acontis technologies GmbH

SOFTWARE

Hypervisor-WindowsGuest-Guide

acontis Real-time Hypervisor and Windows guest

Version 9.x

Edition: July 29, 2025

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1 Introduction

This guide describes how to set up a Windows guest in the acontis RTOSVisor. The Windows guest is running in a virtual machine, which is powered by QEMU/KVM. It is assumed that the steps listed in the Hypervisor Quick Start guide have been successfully executed.

2 Copy a Windows ISO installation media to the Hypervisor Host

In a first step, we need to copy the `Windows` installation media (`ISO` file) into the Hypervisor filesystem.

2.1 Using Filezilla (recommended)

With this setup, you can upload the Windows installation `.iso`-file via SFTP from a PC to the Hypervisor Host. First you need to find out the IP address of the computer running Hypervisor.

- Open a shell (right click on desktop and select *'Open Terminal here'* **or** press `CRTL` + `ALT` + `T`) on the Hypervisor `Host`.
- Determine the *IP* address of the Hypervisor Host (with `ifconfig` command and through `inet` entry):

```
rte@RTV-TP104:~$ ifconfig
enp2s0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
    inet 172.17.10.5  netmask 255.255.0.0  broadcast 172.17.255.255
    inet6 fe80::ccbb:85f1:38d3:fa2a  prefixlen 64  scopeid 0x20<link>
    ether 90:1b:0e:18:c9:83  txqueuelen 1000  (Ethernet)
    RX packets 4618420  bytes 4033770375 (4.0 GB)
    RX errors 0  dropped 8865  overruns 0  frame 0
    TX packets 1460482  bytes 96608727 (96.6 MB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
    inet 127.0.0.1  netmask 255.0.0.0
    inet6 ::1  prefixlen 128  scopeid 0x10<host>
    loop  txqueuelen 1000  (Local Loopback)
    RX packets 6864  bytes 427092 (427.0 KB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 6864  bytes 427092 (427.0 KB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

vnet0: flags=99<UP,BROADCAST,NOTRAILERS,RUNNING>  mtu 1500
    inet 192.168.157.1  netmask 255.255.255.0  broadcast 192.168.157.
↪255
    ether 00:60:c8:00:00:00  txqueuelen 1000  (Ethernet)
    RX packets 765775  bytes 74216258 (74.2 MB)
    RX errors 0  dropped 0  overruns 0  frame 0
    TX packets 767935  bytes 74780268 (74.7 MB)
    TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

  In this *example* the IP address is `172.17.10.5`.

Hint: The device name `enp2s0` **differs** on different *PC/IPC's*!

- Open Filezilla (get current version from https://filezilla-project.org/) on the computer where your `windows.iso` is located and create a new connection entry:

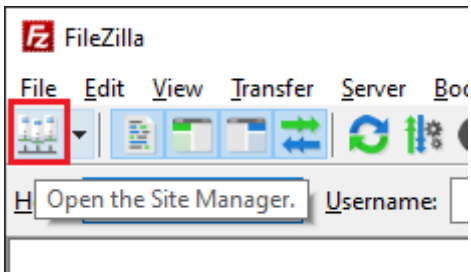


Fig. 2.1: Create new entry through site manager.

1. Push `New_site` button
2. Give a qualified name
3. Select *SFTP - SSH File Transfer Protocol*
4. Give host IP/name. In the screenshot above the *last* byte is `X`-ed out. Replace it with the *'detected' IP* address.
5. Enter User name (same as at Hypervisor install)
6. Enter password (same as at Hypervisor install)
7. Push `Connect` button

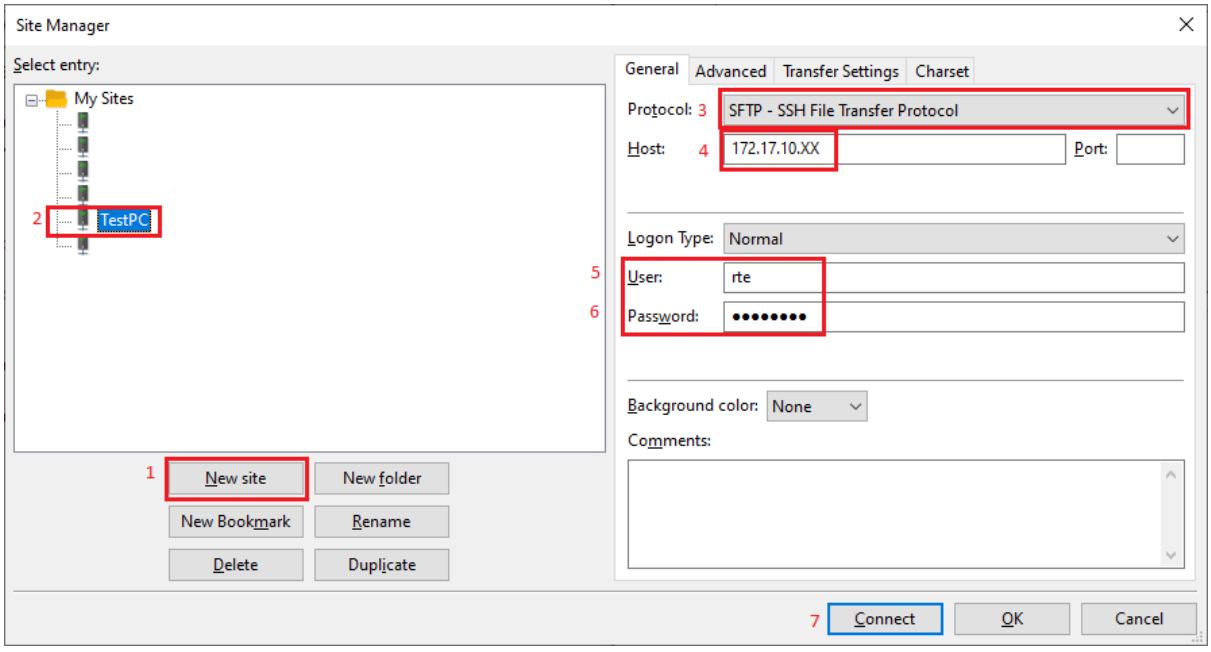


Fig. 2.2: Site manager dialog.

Select the installation media file (the `.iso` image) in the *Local* tab on the left and *upload* it to `/hv/iso` into the *Server* tab on the right.

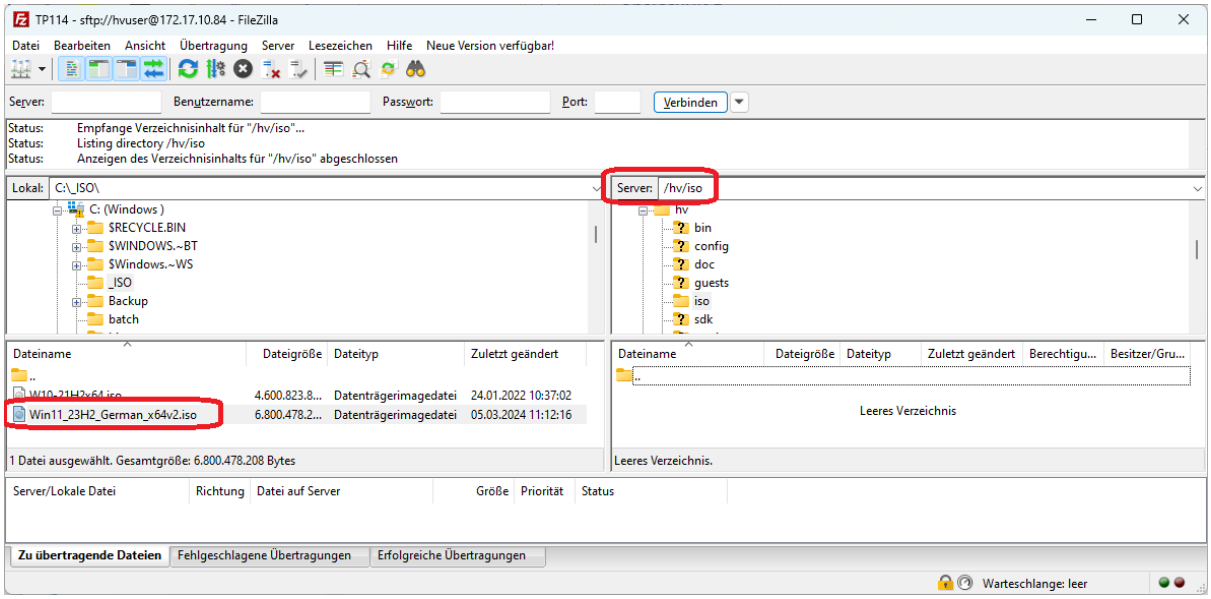


Fig. 2.3: Download installation media

2.2 Using a Windows Network Share

Here we will show how to upload the `.iso` via network share visible to the computer running the RTOSVisor. We assume the network share has a directory `/hv` containing the file `windows.iso`.

```
$ sudo mount -t cifs //NameOrIpAddressOfPcWithShare/NameOfShare /mnt -o
↪  user=NameOfUserWithAccessToShare
```

Copy the Windows ISO image to `/hv/iso`.

```
$ cp /mnt/hv/windows.iso /hv/iso/windows.iso
```

The mount point `/mnt` isn´t needed anymore and thus will be unmounted.

