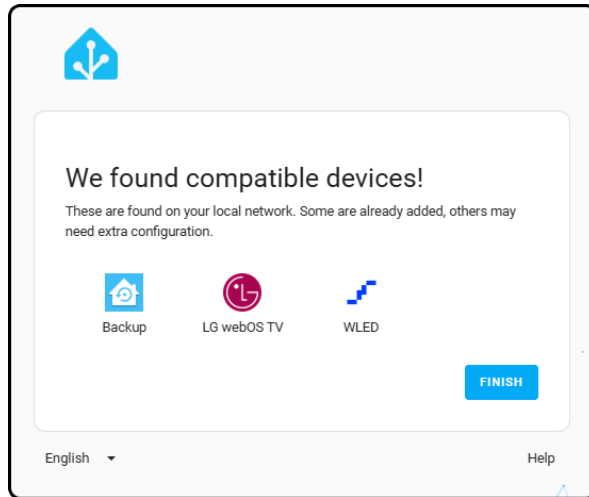


Now Home Assistant will automatically scan your local network for compatible devices that can be integrated immediately.

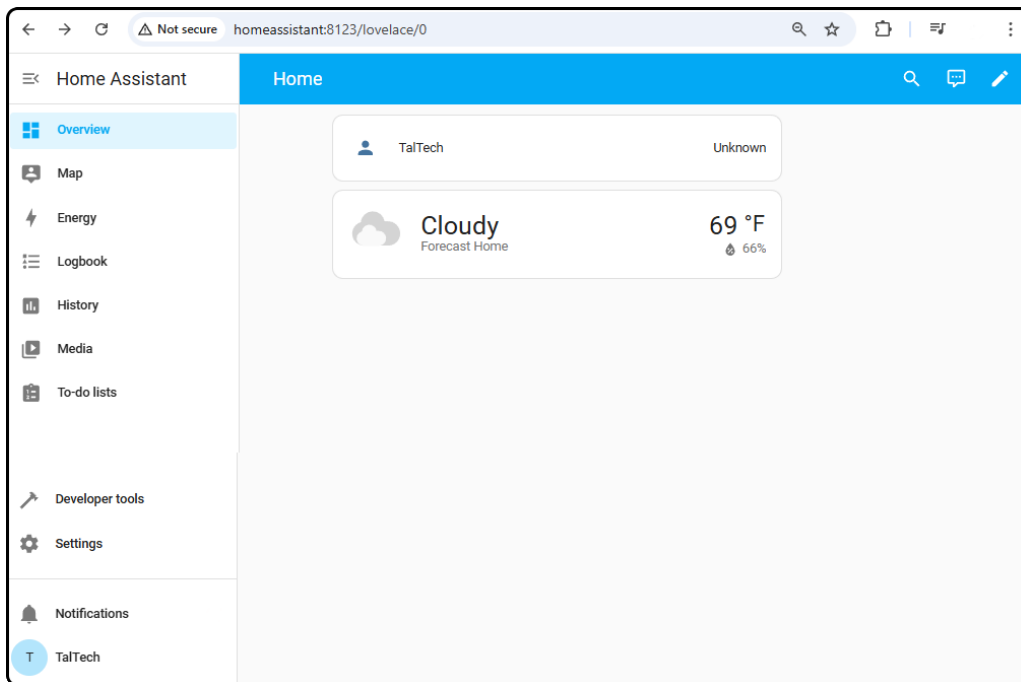
You might see devices such as:

- LG webOS TV
- WLED (smart lighting controllers)
- Backup (previous Home Assistant instances available for restoration)

Click **Finish** to complete the setup.



After setup, the main interface (dashboard) will load. Here you can add integrations, add and manage devices, configure integrations, create automations and scenes, and monitor sensor data.



4 Sonoff Zigbee 3.0 USB Dongle Plus

To enable communication with Zigbee devices in Home Assistant, we need to connect and properly configure a Zigbee dongle. In this manual, we use the Sonoff Zigbee 3.0 USB Dongle Plus as a universal and widely supported solution.

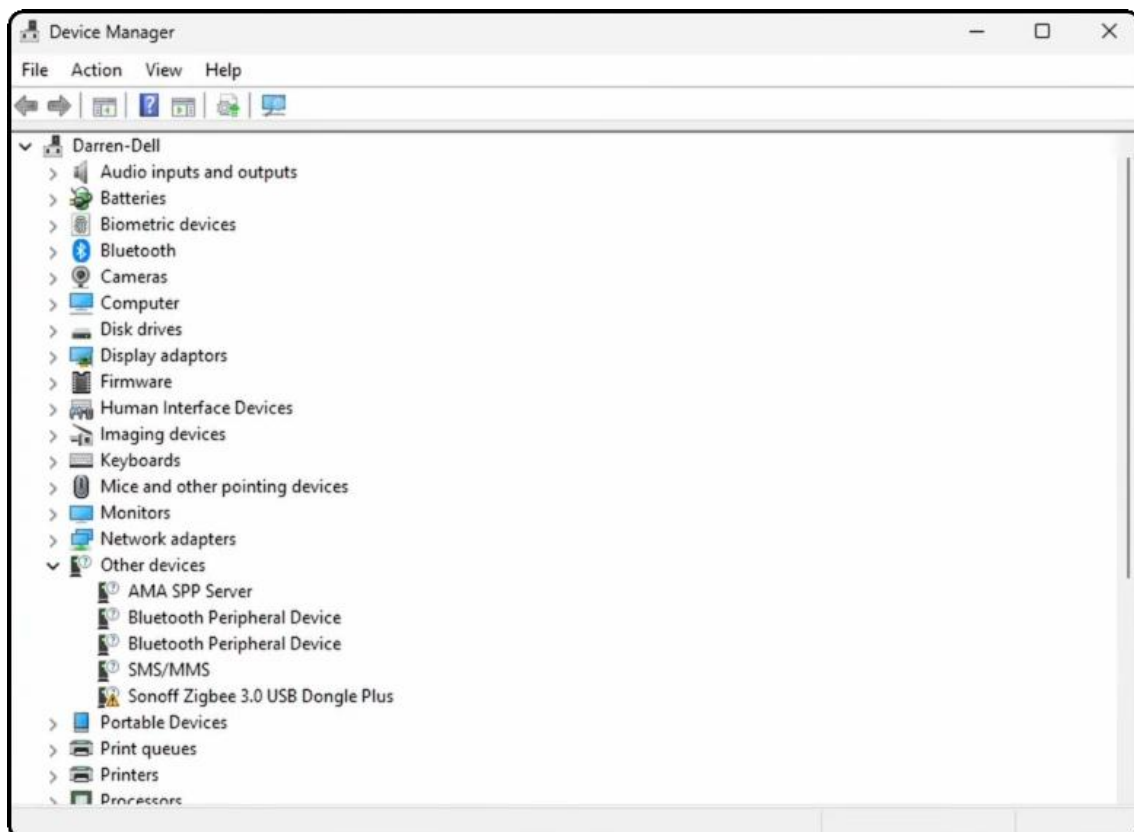
The setup consists of two main parts:

- Installing drivers on the host system (Windows)
- Passing the device through to the virtual machine in VirtualBox

Plug the Zigbee dongle into a USB port on the computer or server where the Home Assistant OS virtual machine is running. Open Device Manager. Under the Other Devices section, you will see a device named something like Sonoff Zigbee 3.0 USB Dongle Plus.