```
$ sudo umount /mnt
```

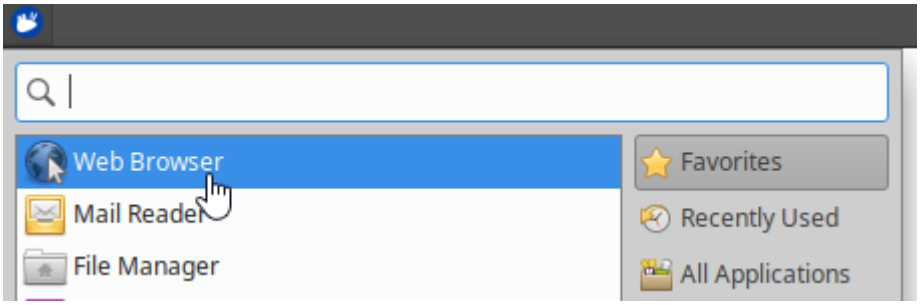
3 Guest Configuration

Hint: This guide focuses on the Windows example guest. Initially, the Hypervisor Host does not provide any example guest folders. To switch to the Windows guest example, you need to perform the suitable initialization.

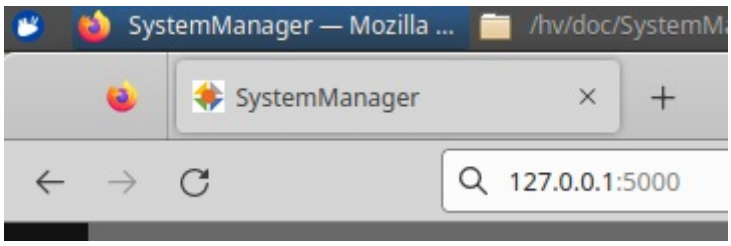
3.1 Open Example Project in System Manager

3.1.1 Browser Start

The Firefox browser can be launched directly on the Hypervisor Host. Press the top left icon and select `Web Browser`.

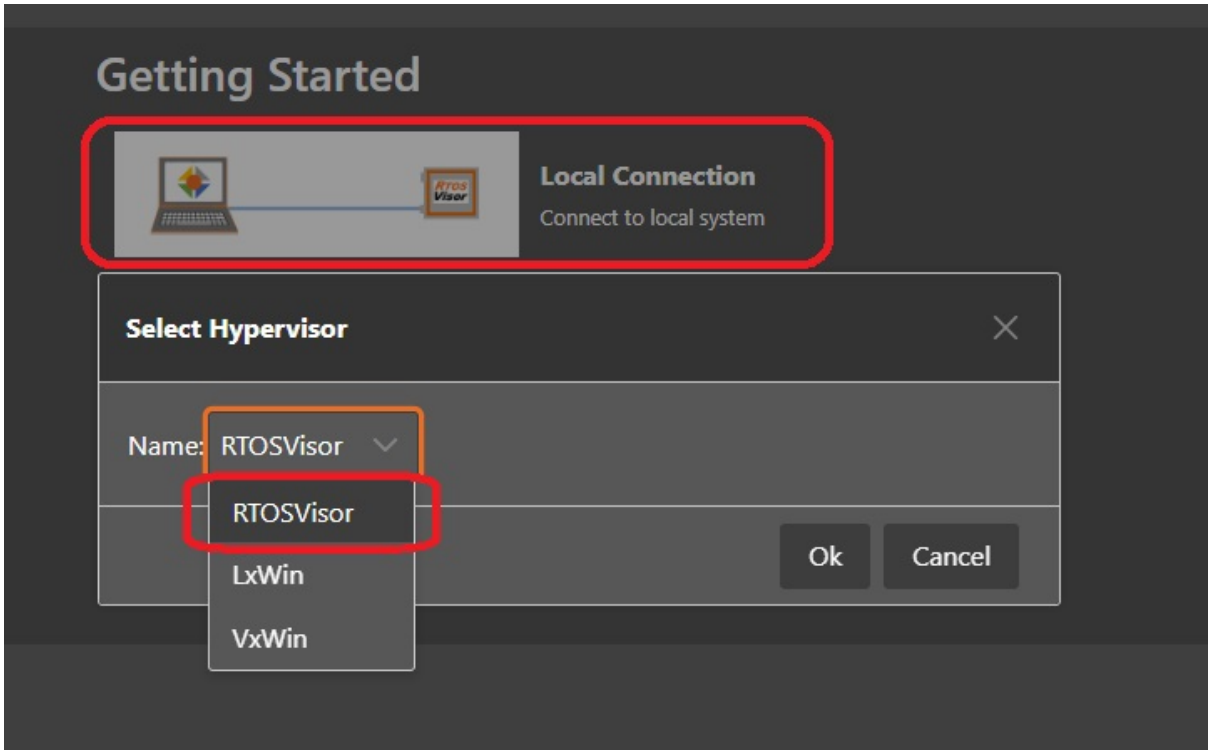


Type in the localhost IP address `127.0.0.1` and connect to port 5000.
The following URL can be used: `http://127.0.0.1:5000`

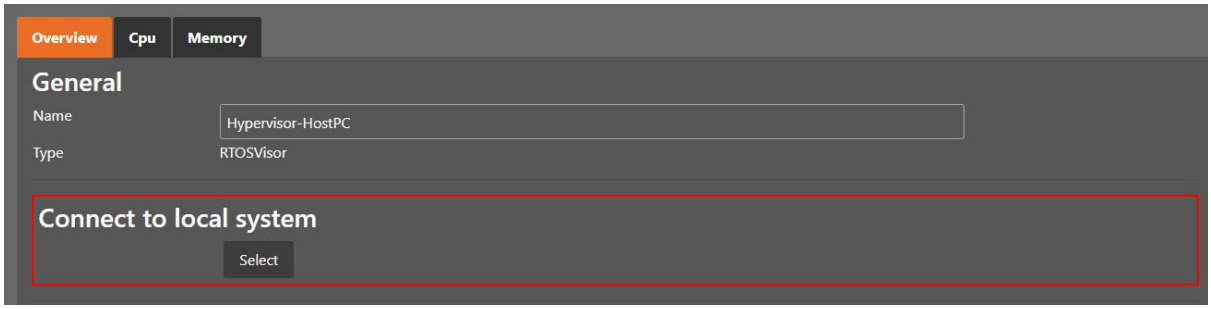


3.1.2 Local Connection

To connect the browser with the Hypervisor backend, please select `Local Connection` and the respective hypervisor type (`RTOSVisor`).



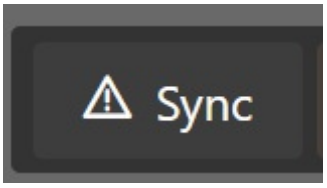
After acknowledging `Connect to local system`, the Hypervisor Host connection dialog will be shown. You should provide an appropriate name for this Hypervisor Host and press the `Select` button.



3.1.3 Initial Synchronization

When you have started the System Manager for the first time, you need to run an initial synchronization step.

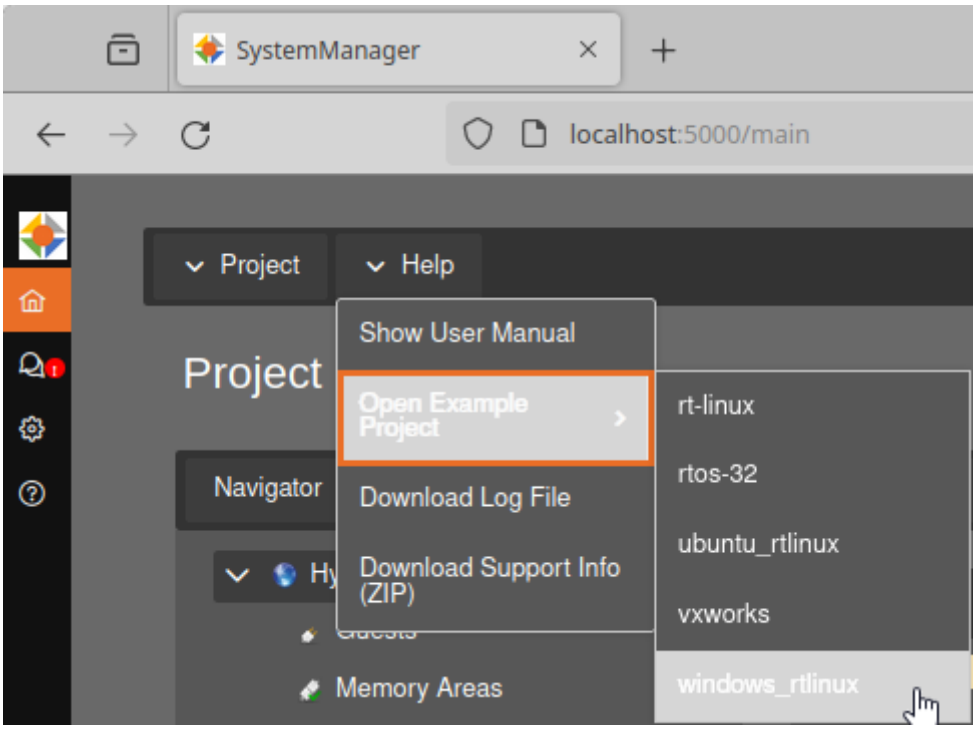
Press the synchronization button.



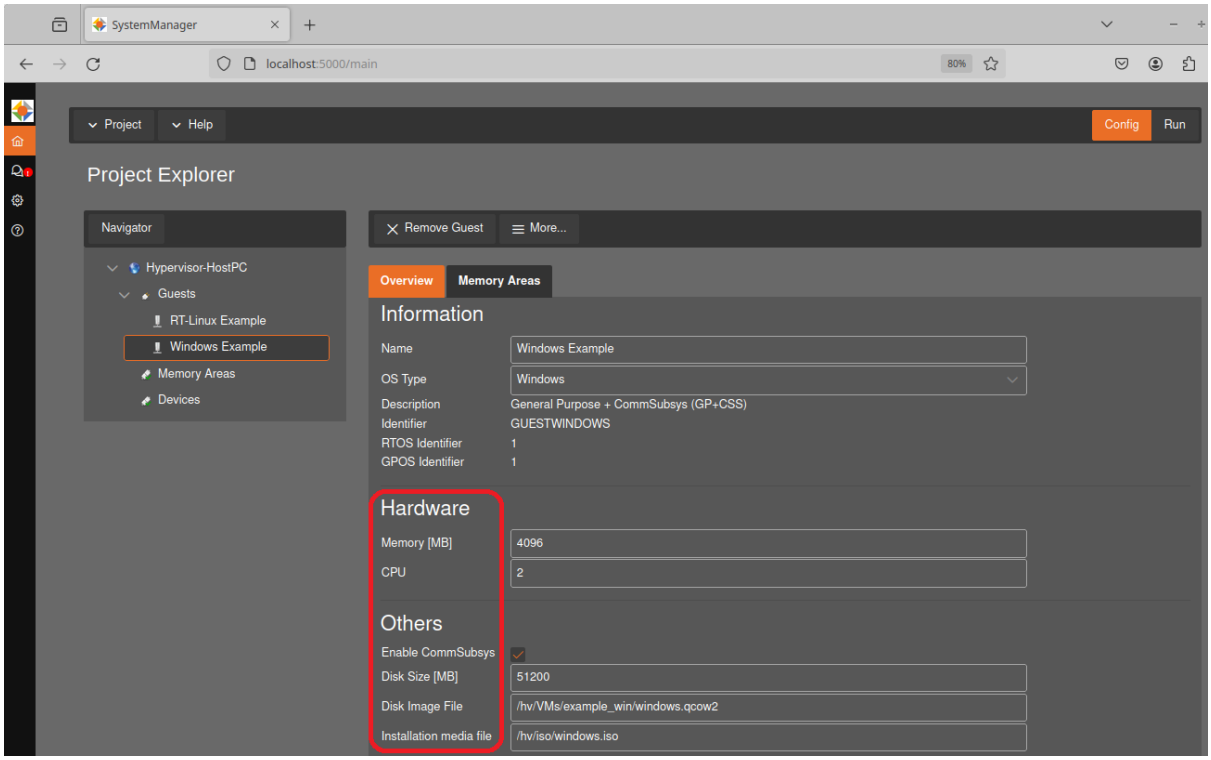
A confirmation popup will then appear, where you need to press the ‘Apply’ button.

3.2 Windows Guest Example

Open the Windows Example project, it includes a Windows guest and a RT-Linux guest.

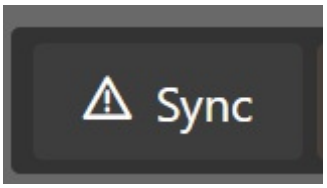


Before installing the guest operating system, it's necessary to set up the corresponding virtual machine, including configuring settings like the number of CPU cores and network options. In the Navigator, open `Guests`, then `Windows Example`. You will see this screen:

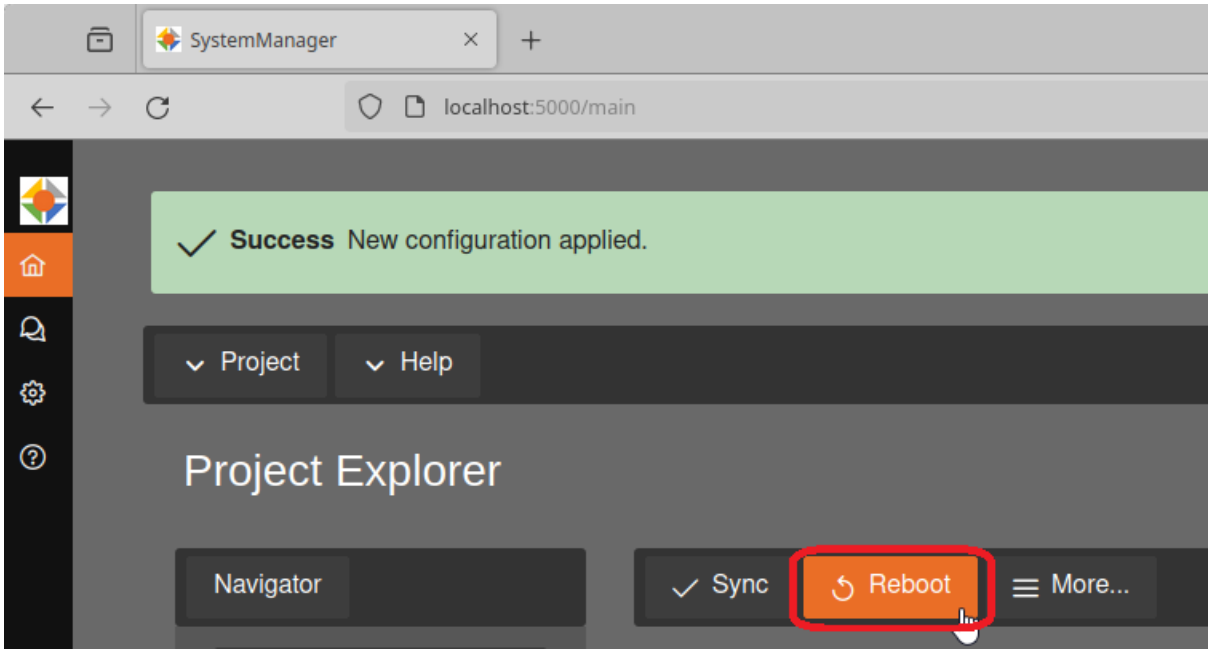


- For the example Windows Guest setup, the installation media should be located at `/hv/iso/windows.iso`. You have the option to rename your existing `.iso` file to match this location on the Hypervisor host, or you can modify the `Installation Media file` setting to point to your file.
- By defining the `Disk Image File`, you can specify the location and name of the guest's image files. This setting should include a path beginning with `/hv/VMs` and a filename ending with the `.qcow2` extension, such as `/hv/VMs/example_win/windows.qcow2`. This makes it possible to copy image files and use them in various projects without having to reinstall the Windows operating system.
- Ensure the number of CPU cores allocated does **not** exceed the number of physical cores available on the system that are not allocated to Real-time guests. For example, if on a *quad core* CPU, you need `2` cores for Real-time guests, the number of cores for the Windows guest must not exceed `2`. The default parameters should fit for most cases.
- Tailor the memory allocation to meet the requirements of the Windows guest, ensuring not to allocate more RAM than what is physically available on the Hypervisor Host.
- Expand the disk size as needed (Windows 11 requires a minimum of 75GB).

After making changes to a project, it's essential to perform the synchronization step again: in the Navigator select `Hypervisor-HostPC`, then press the `Sync`-button and click 'Apply' in the confirmation popup. This process commits the configurations to the Hypervisor Host.



Once synchronization is successful, the Hypervisor Host has to be rebooted.



After rebooting the system, repeat the steps from the beginning:

- Start the browser
- Connect to 127.0.0.1:5000
- Select `Local Connection`
- Select `Connect to local system`
- Click the `Sync` button and `Apply`

3.3 Command Line operation

This chapter demonstrates how to use the example projects using the command line instead of the System Manager. Note that it will override the settings made by the System Manager.

For the Windows Guest example setup, the installation media should be located at `/hv/iso/windows.iso`. Use the *mv* command to rename your existing `.iso` file if required.

```
mv /hv/iso/windows10.iso /hv/iso/windows.iso
hv_open_example windows_rtlinux
hv_sync_example windows_rtlinux
cd /hv/guests/guestwindows
```

If you are prompted whether you want to overwrite an existing project, type `y` if you are sure that you don't need the existing project anymore.

Prior to installing the guest, we need to configure the respective virtual machine (e.g. number of CPU cores, network settings etc.). The configuration files `guest_config.sh` and `usr_guest_config.sh` are located in the guest folder. The meaning of each configuration setting is explained in detail in those files. You need to edit these files and adjust them according to your needs and environment.

> **Caution:** If the guest is controlled by the System Manager tool, you must not change the `guest_config.sh` file (the content may be overwritten by the System Manager), instead uncomment the respective settings in `usr_guest_config.sh`.

The number of CPU cores must **not** exceed the number of physical cores available in the system and not assigned to Real-time guests. For example, if on a *quad core* CPU, you need `2` cores for Real-time guests, the number of cores for the Windows guest must not exceed `2`. The default parameters should fit for most cases.

```
$ mousepad /hv/guests/guestwindows/usr_guest_config.sh (and/or
↪  guest_config.sh)
```

```
# Adapt following lines to your system and needs (e.g. uncomment the␣
↪respective lines):
vmname=...
vmid=...
windows_guest=...
cdrom_iso=...
num_cpus=...
ramsize=...
hdsize=...
shutdown_timeout=...
perfmon=...
```

Caution: **Windows 11** requires a larger `hdd` size therefore the `hdsize` entry **must be** adjusted to a larger value, e.g. `75G`!

```
export hdsize=75G      # Hard disk size
```

You have to set the `cdrom_iso` parameter to the appropriate folder where the installation media `ISO` file had been copied before.

By default, the network connection is set up automatically (using `DHCP`). Please check the Hypervisor Manual for other settings.

Caution: Automatic network setting will only work, if the Ethernet cable is connected!

Caution: Please do not configure more *CPUs* than physically available (*CPUs* used for the Real-time OS are not available for the Windows guest). Example: The maximum number of of *CPUs* on a quad-core *CPU* where 1 *CPU* is used for the Real-time OS is `3`.

Caution: Please do not configure more RAM than available. The VM may unexpectedly crash if too much RAM is configured. You can determine the available RAM as follows:

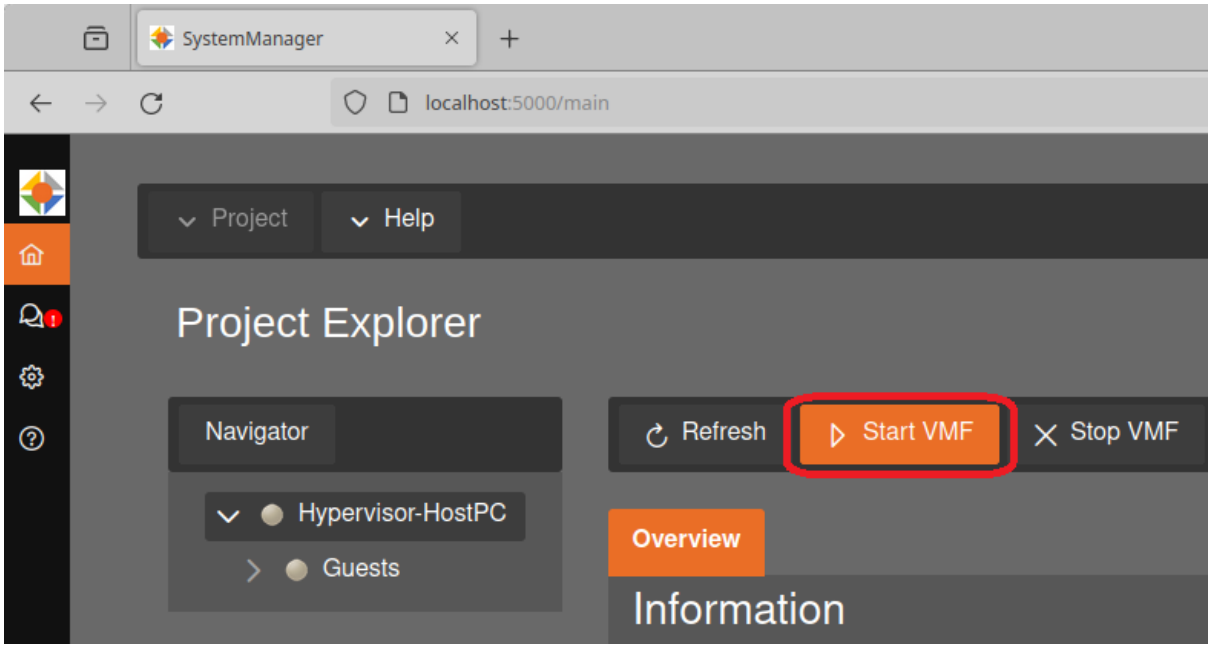
```
$ cat /proc/meminfo | grep MemAvailable
```

4 Guest Installation

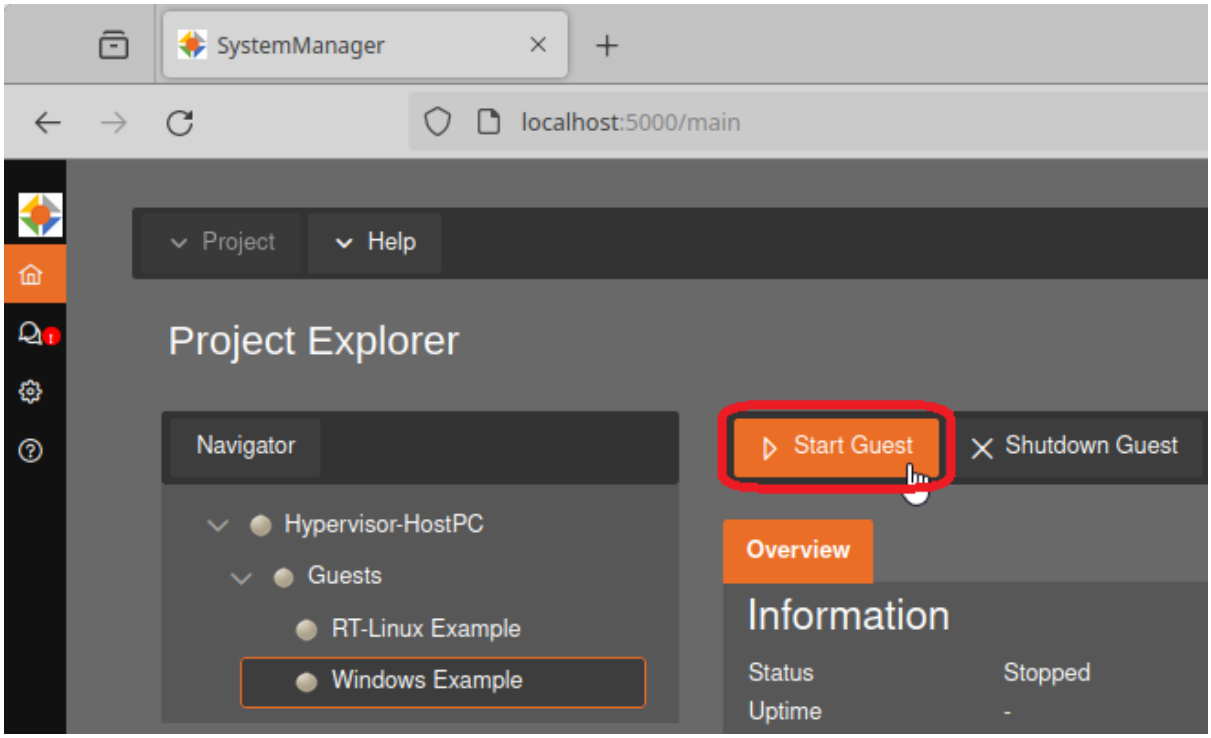
After VM configuration you need to start the guest for the first time. The following steps outline how to start the Windows guest installation in the System Manager.

Change to `Run` mode.

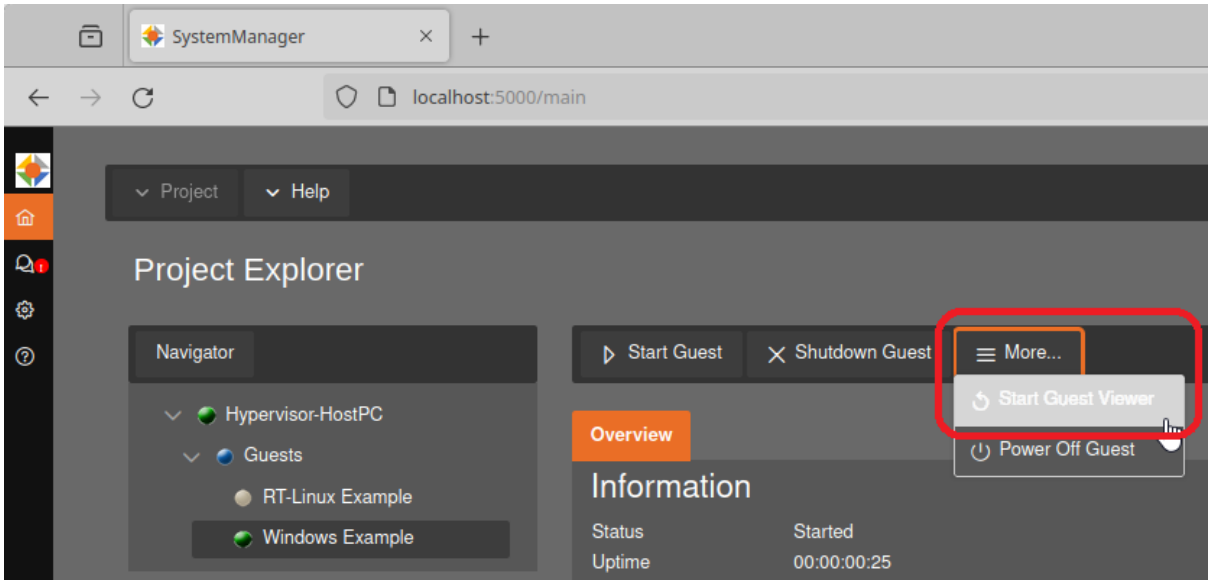
Start the Virtual Machine Framework (VMF). Starting the VMF will load the configuration for all guests. Real-time guests can only be launched when the VMF is running.



Select the `Windows Example` guest in the `Navigator` on the left side.
Click the `Start Guest` Button.



Select `More.../Start Guest Viewer` to open the guest viewer, where you can see the Windows guest's output or desktop.



Optional: The Windows guest operating system can be launched using the command line interface, too.