4.1 Updating Zigbee Dongle drivers

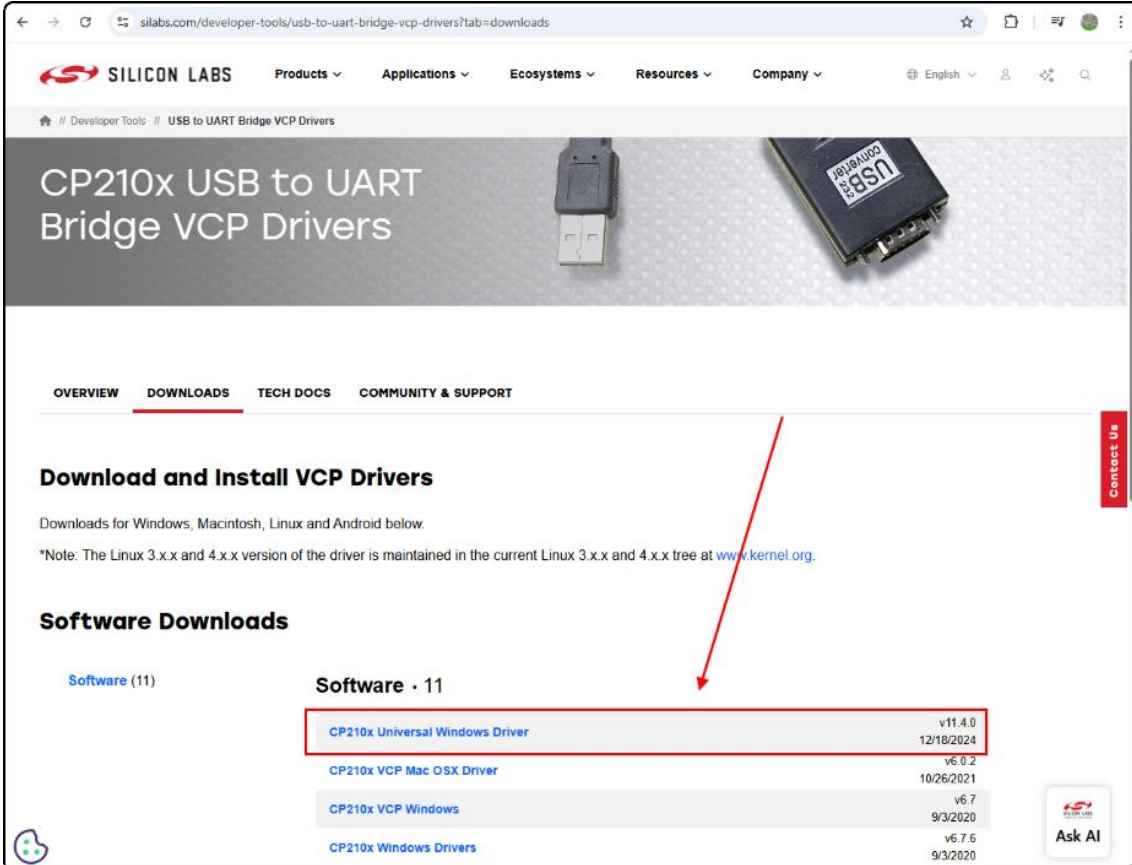
A yellow warning triangle may appear on the dongle icon — this indicates that the driver is not installed.



To proceed, we need to download the official USB-to-UART driver package provided by Silicon Labs.

- Open your browser and go to: <https://www.silabs.com/developer-tools/usb-to-uart-bridge-vcp-drivers>
- Scroll down to the section labeled Software Downloads.
- From the list, download the version titled: CP210x Universal Windows Driver

This will come as a ZIP file. Once it finishes downloading, extract its contents to a location you can easily find again — for example, a folder on your Desktop called ZigbeeDriver.

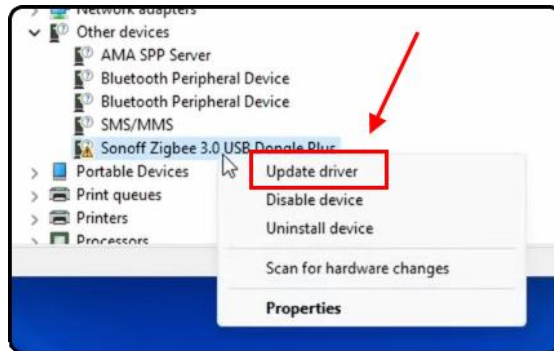


The screenshot shows the Silicon Labs website page for 'USB to UART Bridge VCP Drivers'. The page has a navigation menu with 'Downloads' selected. Below the navigation, there is a section titled 'Download and Install VCP Drivers' with a sub-section 'Software Downloads'. A table lists software downloads, with the first entry, 'CP210x Universal Windows Driver', highlighted by a red box. A red arrow points from above to this entry.

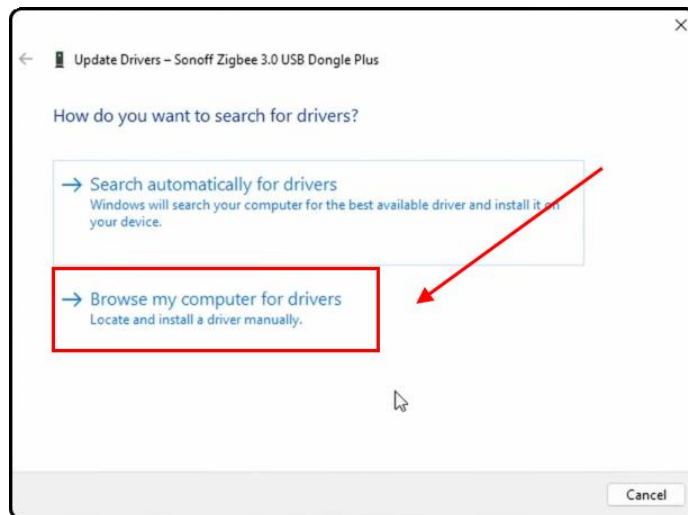
Software	Version	Release Date
CP210x Universal Windows Driver	v11.4.0	12/18/2024
CP210x VCP Mac OSX Driver	v6.0.2	10/26/2021
CP210x VCP Windows	v6.7	9/3/2020
CP210x Windows Drivers	v6.7.6	9/3/2020

Now that we have the correct driver files, we need to tell Windows where to find them.