```
$ cd /hv/guests/guestwindows
$ hv_guest_start -view
```

Caution: if you see an error like `(remote-viewer:5083): Gtk-WARNING : 11:15:50.298: cannot open display: :10.0`, you may be using a RDP connection when installing

the guest. In this case the GUI Window (remote-viewer) will **not** be shown. To fix this execute the commands

```
$ sudo -u username xhost +SI:localuser:root
```

where the `username` is the *username* you are logged in with. After that execute `hv_guest_console` to start the viewer.

The installation media `iso` file will be detected by the virtual bios, you need to press a key to boot from it:

Fig. 4.1: Boot from `ISO` file.

Hint: In case **no key** was pressed in time or the installation media was **not** found, the *EFI shell* will be started.

- Option a) You can enter the *BIOS* by entering `exit`. Once you leave *BIOS* the boot begins again and you can press a key to boot from *CD*.
- **Option b) You can manually start the *CD's* bootloader by entering**
  - `$ FS0:`
  - `$ \EFI\BOOT\BOOTX64.EFI`

Hint: If the start *EFI* file is not set in the *BIOS* (`BOOTX64.EFI` does not exist), you need to type `exit` to leave the shell and switch into the *BIOS*. There you need to select the *CDROM* in the `boot` menu.

5 Windows Installation

Caution: A **Windows 11** installation requires some *additional* steps. Please check the **next** chapter!

- Follow the steps as usual until the **Where do you want to install Windows** dialog shows up

---

Hint: If you are prompted for the installation type, select `Custom`

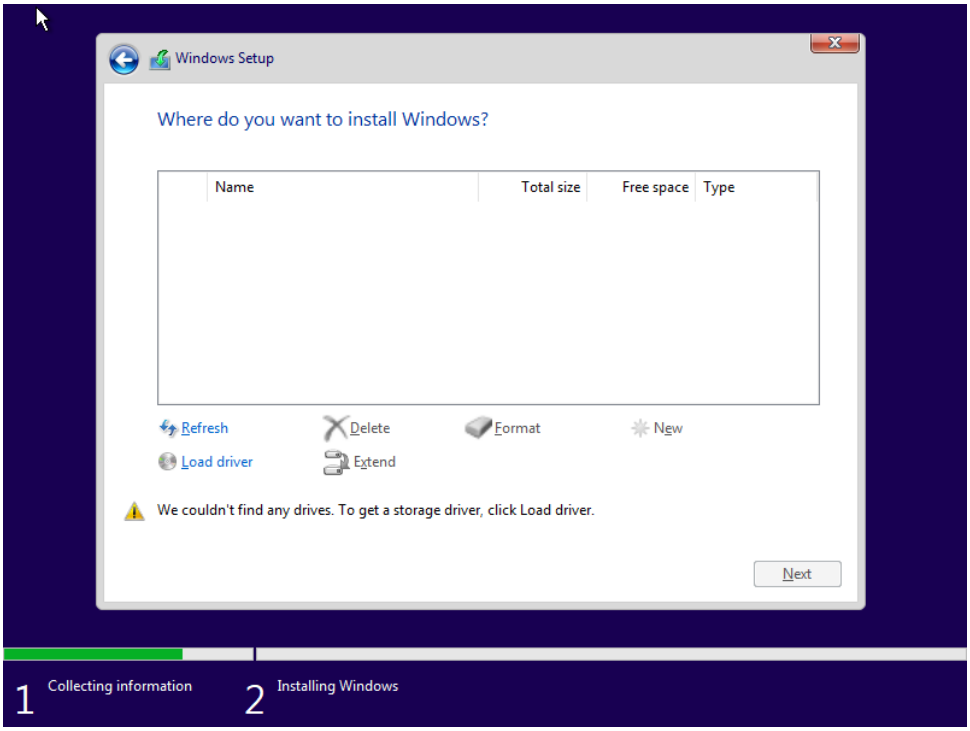


Fig. 5.1: Where do you want to install Windows.

Click on `Load Driver` and browse to the *CD* Drive with the virtio drivers. Select the appropriate driver in the respective folder (e.g. **Windows 10:** `\viostor\w10\amd64` **Windows 11:** `\viostor\w11\amd64`).

- Then select **Load driver** –> `OK` –> **Red Hat VirtIO SCSI controller" (W10)** –> `Next`

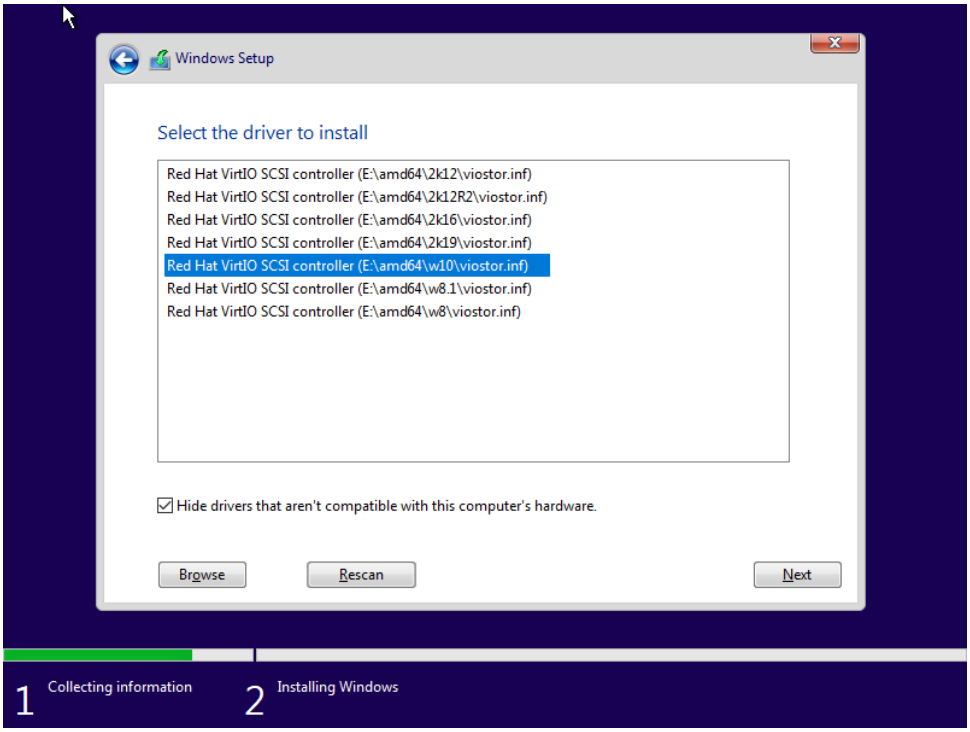


Fig. 5.2: Windows Install driver selection for Windows 10.

– **Windows 11:**

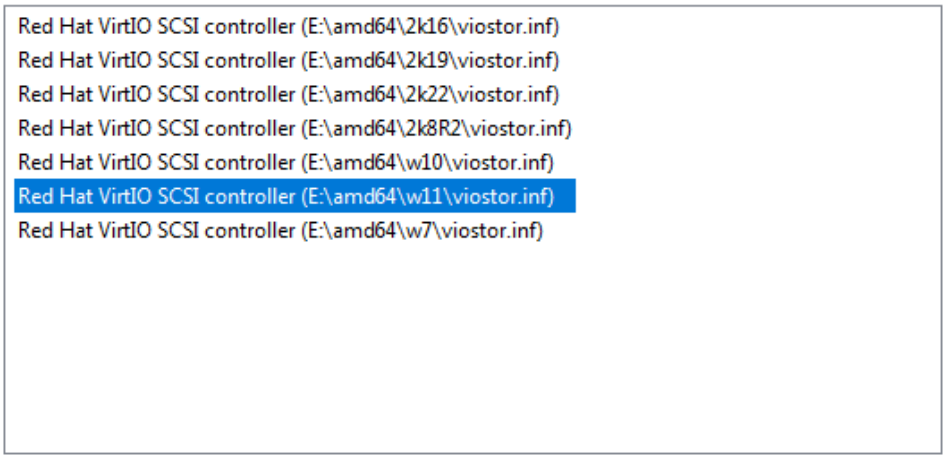


Fig. 5.3: Windows Install driver selection for Windows 11.

- Select your drive (`50GB` or larger)

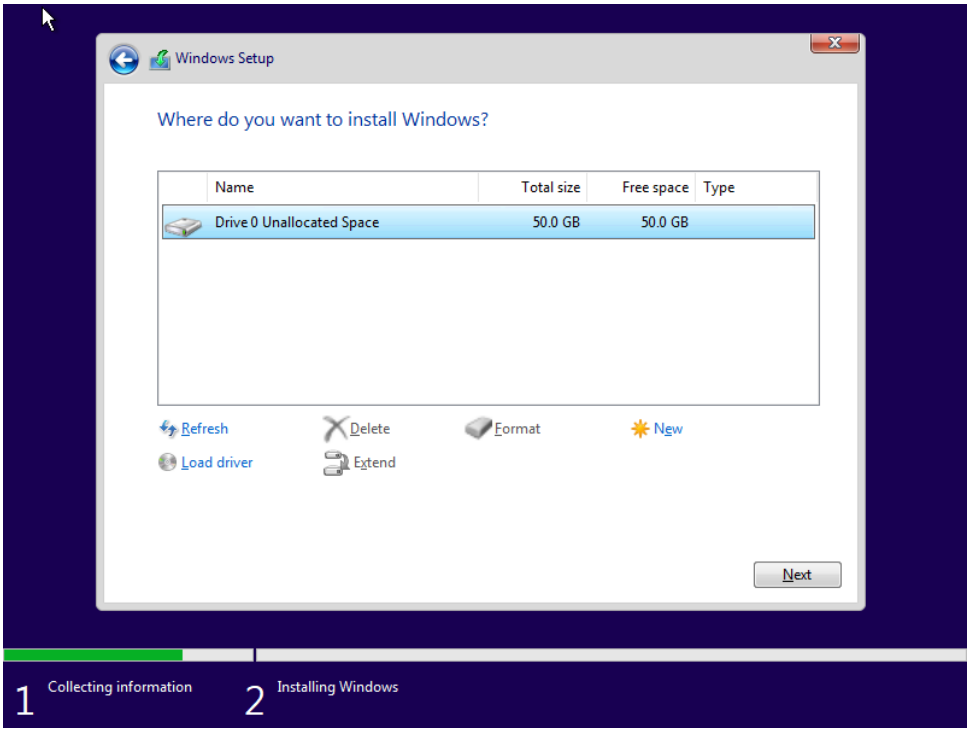


Fig. 5.4: Windows Install disk.

- Finish Installation (please note, there is **no network/internet** available in this setup)

6 Windows 11 Installation

Installing Windows 11 need some **additional** handling regarding prerequisites.

The Windows 11 installer checks for `TPM` and `Secure Boot`.

Disable `TPM` and `Secure Boot` checks in the installer:

a. When the installer begins, press `Shift` + `F10` and launch `Regedit` from the `command prompt`.

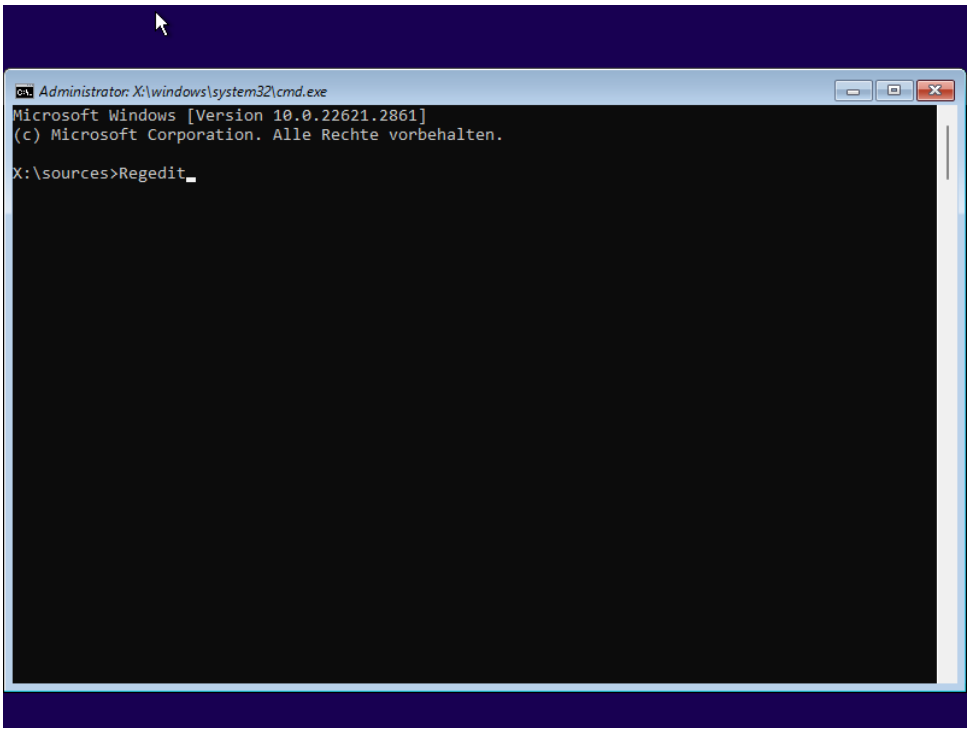


Fig. 6.1: Registry editor.

b. Create a **new** key named `LabConfig` under `HKLM\SYSTEM\Setup`.

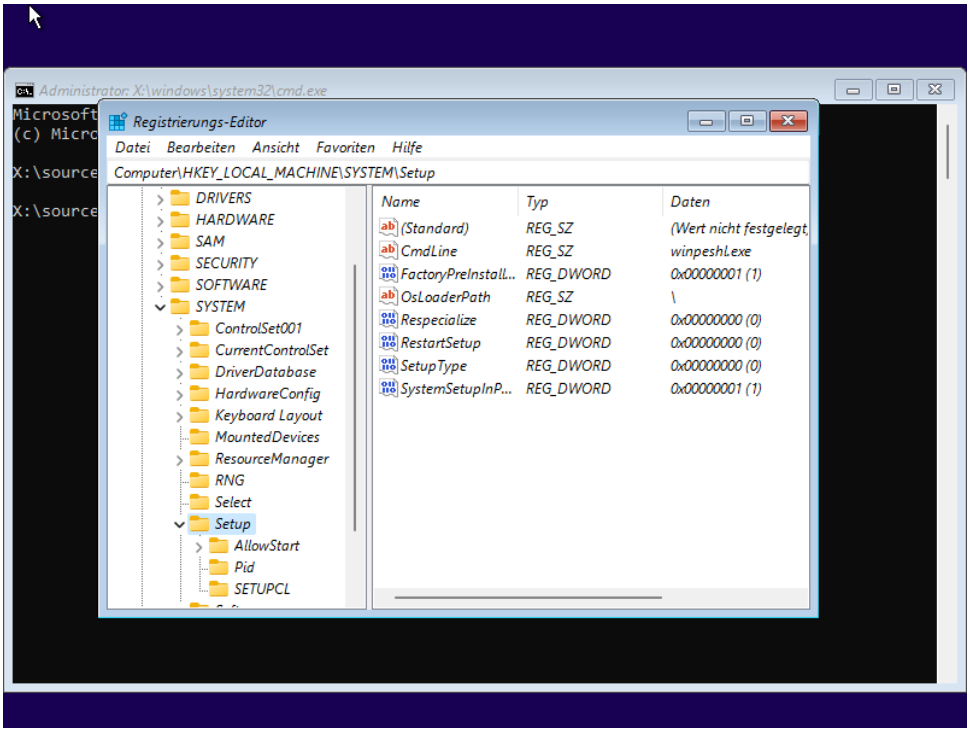


Fig. 6.2: New `LabConfig` registry key location.

c. Add a **new** `DWORD` value to `HKLM\SYSTEM\Setup\LabConfig` named `BypassTPMCheck` and set it to `1`.

d. Add a **new** `DWORD` value to `HKLM\SYSTEM\Setup\LabConfig` named `BypassSecureBootCheck` and set it to `1`.