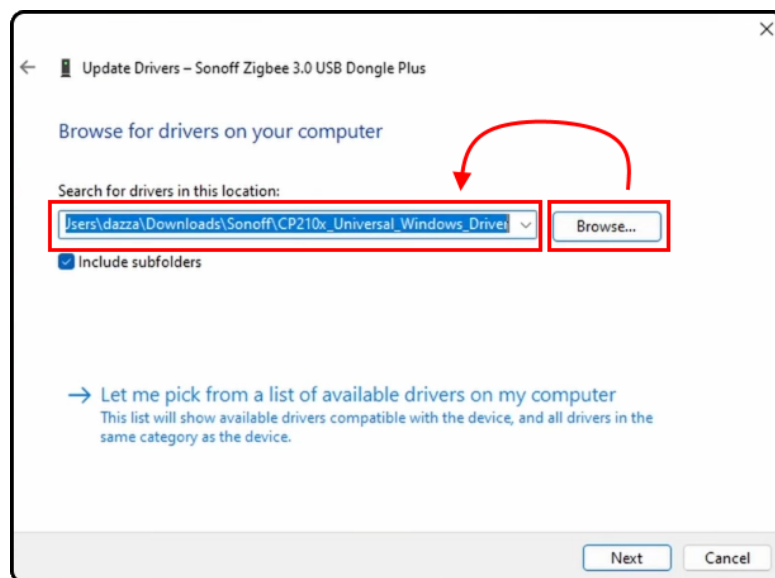
- Return to Device Manager.
- Right-click on the dongle's entry and choose **Update driver**.



- In the window that appears, click **Browse my computer for drivers**.

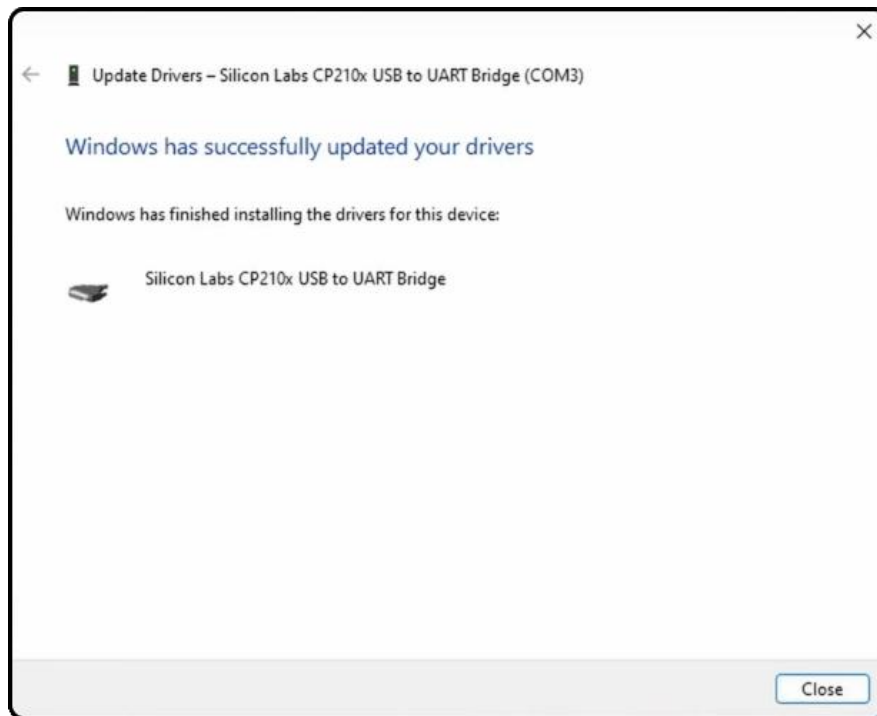


- Use the **Browse...** button to navigate to the folder where you extracted the driver.

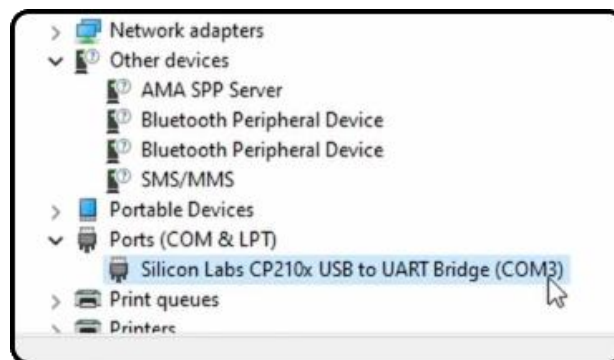


- Confirm your selection and click **Next**.

If all goes well, Windows will successfully install the driver and show the message: “Windows has successfully updated your drivers.”



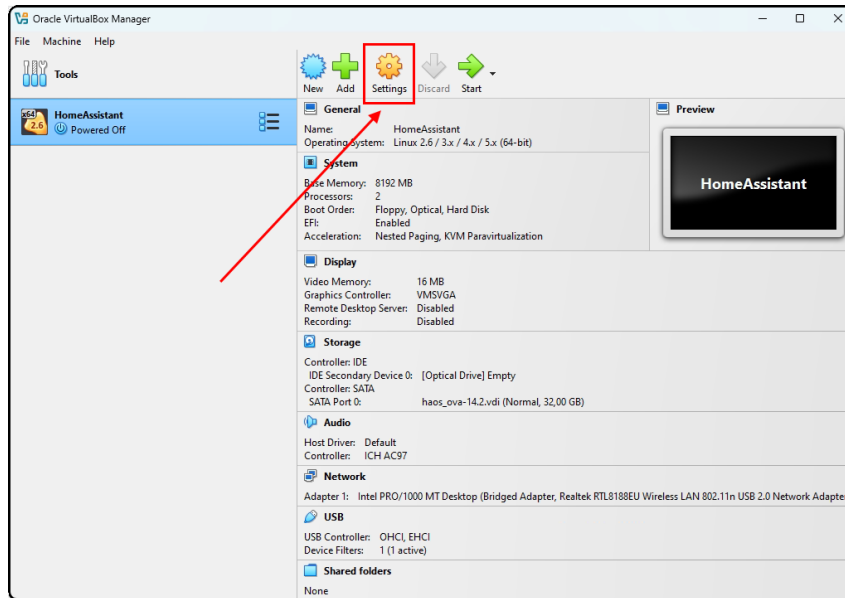
The dongle will now move to a new category in Device Manager, showing up under: Ports (COM & LPT) → Silicon Labs CP210x USB to UART Bridge (COMx)



At this point, your dongle is fully recognized by the host system and ready to be passed into the virtual machine.

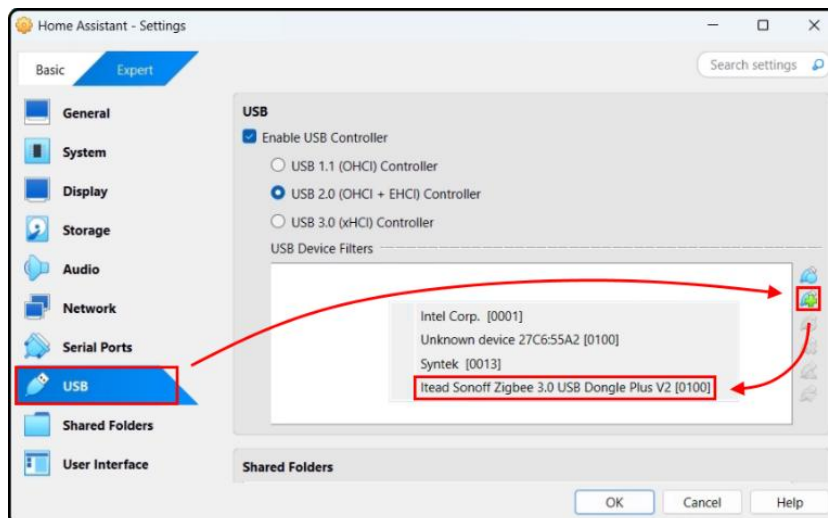
4.2 Connecting Zigbee Dongle to Home Assistant

Open VirtualBox and locate your virtual machine. Select it from the list (for example, "HomeAssistant") and click the Settings icon in the toolbar. This will open the configuration panel for the Virtual Machine (VM).



To allow the dongle to be forwarded into the VM, we'll use the USB passthrough feature.

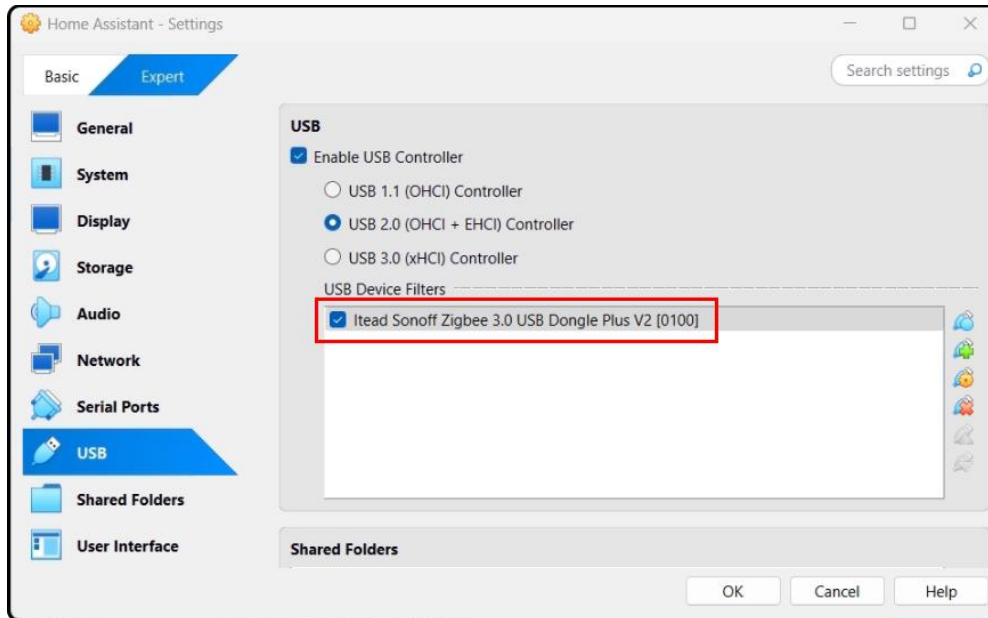
- In the left-hand menu, select the USB section.
- Make sure USB 2.0 (EHCI) Controller is selected (this is required for most dongles to function).
- On the right side of the window, click the + (plus) button.
- From the list of connected USB devices, find and select: Itead Sonoff Zigbee 3.0 USB Dongle Plus V2 (0100) or a similar name matching your specific device.



Once added, you should see the dongle listed under USB Device Filters.

To finalize everything:

- Click **OK** to save the settings.
- Start your virtual machine.



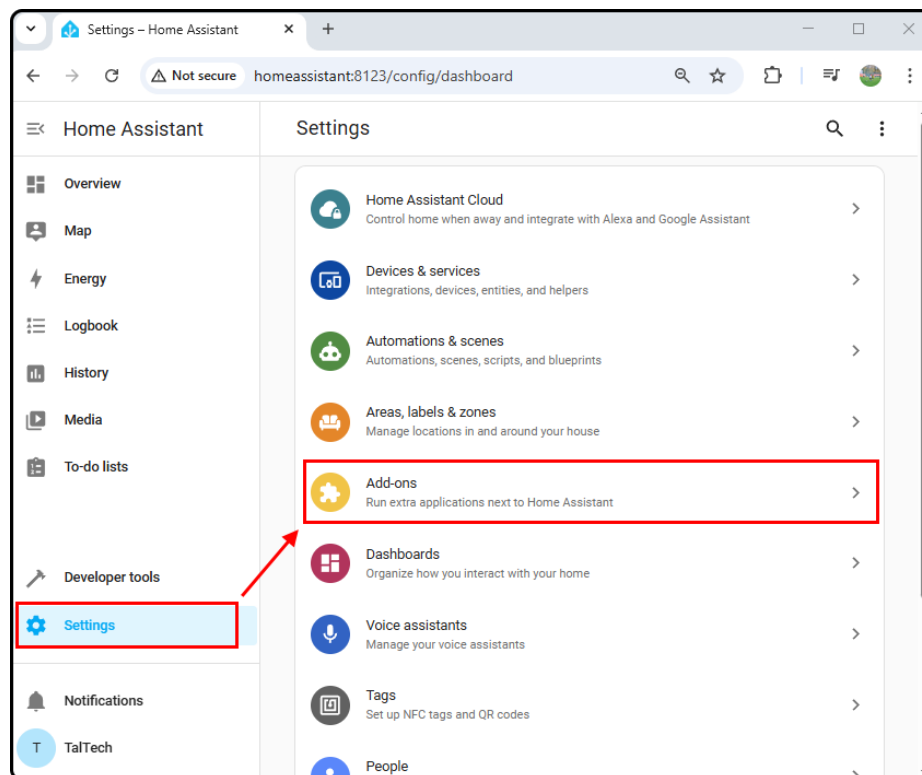
From now on, the dongle will be automatically attached to the VM every time it starts — and will be available inside Home Assistant for use with Zigbee2MQTT integrations.

5 Mosquitto Broker

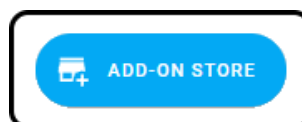
To allow Home Assistant to communicate with Zigbee2MQTT and other MQTT-compatible devices, we first need to install an MQTT broker. In this case, we'll use the popular Mosquitto broker, which is available directly from the official Home Assistant add-on store.

5.1 Installing Mosquitto Broker

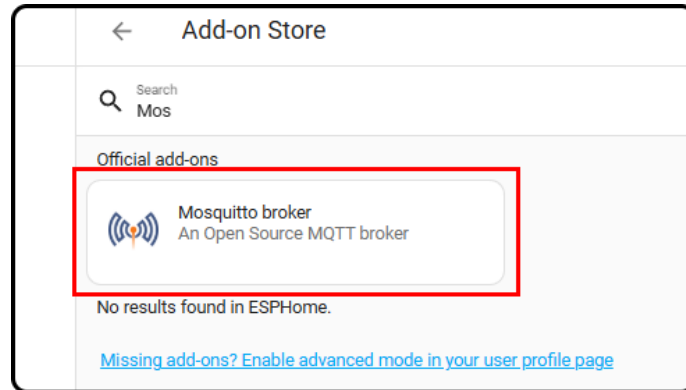
- Open Settings → Add-ons from the Home Assistant sidebar. This is where all additional services and system components are managed.