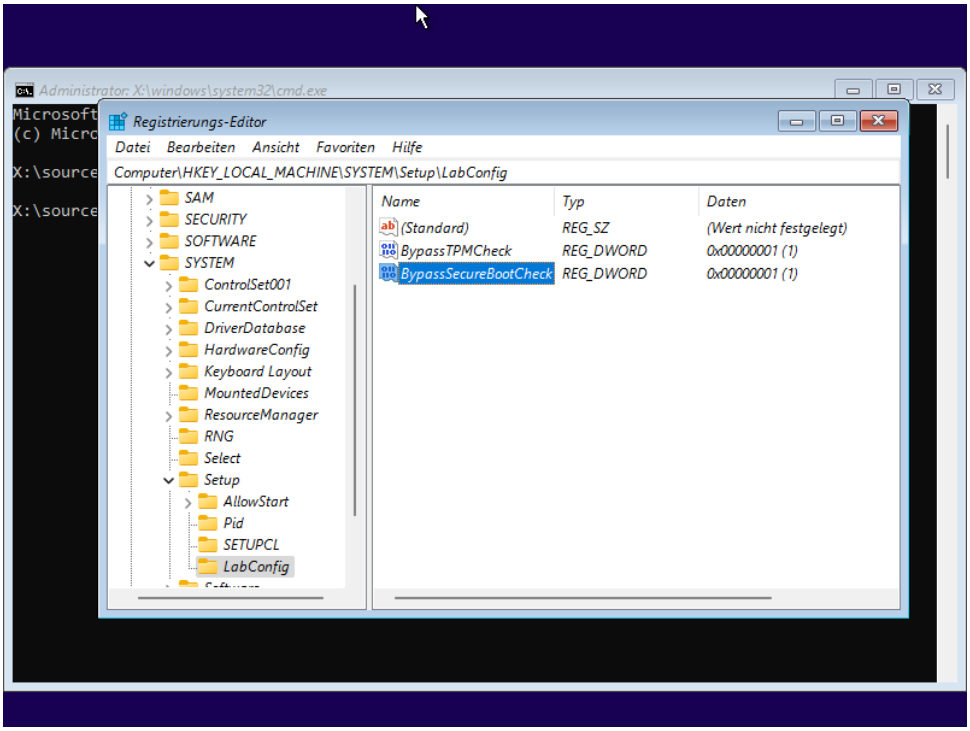


Fig. 6.3: The figure shows the finally `LabConfig` registry key and `BypassTPMCheck` + `BypassSecureBootCheck` values.

e. **Exit** `Regedit`.

f. To **disable** the network check, enter `OOBE\BYPASSNRO` into the `command prompt`.

g. **Close** the `command prompt`, and *continue*.

The other steps are the same as for Windows 10, but with drivers for Windows 11 where applicable.

7 Hypervisor Guest Tools

After successfully installing Windows you need to install the `SPICE` Windows guest tools.

- Open the Windows Explorer and install the spice guest tools.

The installation file is located in *CD* Drive `(E:) virtio-win-0.1.266: virtio-win-guest-tools`. Select and start to install these tools. In case a message box appears to confirm driver installation, please confirm install the driver(s).

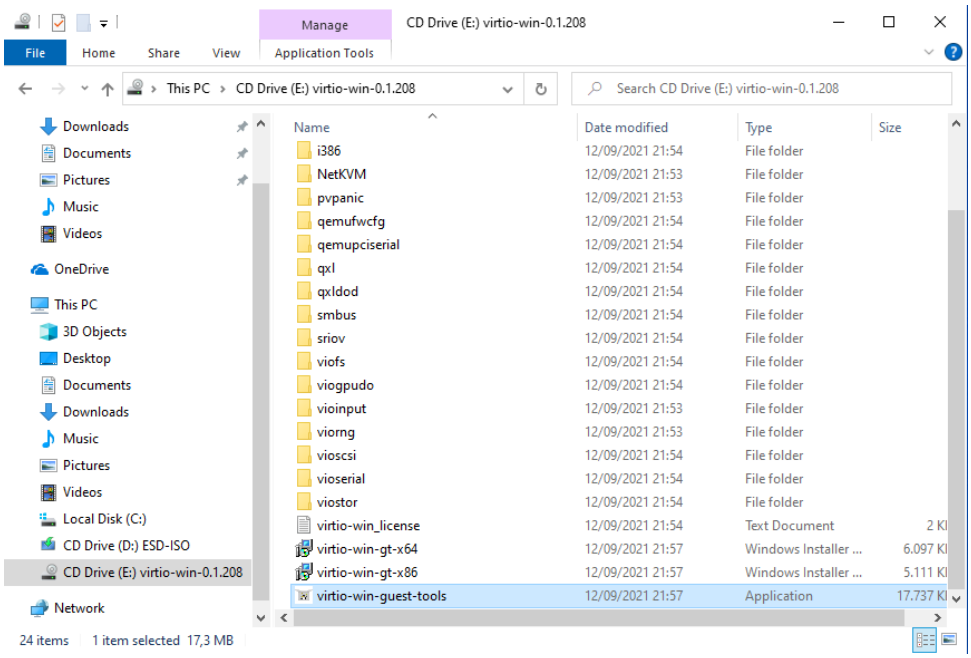


Fig. 7.1: SPICE/virtio-win guest tools.

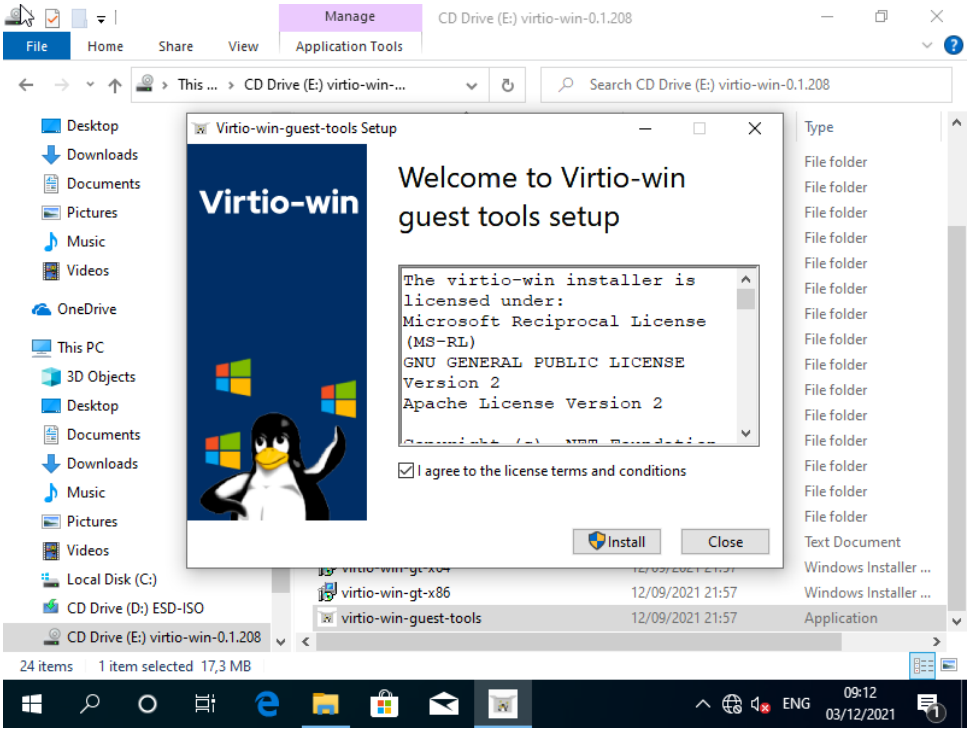


Fig. 7.2: SPICE/virtio-win guest tools setup screen.

After the setup finished, you may not be able to use the mouse anymore. This is related to a new driver installed which is not supported by the viewer application. In any case, close the setup message box (type enter, while the focus is on the finish box).

- Shutdown Windows

  You need to shut down the guest (do **NOT** reboot Windows!).

  If this is not possible inside the guest, please run `hv_guest_stop` in the guest folder (`/hv/guests/guestwindows`).

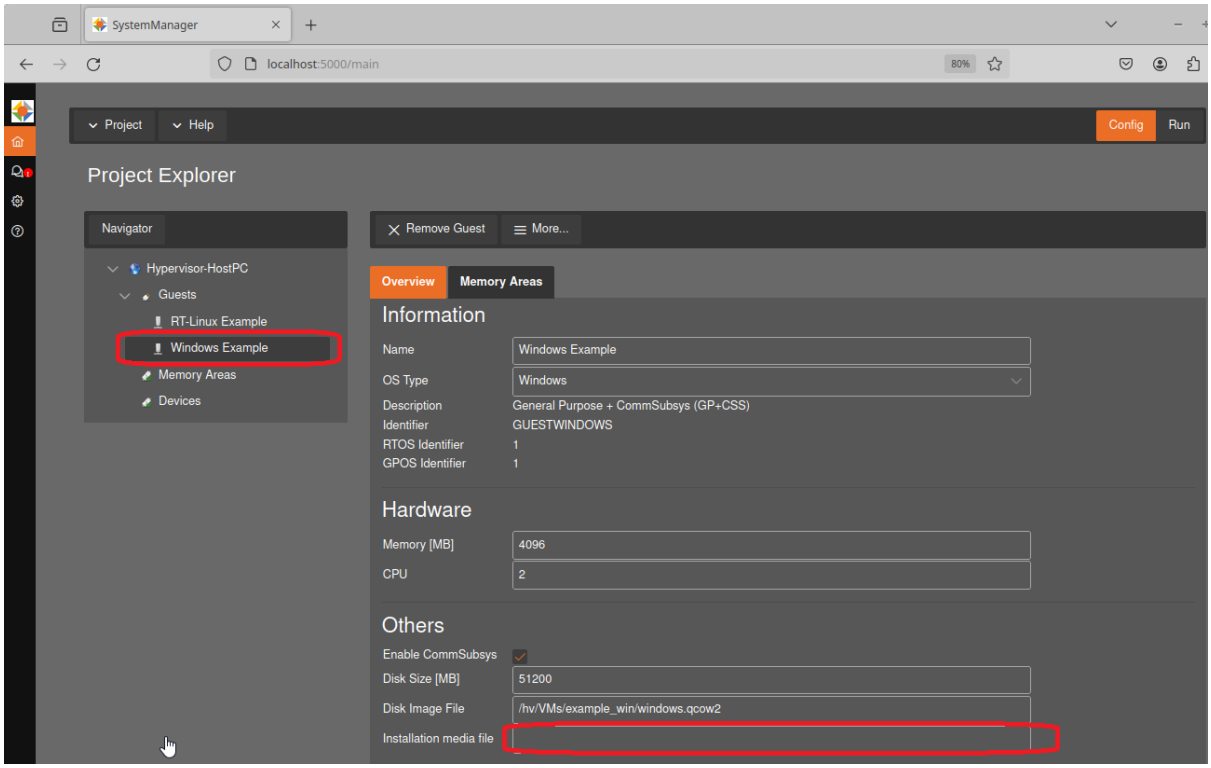
  If shutdown does not work, you need to close the setup windows before (e.g. using tab keys to select the finish button).

  You may power off the guest by running `hv_guest_stop -kill` in the guest folder (`/hv/guests/guestwindows`).

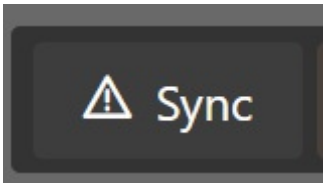
8 Final Windows startup

8.1 System Manager operation case

- Clear the “Installation media file” entry field to remove the .iso file, preventing the system from booting from the installation media again. You need to switch into Config mode first, then select the Windows Example guest and finally clear this entry.



- Then you need to synchronize the updated settings with the Hypervisor backend. Switch to the Hypervisor HostPC entry in the Navigator tab and press the `Sync` button again.



A confirmation popup will then appear, where you need to press the ‘Apply’ button.

- Change to `Run` mode.

- Select the `Windows Example` guest in the `Navigator` on the left side.
- Click the `Start Guest` Button.

Hint: If the message `Starting guest failed, because VMF restart is required` appears, navigate to “Hypervisor-HostPC” in the Navigator, then click “Stop VMF” followed by clicking “Start VMF”.

8.2 Command Line operation case

If you had set up the example project via the command line, then you will have to manually adjust the configuration again. You need to remove installation media file setting in the configuration and reboot the Windows example guest using the command line instead of the System Manager.

- Adjust the file `usr_guest_config.sh` (to avoid booting the installation media again)