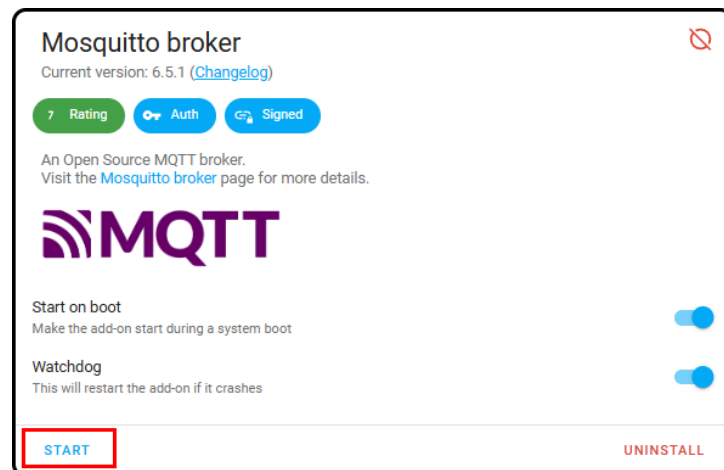
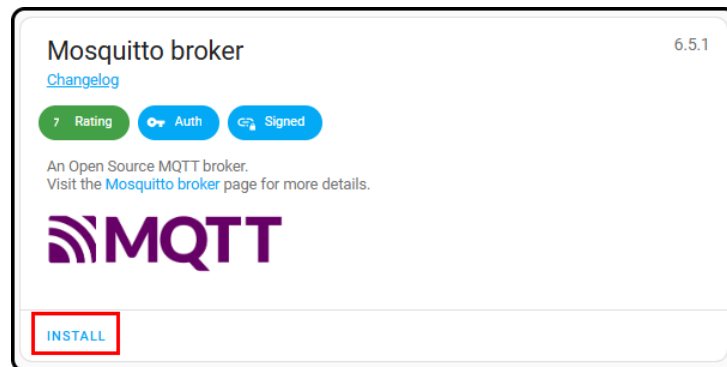
- Scroll to the bottom and click on the ADD-ON STORE button to open the list of available add-ons.



- In the search bar, type Mosquitto broker. Once it appears in the list, click on it to open the add-on details.



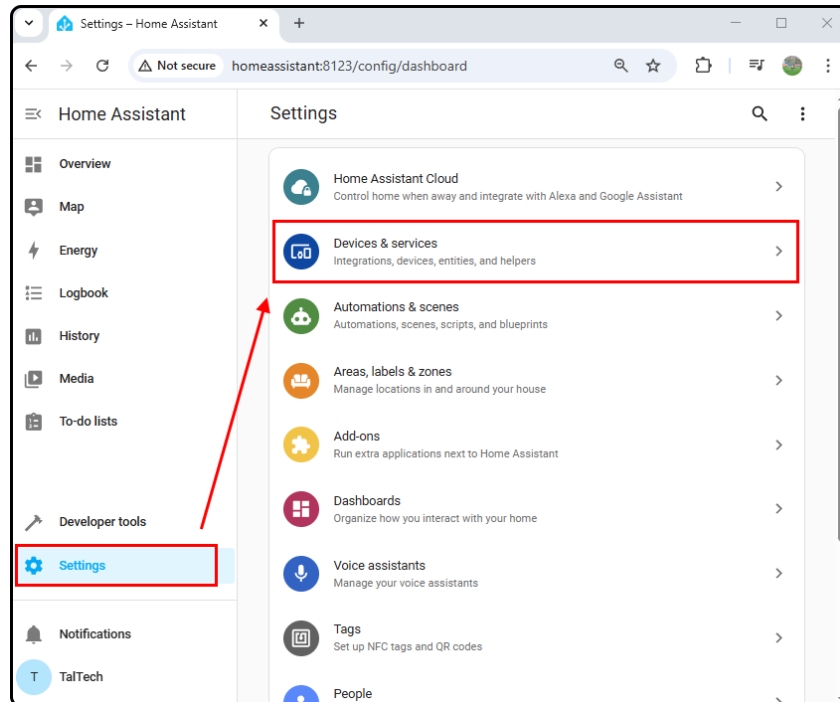
- Click **Install** to begin the installation. After it finishes, press **Start** to launch the broker.



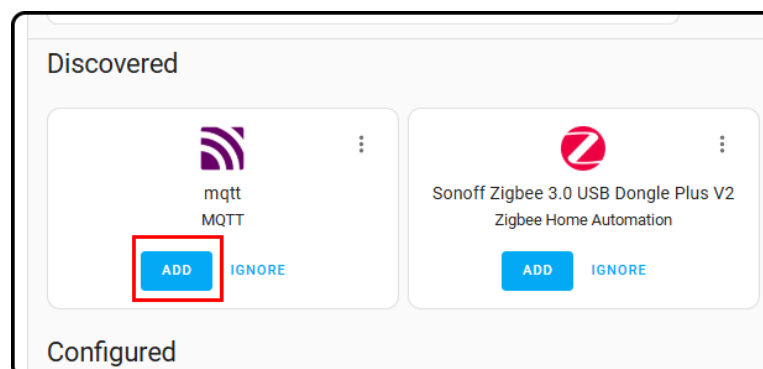
5.2 Integrating Mosquitto Broker into Home Assistant Core

Now that the Mosquitto broker is running, we need to integrate it into Home Assistant's core system. This will enable the automation engine and the Zigbee2MQTT add-on to talk to each other through the MQTT protocol.

- Navigate to Settings → Devices & Services — this is the central place for managing all integrations in Home Assistant.

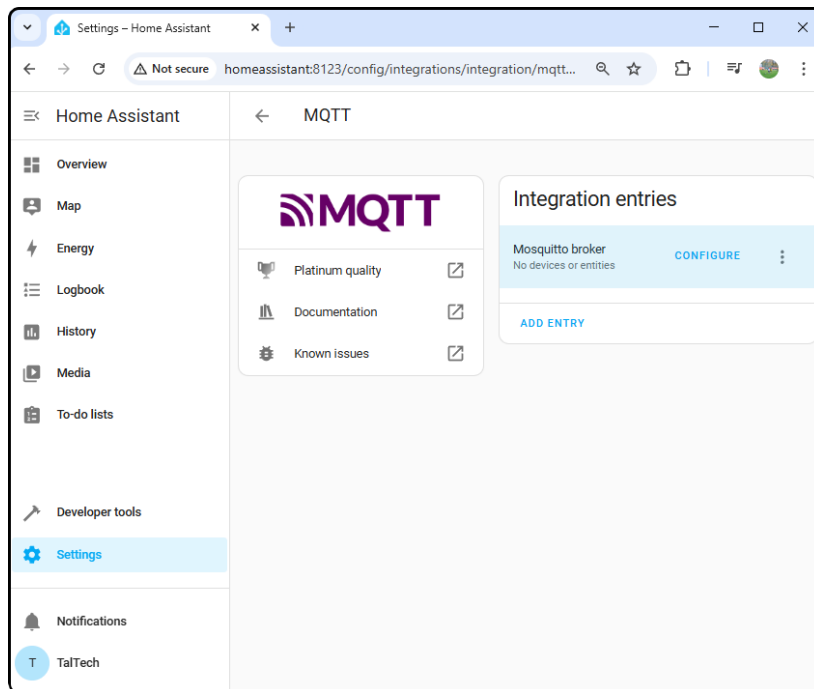


- Under the Discovered section, you should see a card labeled mqtt — this means Home Assistant has automatically detected the Mosquitto broker we just installed.
- Click **Add** on the mqtt card to proceed with the integration.



Once added, you'll see the MQTT service listed among your active integrations. From this point on, Home Assistant can subscribe to topics and receive data from any MQTT-enabled component, including Zigbee2MQTT.

The foundation for Zigbee device communication is now complete, and we can move on to installing Zigbee2MQTT itself.



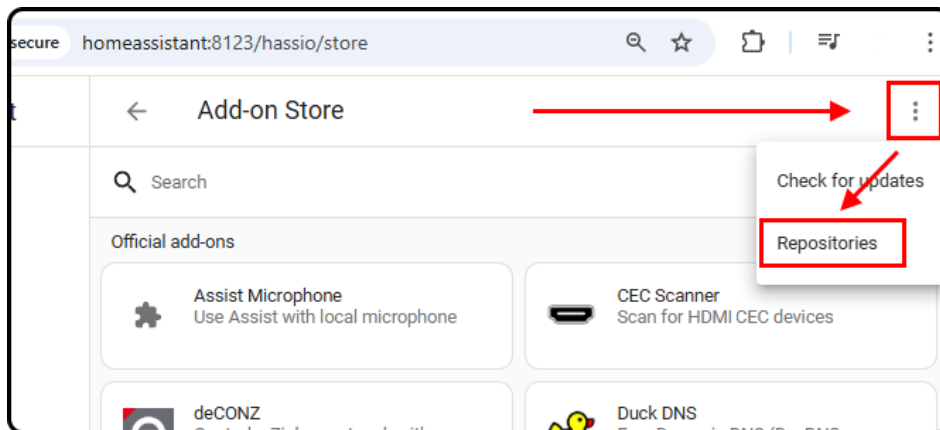
6 Zigbee2MQTT

Zigbee2MQTT acts as a bridge between your Zigbee devices and Home Assistant. It allows you to control a wide range of Zigbee-based smart devices directly, without relying on proprietary hubs — giving you full local control and flexibility.

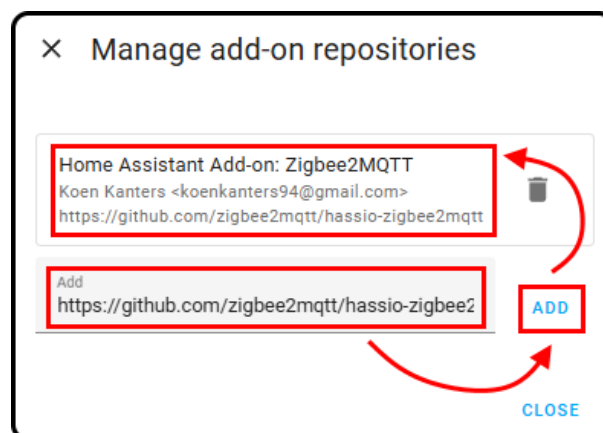
6.1 Installing Zigbee2MQTT

To install Zigbee2MQTT we first need to add its external repository to the Home Assistant add-on store.

- Return to the Add-on Store from the Settings → Add-ons menu.
- In the top right corner, click the three-dot menu and select Repositories.



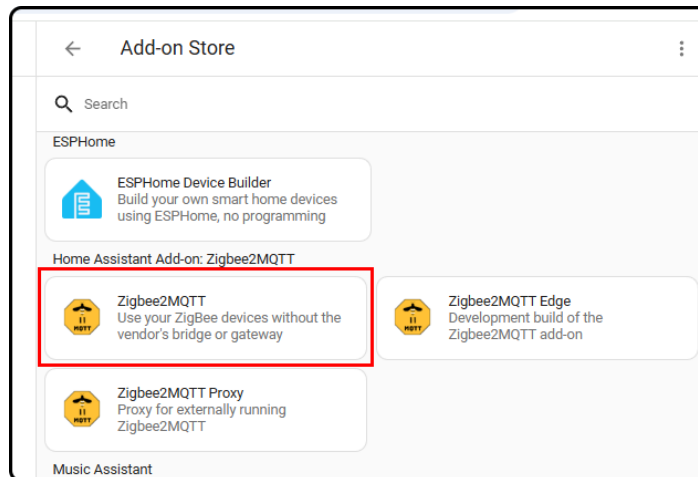
- In the input field that appears, paste the following URL:
`https://github.com/zigbee2mqtt/hassio-zigbee2mqtt`
- Click **Add** to confirm.



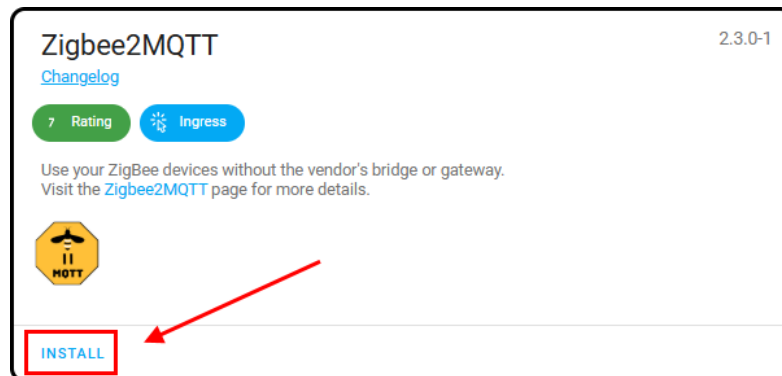
If everything is entered correctly, you will see a notification box at the top labeled: Home Assistant Add-on: Zigbee2MQTT. This means the external add-on repository has been successfully added and is now visible in your store.

After adding the repository, three new add-ons will become available in the store. Among them is the one we need: Zigbee2MQTT.

- Locate Zigbee2MQTT in the list and click on it.



- Click **Install** to begin installation.



6.2 Configuring Zigbee2MQTT

Before starting Zigbee2MQTT, we must configure its connection to the MQTT broker and specify how it communicates with the Zigbee dongle.

- Go to the Configuration tab inside the add-on.