  ```
  $ mousepad /hv/guests/guestwindows/usr_guest_config.sh
  ```

  ```
  comment "cdrom_iso" with #
  ```

- Start the Windows guest

  ```
  $ hv_guest_start -view
  ```

8.3 Windows specific notes

Due to hardware changes, Windows may automatically reboot once. Mouse and desktop may still not work properly. In this case, please install the latest Windows updates.

Caution:

In some cases the guest network does not work after guest tools installation. In case a guest reboot does not help you may try to execute the following steps:

- Open the `Windows Device Manager`
- Open `Network Adapters` and check if `Red Hat VirtIO Ethernet Adapter` has an **exclamation mark** near its icon.
- **Delete all** adapters with the exclamation mark (drivers deletion checkbox should not be checked out!).
- Let Windows search for hardware changes –> the drivers should be found and installed properly.

9 RTOS Communication Support

To communicate with an RTOS via the Hypervisor we need to install `RTOSVisor.exe` containing the required drivers and packages.

Hint: If you encounter a message like `Applying execute package: RteRuntime_x64. Error 0x80070643: Failed to install MSI package` when running this command, you may have got a **test** version of the `RTOSVisor`. In **test** versions **unsigned** drivers are included. You need to enable *testsigning* **before** installing the guest support.

- Step 1: Run `Command Prompt` as **administrator**.
- Step 2: Input the command in the window: `bcdedit /set testsigning on` and press `Enter`. Reboot the guest.

Caution:

You may get an error (`0x80004005`) when accessing the share due to some restrictive Windows settings. In that case, try to allow insecure guest logins. Windows blocks guest logins to network devices using SMB2 by default.

Another security related issue is SMB signing, which is indicated by messages like *You can't access this shared folder because your computer is configured to require SMB signing.*

Please check the Hypervisor Manual chapter `KVM Guests` for more information and how to solve these issues.

Open `CMD` prompt in Windows guest and enter the following:

```
Call \\10.0.2.4\qemu\files\RTOSVisor.exe
```

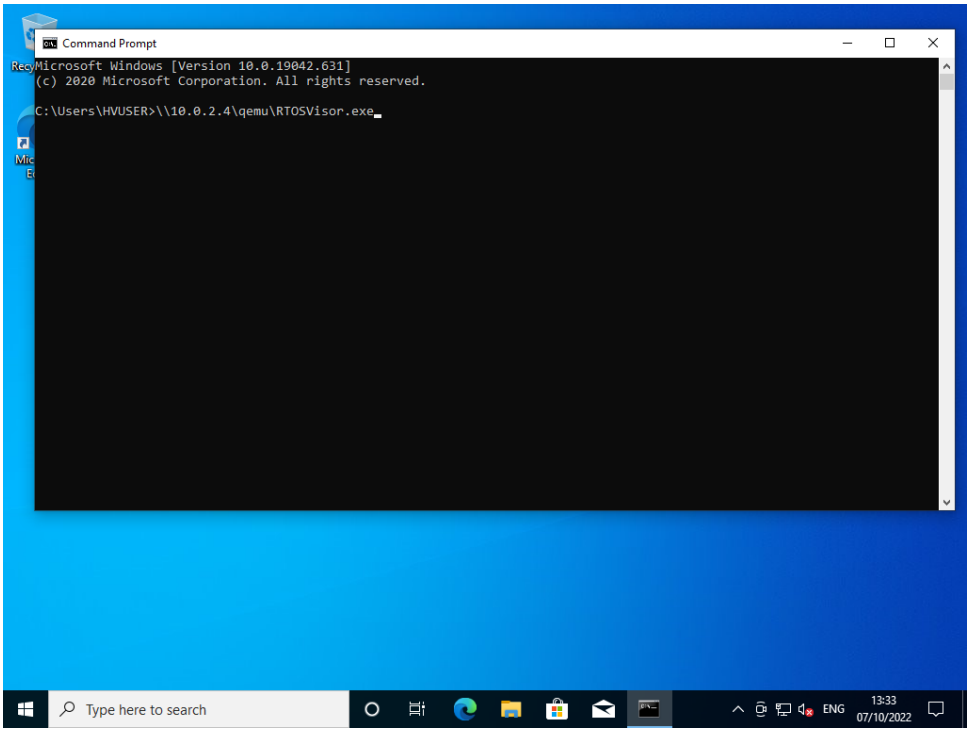


Fig. 9.1: Setup command.

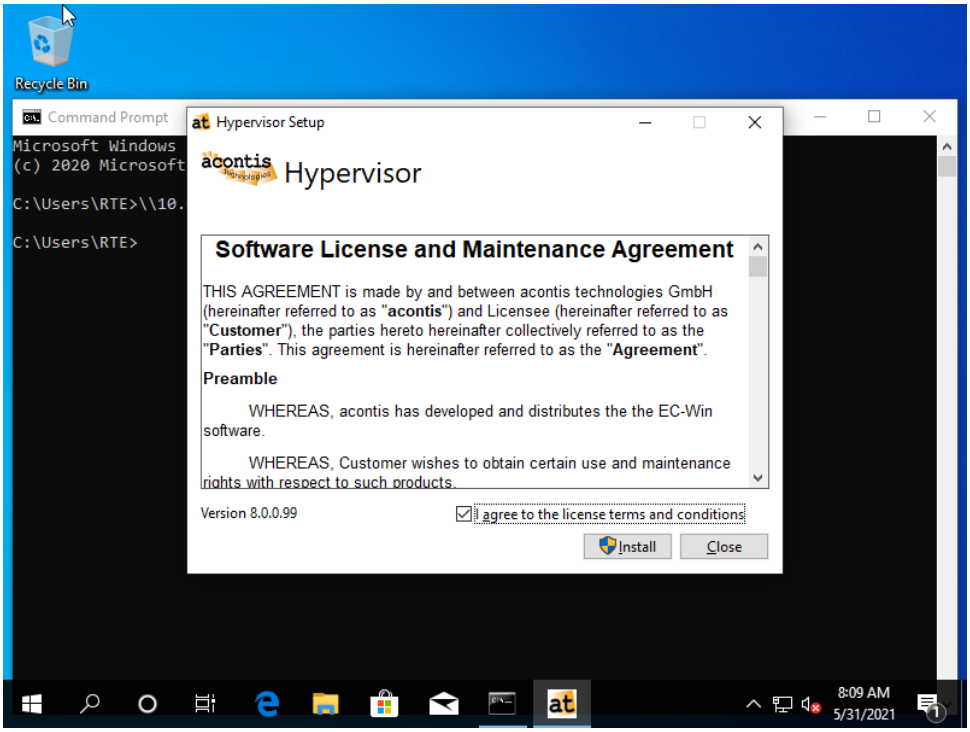


Fig. 9.2: Running setup.

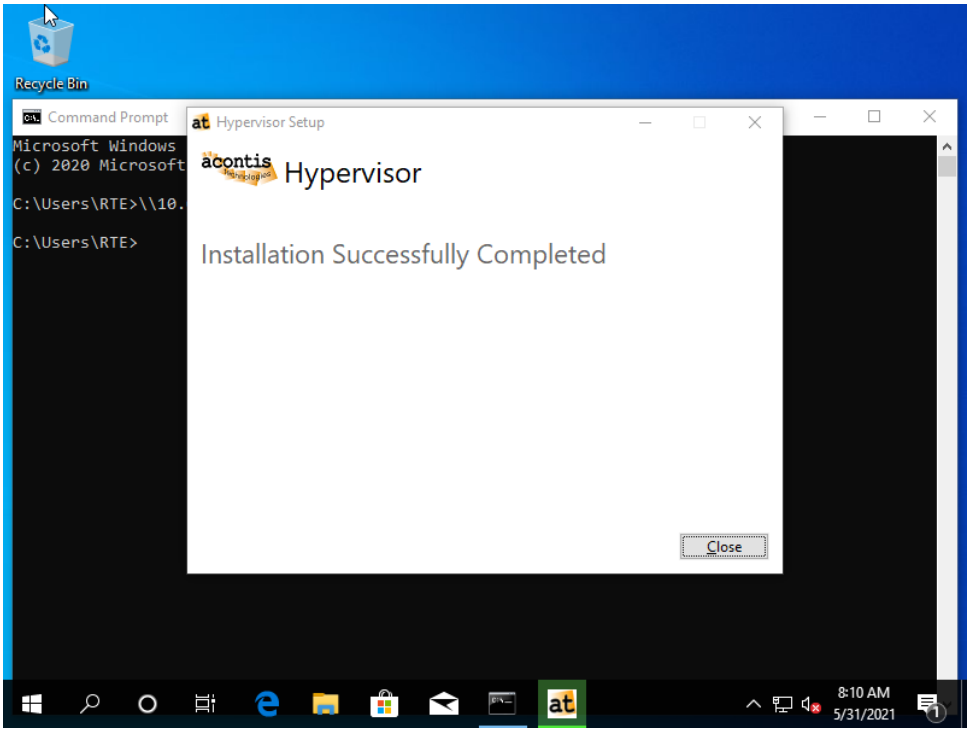


Fig. 9.3: Installation successful.

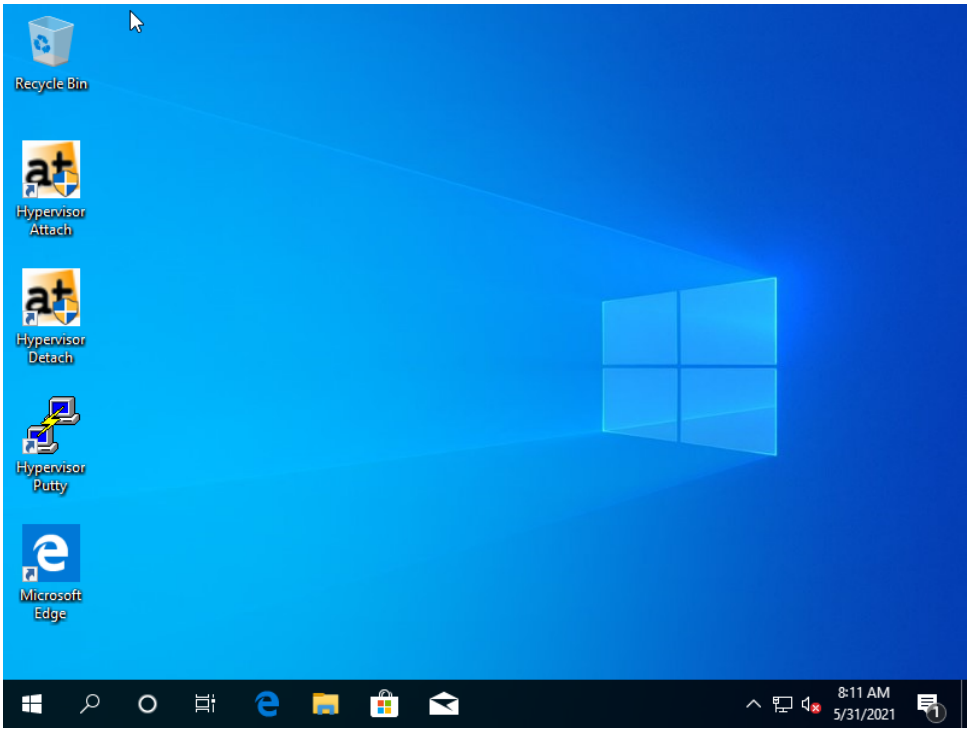


Fig. 9.4: New desktop icons.

Caution: The installer will set-up the **default** values of `Vnet IP address`, `Vnet MAC ID` and `attach ID`! Therefore a **2nd** (or more) Windows guest(s) will **require** *manual* adjustments to the

aforementioned settings. Please adjust it accordingly!

10 Power & sleep

Sleep and Hibernate are currently not supported (S3 or S4 mode). Disable Sleep (Windows Settings – System – Power and sleep):

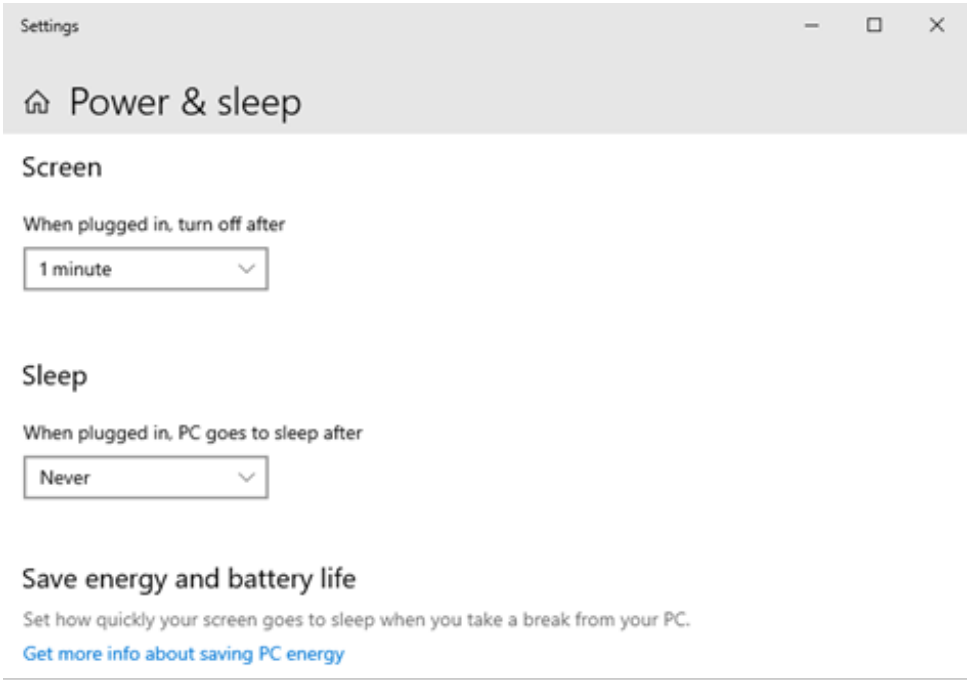


Fig. 10.1: Power and Sleep settings.

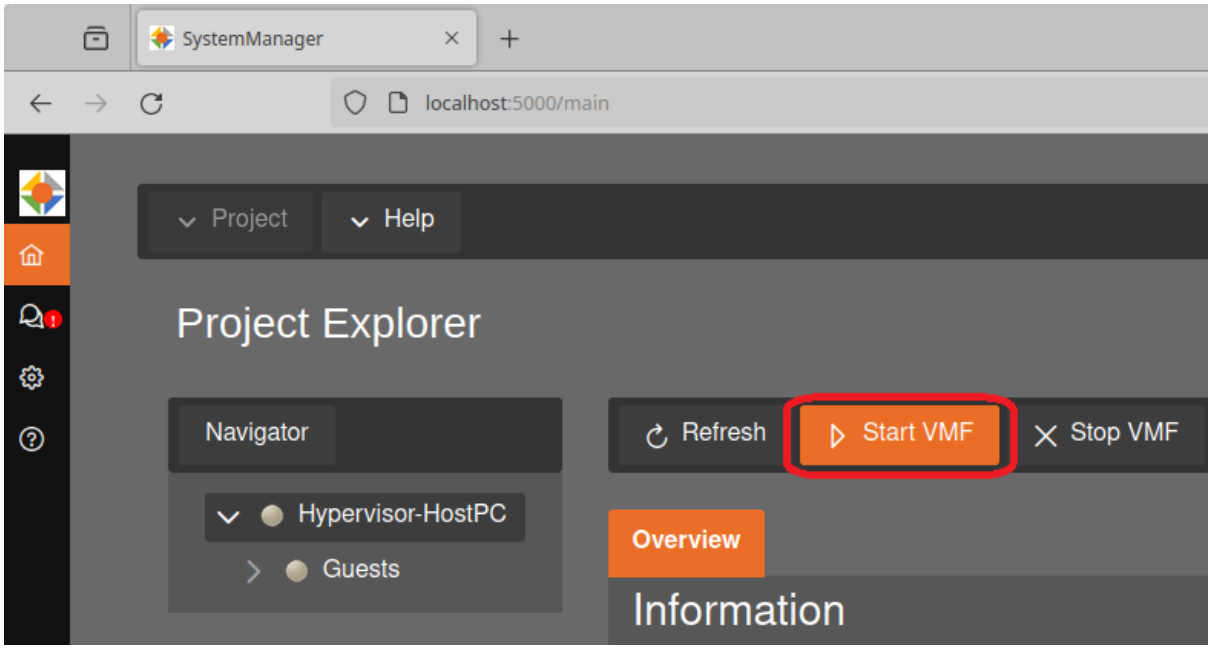
11 Windows and Real-time guest in parallel