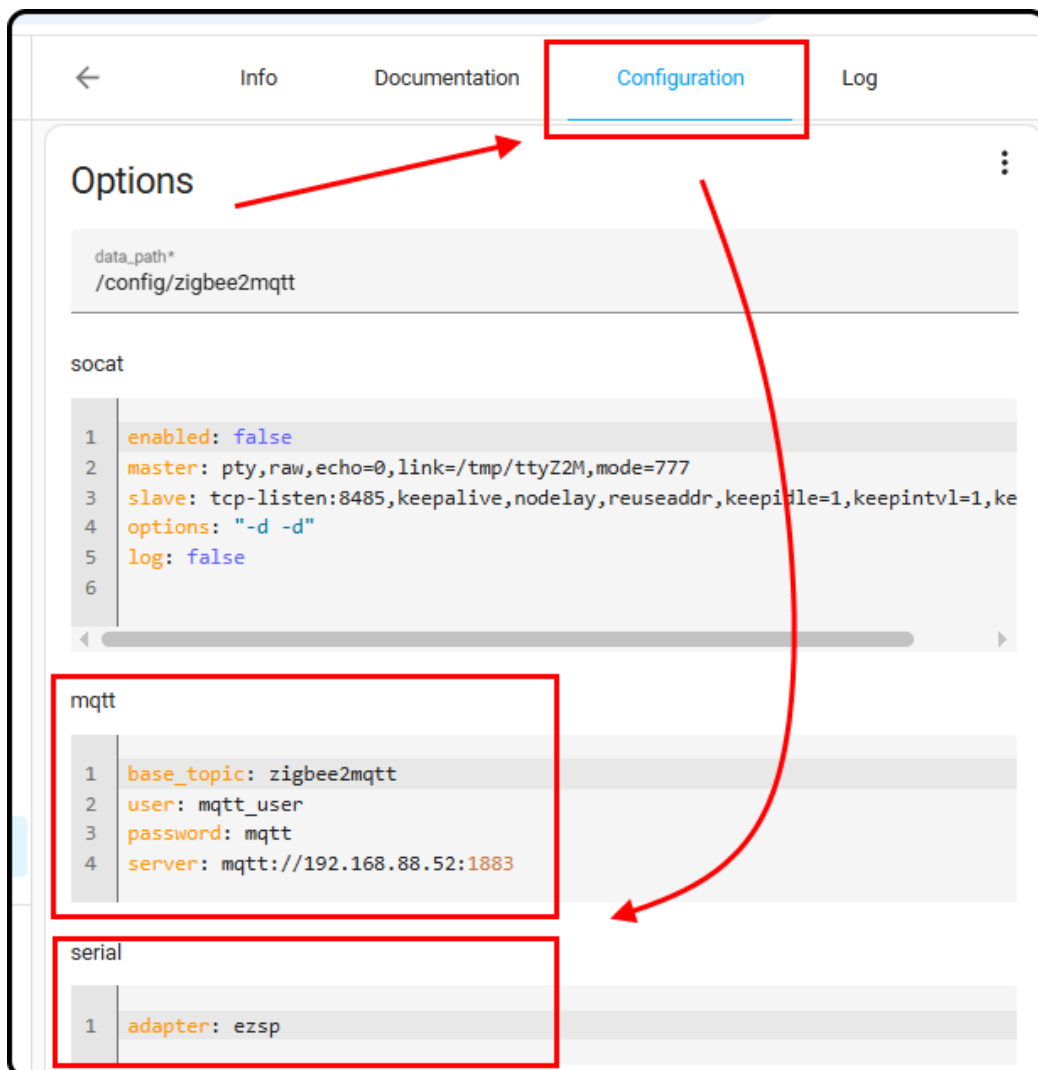
- In the mqtt section of the configuration, enter the following:

```
base_topic: zigbee2mqtt
user: mqtt_user
password: mqtt
server: mqtt://192.168.88.52:1883
```

- In the serial section, specify the adapter type (for Sonoff Dongle E with EZSP firmware):

```
adapter: ezsp
```

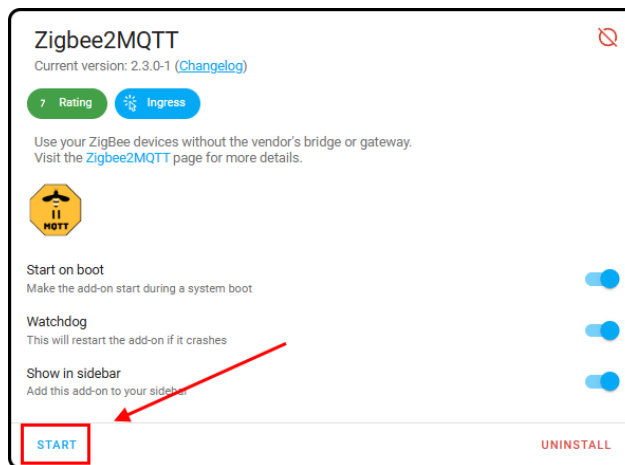
Note: the IP address and user credentials may differ based on your actual network and MQTT setup. Be sure to enter values that match your environment.



Once this configuration is saved, Zigbee2MQTT will be able to connect to your MQTT broker and begin managing Zigbee devices.

Now that everything is configured, it's time to start the add-on:

- Return to the main Info tab of the Zigbee2MQTT add-on.
- Make sure that **Show in sidebar** is enabled.
- Click **Start** to launch the service.



If the configuration is correct, Zigbee2MQTT will start successfully. You'll now be able to pair Zigbee devices and manage them directly through Home Assistant.

This completes the Zigbee2MQTT setup — your system is now ready to work with a wide variety of Zigbee sensors, lights, switches, and more.

7 Zigbee devices

In order to understand how Zigbee2MQTT operates in Home Assistant, it's essential to know what Zigbee devices are and how they communicate. Zigbee is a low-power, wireless communication protocol specifically designed for smart home devices. It forms a mesh network, allowing devices to talk to each other with low latency and great energy efficiency.

In this part of the guide, we will demonstrate how to connect Zigbee devices to your Home Assistant setup using Zigbee2MQTT. The process will be shown step-by-step. The following Zigbee devices will be used to illustrate various device types and pairing scenarios:

- Smart Plug TS011F_plug_3 by Tuya
- Smart Plug TRADFRI by IKEA Home
- Motion Sensor ZG-204ZL by Tuya
- Smart Bulb HG07834B by Livarno Home (Lidl)
- Door Sensor TS0203 by Tuya
- Wall Switch TS0001 by Tuya

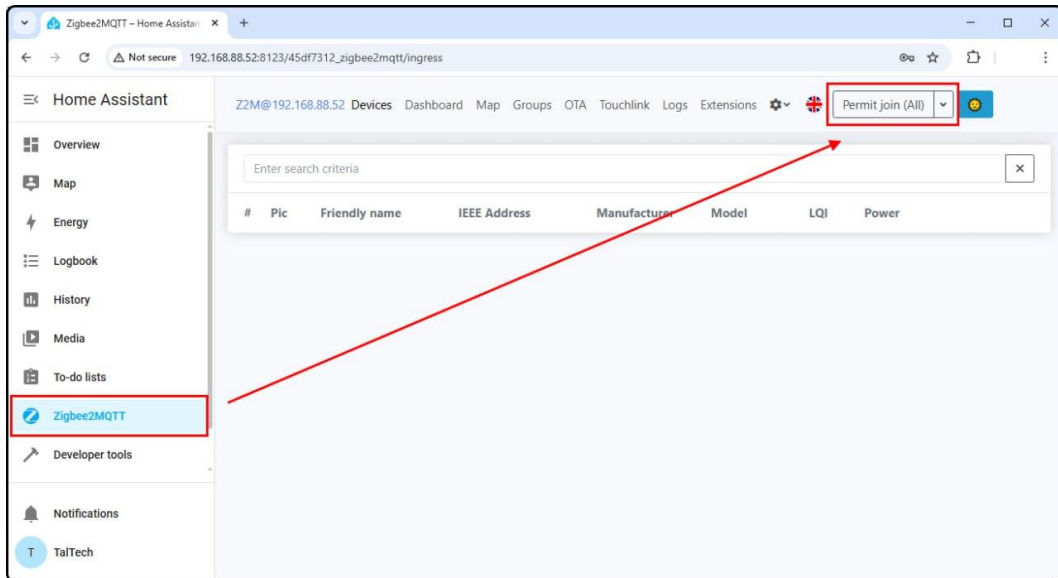
7.1 Connecting Zigbee devices

To begin pairing new Zigbee devices, we first need to enter the Zigbee2MQTT control interface. In the Home Assistant sidebar, click on the Zigbee2MQTT tab. You will now see the main dashboard of the Zigbee2MQTT add-on. This interface includes several useful sections:

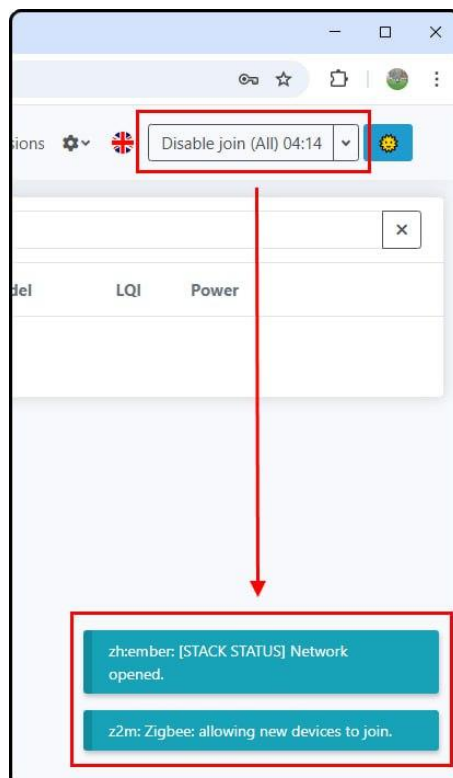
- Devices – Displays all currently paired Zigbee devices
- Dashboard – Offers a general overview including logs and pairing status
- Map – Shows a visual mesh of how Zigbee devices are connected to each other
- Groups – Allows logical grouping of devices (e.g., all lights in one room)
- Settings – Configuration options for advanced use

Each section gives you control and insights over your Zigbee network.

In order to connect a new device, we must first allow the network to accept new nodes. To do this, click the **Permit join (All)** toggle switch located on the top right corner of the dashboard.

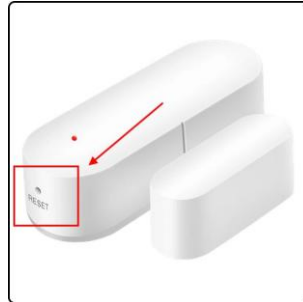


Once activated, a **countdown timer** will begin. This timer indicates the duration for which the Zigbee coordinator will stay in pairing mode. A message such as “Zigbee: allowing new devices to join” will appear — confirming that the network is ready to accept new devices.



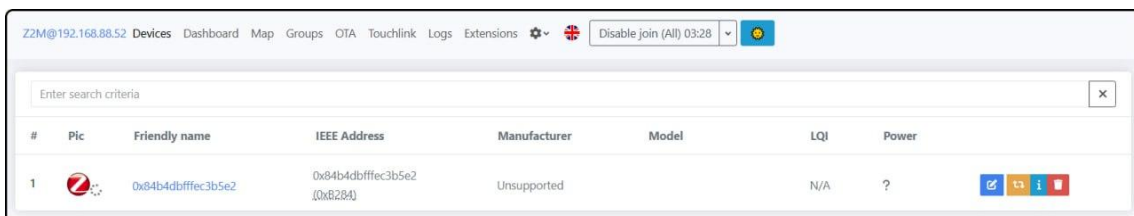
If the Zigbee device is new or not previously connected to another coordinator, it may connect automatically. However, if the device was already used in another network, it must first be reset. Here are some common reset procedures:


- Sensors (e.g., motion, door): Press and hold the reset button, typically hidden inside a small hole.



- Wall switches, smart plugs, bulbs: Turn the device on and off 5 times quickly to trigger pairing mode. You may see a blinking LED as confirmation.

Once the device enters pairing mode and communication is successful, Zigbee2MQTT will begin discovering the device.



#	Pic	Friendly name	IEEE Address	Manufacturer	Model	LQI	Power
1		0x84b4dbffec3b5e2	0x84b4dbffec3b5e2 (0x8284)	Unsupported		N/A	?

This usually takes a few seconds. If successful, the dashboard will display a pop-up notification showing that a new device has been found and is being integrated.



- z2m: Successfully configured '0x84b4dbffec3b5e2'
- z2m: Configuring '0x84b4dbffec3b5e2'
- z2m: Device '0x84b4dbffec3b5e2' is supported, identified as: IKEA TRADFRI control outlet (E160x/E170x/E190x)
- z2m: Successfully interviewed '0x84b4dbffec3b5e2', device has successfully been paired
- zh:controller: Successfully interviewed '0x84b4dbffec3b5e2'
- z2m: Starting interview of '0x84b4dbffec3b5e2'
- z2m: Device '0x84b4dbffec3b5e2' joined
- zh:controller: Interview for '0x84b4dbffec3b5e2' started

Shortly thereafter, Zigbee2MQTT will retrieve detailed information about the device — including its model, manufacturer, power status, and capabilities. The device will now appear in the **Devices** list of Zigbee2MQTT, fully integrated and ready to use.

The screenshot shows the Zigbee2MQTT web interface. At the top, there's a navigation bar with 'Z2M@192.168.88.52' and 'Devices' selected. Below it is a search bar with the placeholder 'Enter search criteria'. The main content is a table with the following data:

#	Pic	Friendly name	IEEE Address	Manufacturer	Model	LQI	Power
1		0x84b4dbffec3b5e2	0x84b4dbffec3b5e2 (0x8284)	IKEA	E160x/E170x/E190x	N/A	

At this point, you have successfully added one or more Zigbee devices to your Home Assistant setup via Zigbee2MQTT. All paired devices will be clearly listed in the Devices tab with individual cards showing their status and available actions. From here, you can rename them, assign them to rooms, or start creating automations.

The screenshot shows the Zigbee2MQTT web interface with six devices listed. The table data is as follows:

#	Pic	Friendly name	IEEE Address	Manufacturer	Model	LQI	Power
1		0x70b3d52b60146505	0x70b3d52b60146505 (0xADA5)	Tuya	TS011F_plug_3	180	
2		0x84b4dbffec3b5e2	0x84b4dbffec3b5e2 (0x8284)	IKEA	E160x/E170x/E190x	248	
3		0xa4c138bec7f45ee8	0xa4c138bec7f45ee8 (0x2f44)	Tuya	ZG-2042L	255	
4		0x0c4314ffe67f9a3	0x0c4314ffe67f9a3 (0x0579)	Lidl	HG07834B/HG09155B/HG08131B	252	
5		0xa4c1389e7e6bb498	0xa4c1389e7e6bb498 (0x1778)	Tuya	TS0203	232	
6		0xa4c138e44de29942	0xa4c138e44de29942 (0x3DEB)	Tuya	TS0001	232	

Thus, with Zigbee2MQTT, you gain full control over a powerful, vendor-independent smart home network — one device at a time.

References

- [1] VirtualBox download page for Windows - <https://www.virtualbox.org/wiki/Downloads>
- [2] Home Assistant OS installation page for Windows - <https://www.home-assistant.io/installation/windows>
- [3] Official USB-to-UART driver package - <https://www.silabs.com/developer-tools/usb-to-uart-bridge-vcp-drivers>