In this step, we will run Windows and Real-Time Linux in parallel.

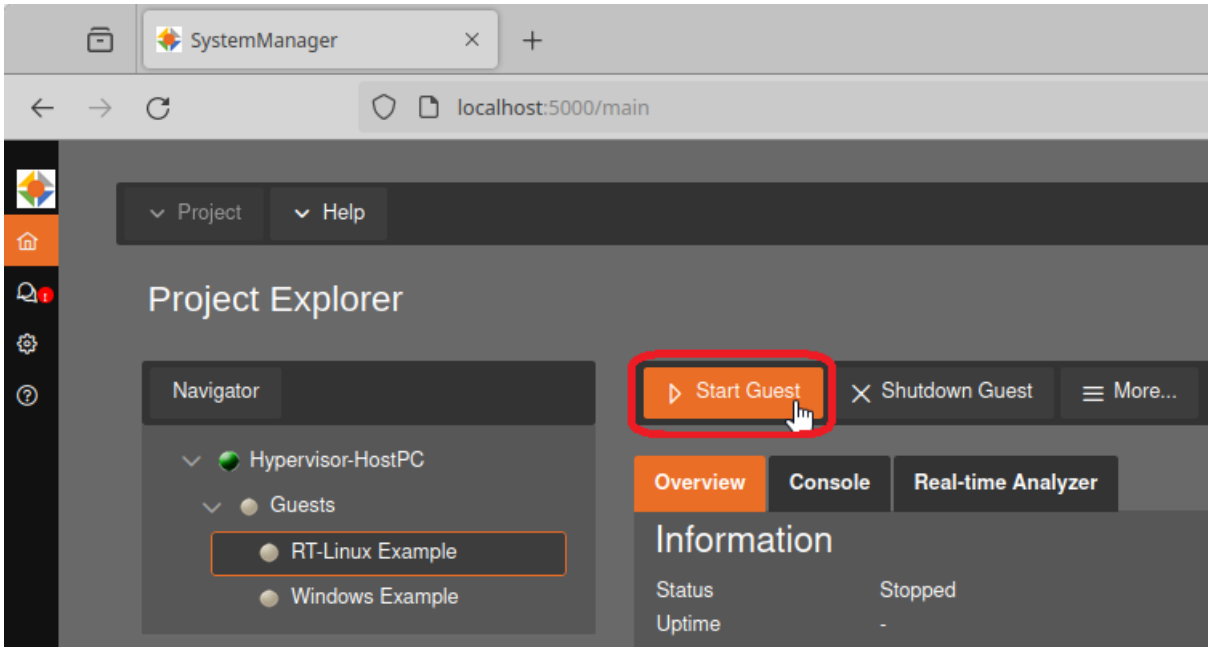
- Shutdown Windows, do **NOT** reboot!
- Reboot the Hypervisor Host
- Open the browser, connect with the Hypervisor backend click the `Sync` button and `Apply` again.

Change to `Run` mode.

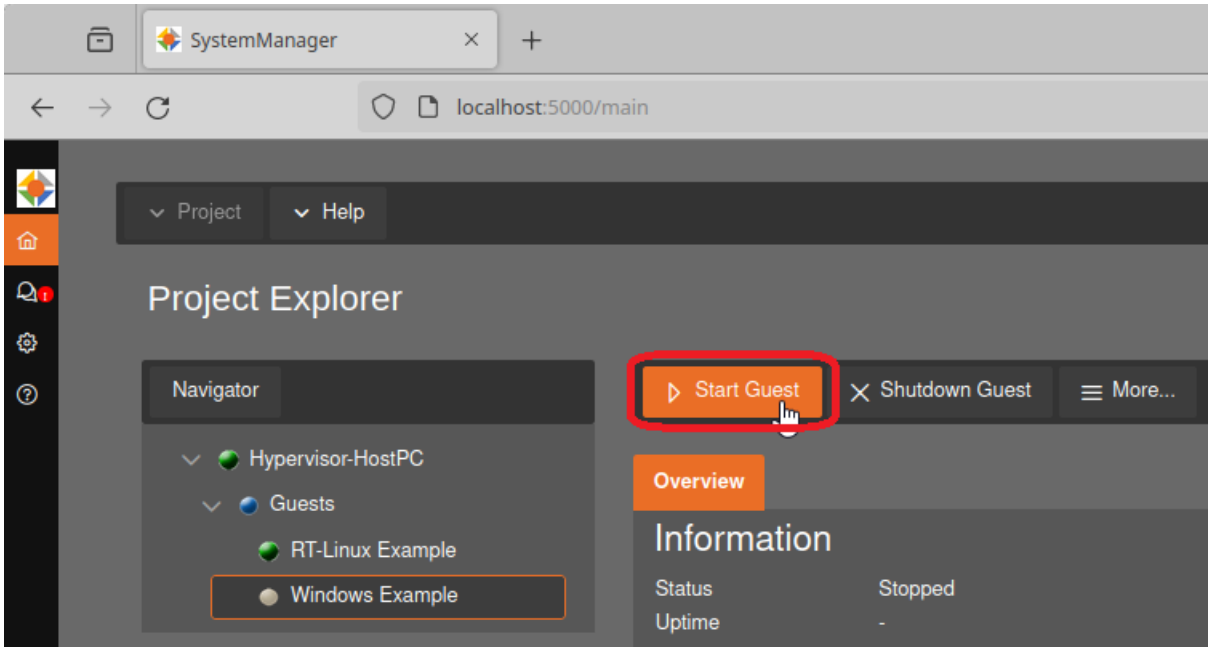
Start the Virtual Machine Framework (VMF).



- Run the `Real-Time Linux` guest



- Start the `Windows` guest



- After logging in into Windows, execute `Hypervisor Attach` (Desktop icon)

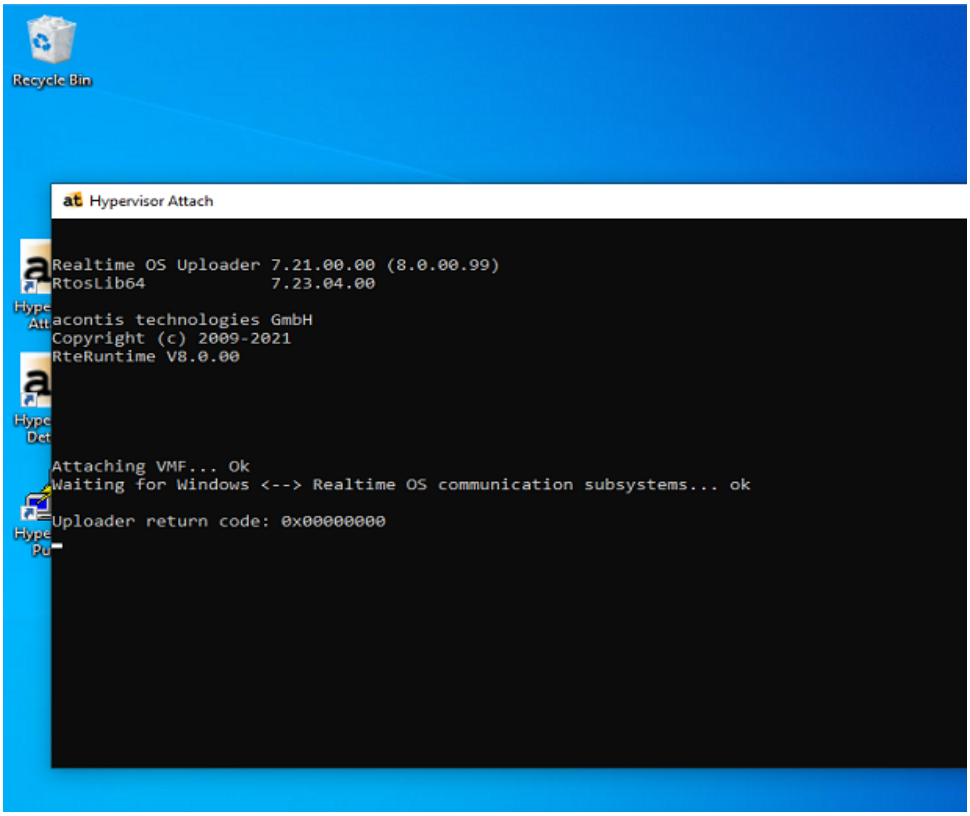


Fig. 11.1: Hypervisor Attach.

- Download and install the appropriate `putty` package from https://www.putty.org/
- Open the RT-Linux shell: execute `Hypervisor Putty` (Desktop icon)

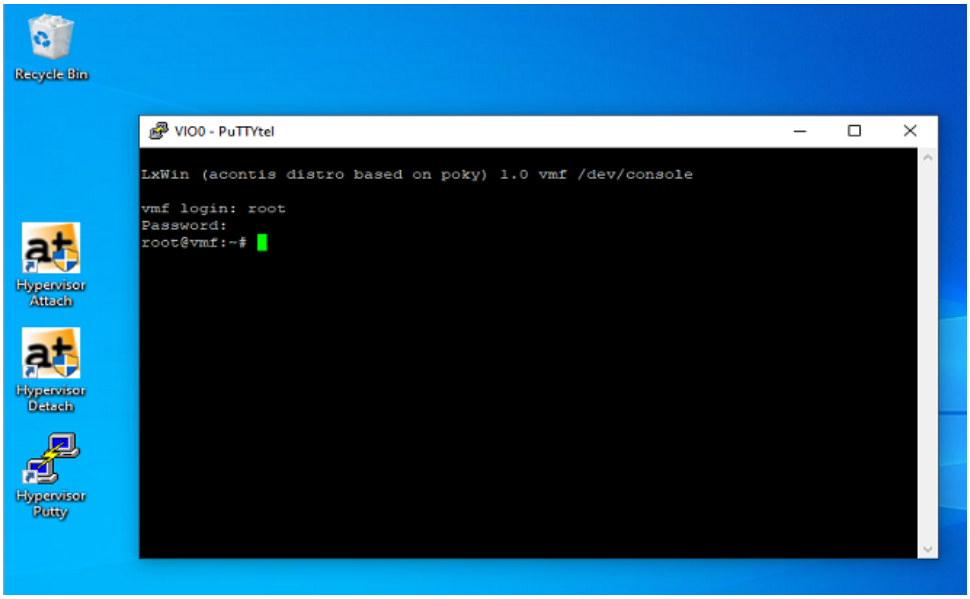


Fig. 11.2: Linux Shell.

- Log in into Real-Time Linux and run the Real-time demo:

```
$ vmf64 login: root
$ password:  root
```

```
$ RealtimeDemo
```